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PHARMACEUTICAL POLLUTION: IMPACT ON ENVIRONMENTAL SUSTAINABILITY AND MANAGEMENT

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ABSTRACT

Recently, pharmaceuticals were thought to reach the environment primarily through usage or inappropriate disposal. Certain production facilities were found to be sources of much higher environmental concentrations than those caused by the usage of drugs. Widespread detection of waste pharmaceuticals in environmental samples and the risks associated with their introduction into wildlife habitats is becoming an important issue for both regulators and the pharmaceutical industry. Pharmaceutical companies should see that it is in their own interest to minimize drug use and pollution of the environment, since avoiding the spread of resistance will keep their medicines effective longer. Possible ways to stimulate action include changes in local and international regulations, including the implementation of appropriate environmental standards within existing industry guidelines as well as demands from prescribers and consumers of medicines. The lack of readily available information regarding the origin of drugs and the environmental impact of the production, however, prevents consumers from making informed decisions. We propose that increased transparency throughout the production chain would be one of several important steps for reducing pollution from the manufacturing of drugs.

KEYWORDS: Pollution, Environmental hazards, Health effects, Pharmaceutical industries, Indian government.

INTRODUCTION

Drug pollution or pharmaceutical pollution is pollution of the environment with pharmaceutical drugs and their metabolites, which reach the aquatic environment

(groundwater, rivers, lakes, and oceans) through wastewater. Drug pollution is therefore mainly a form of water pollution.

"Pharmaceutical pollution is now detected in waters throughout the world," said a scientist at the Cary Institute of Ecosystem Studies in Millbrook, New York. "Causes include aging infrastructure, sewage overflows and agricultural runoff. Even when wastewater makes it to sewage treatment facilities, they aren't equipped to remove pharmaceuticals."

It is recognized that pharmaceutical compounds reach the environment and can be considered as environmental pollution. Pharmaceuticals were thought to reach the environment primarily through usage or inappropriate disposal. Various Production facilities were found to be sources of much higher environmental concentrations than those caused by the use of drugs.

Pharmaceutical plant generate a large amount of wastes during manufacturing, housekeeping and maintenance operations. While maintenance and housekeeping activities are similar from one plant to the next, the actual processes used in pharmaceutical manufacturing vary widely. Typical waste streams include spent fermentation broths, process liquors, solvents, and equipment wash waters, spilled materials, and used processing aids. Pharmaceuticals have been detected in wastewater treatment plant effluents, surface water, ground water, and drinking water.

Pharmaceutical products are used in human and veterinary medicine and are a class of emerging environmental contaminants. These are natural or synthetic chemicals design to have a specific mode of action Worldwide detection of waste pharmaceuticals in the environment causes risks associated with their introduction into wildlife habitats and is becoming a serious issue for both regulators and the pharmaceutical industry.

Although different classes of pharmaceuticals are used in human and veterinary medicine, only a few are of environmental importance because of their consumption volumes, toxicity, and persistence in the environment. Pharmaceuticals in the aquatic environment have been reported in rivers, sewage, streams, seawater, ground water, and drinking water. Measurable concentrations are usually low, may be in ng/l to µg/l in range.

Other sources include agricultural runoff (because of antibiotic use in livestock) and pharmaceutical manufacturing. Drug pollution is implicated in the sex effects of water

pollution. It is a suspected a contributor (besides industrial pollution) in fish kills, amphibian dieoffs, and amphibian pathomorphology.

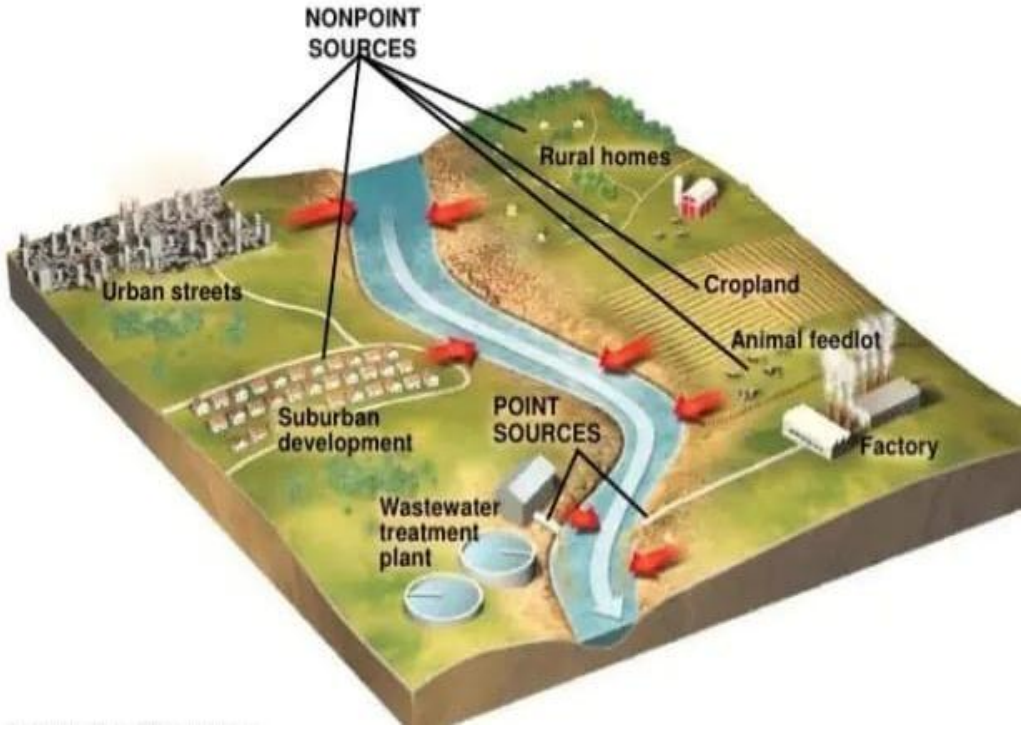
Pharmaceutical industrial ecology

- Aims to reduce the environmental impact of pharmaceutical industry by examining material and energy flows in products, processes, industrial sectors, and economies.
- It provides a long-term perspective, encouraging consideration of the overall development of both technologies and policies for sustainable resource utilization and environmental protection into the future.
- It emphasizes opportunities for new technologies and new processes, and those for economically beneficial efficiencies.
- Industrial ecology draws on and extends a variety of related approaches including systems analysis, industrial metabolism, materials flow analysis, life cycle analysis, pollution prevention, design for environment, product stewardship , energy technology assessment, and eco-industrial parks.
- Greater material efficiency, the use of better materials, and the growth of the service economy can contribute to the "dematerialization" of the economy. Resources that are cheap, abundant, and environmentally benign may be used to replace those that are expensive, scarce, or environmentally harmful.
- As the energy sources have shifted from wood and coal toward petroleum and natural gas, the average amount of carbon per unit energy produced has decreased significantly, resulting in the "decarbonization" of world energy use.
- Another strategy for reducing environmental impact is the substitution of services for products, meaning that customers do not seek specific physical products, but rather the services provided by those products. For example, an integrated pest management service might provide crop protection rather than selling pesticides.
- Another industrial ecology strategy is to use waste products as raw materials. These efforts often come into conflict with concerns about hazardous materials in the wastes, such as the concern that trace metals in ash from
- power plants recycled in fertilizer may contaminate soil. However, in some cases, such waste reuse can be successful. In the industrial district in Kalundborg, Denmark, several industries, including the town's power station, oil refinery, and plasterboard manufacturer, make use of waste streams and energy resources, and turn by-products into products.

- There are many examples of technological innovations that have had significant environmental benefits. An important example is the replacement of chlorofluorocarbons (CFCs) with new compounds in order to protect the stratospheric ozone layer. Other examples are the elimination of mercury in batteries, and the elimination of lead in gasoline, paint, and solder.
- The challenge of industrial ecology is to understand how technological and social innovation can be harnessed to solve environmental problems and provide for the well-being of the entire world.

Types of pollution

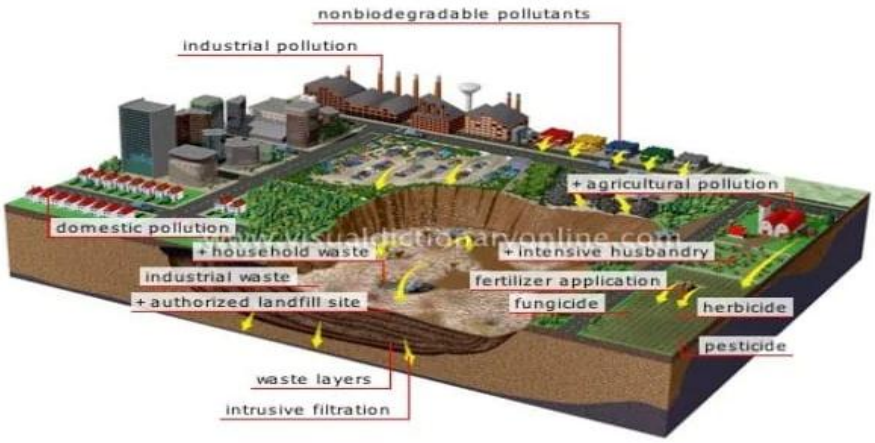
1. Water pollution



Water pollution is caused by organic and inorganic industrial wastes and affluents discharged into rivers.

The main culprits in this regard are paper, pulp, chemical, textile and dyeing, petroleum refineries, tanneries and electroplating industries that let out dyes, detergents, acids, salts and heavy metals like lead and mercury pesticides, fertilisers, synthetic chemicals with carbon, plastics and rubber, etc. into the water bodies.

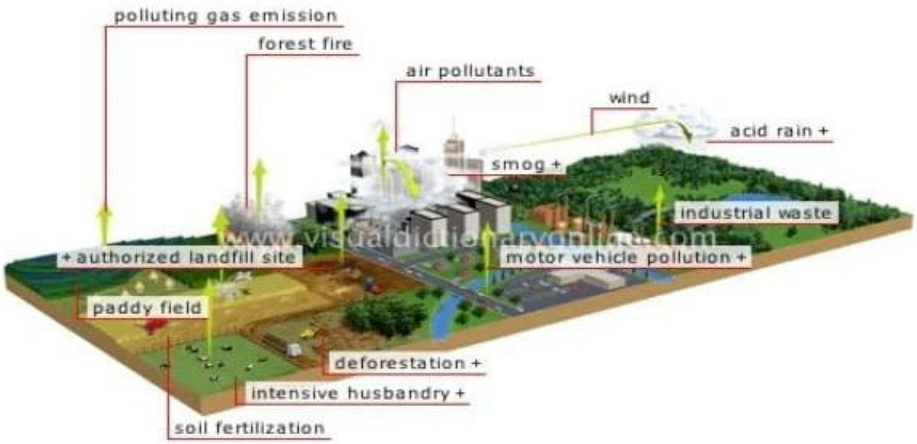
2. Soil pollution



The solid and liquid wastes of industries are dumped over the surface of soil. They include scrap, effluents, sludge, flyash and radioactive wastes which ass a lot of toxic chemicals into the soil.

Soil pollution is creating problems in agriculture and destroying local vegetation. It also causes chronic health issues to the people that come in contact with such soil on a daily basis.

3. Air pollution

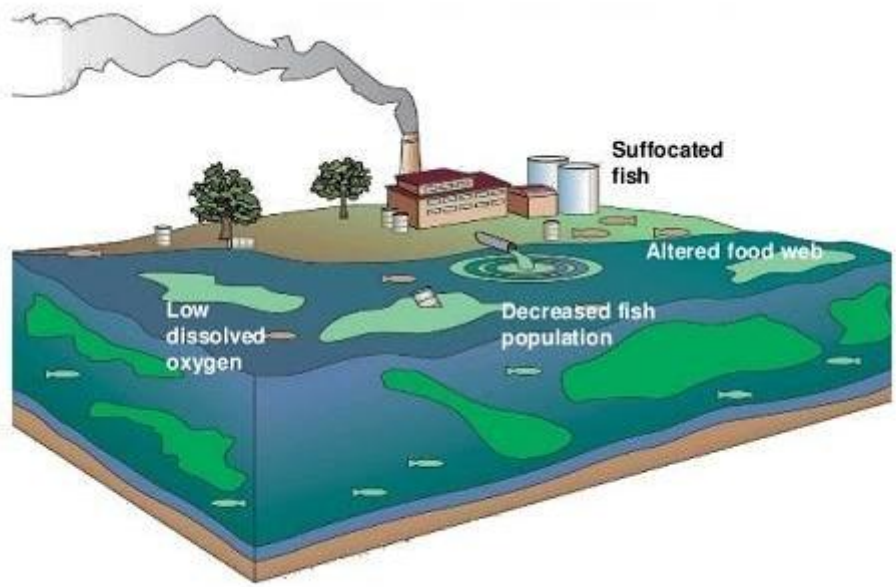


Air pollution is caused by the presence of high proportion of undesirable gases, such as sulphur dioxide and carbon monoxide. Air-borne particulate materials contain both solid and liquid particles like dust, sprays mist and smoke.

Smoke is emitted by chemical and paper factories, brick kilns, refineries and smelting plants, and burning of fossil fuels in big and small factories that ignore pollution norms.

Toxic gas leaks can be very hazardous with long-term effects. Air pollution adversely affects human health, animals, plants, buildings and the atmosphere as a whole.

4. Thermal pollution

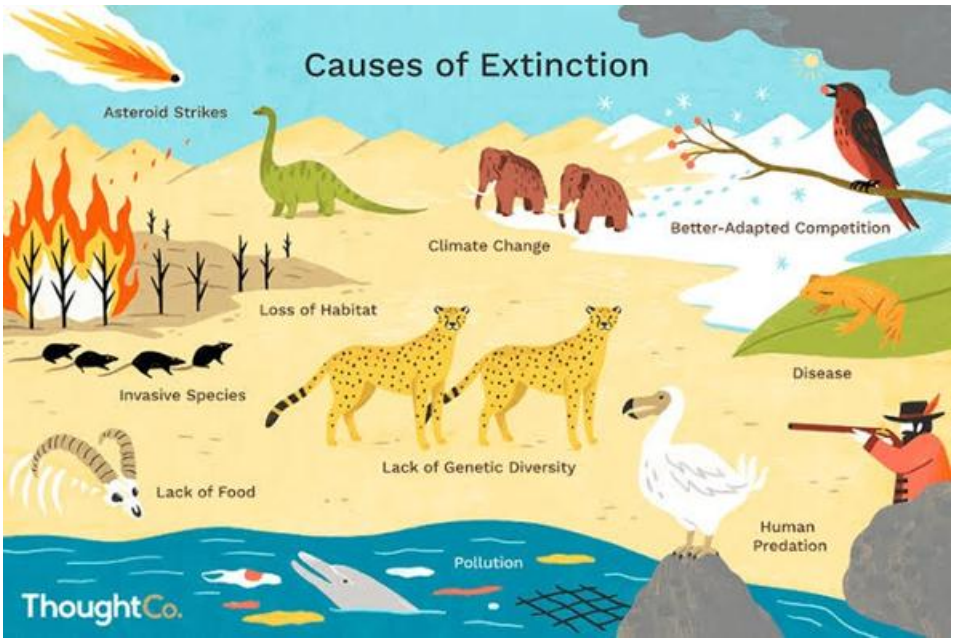


Thermal pollution of water occurs when hot water from factories and thermal plants is drained into rivers and ponds before cooling.

Wastes from nuclear power plants, nuclear and weapon production facilities cause cancers, birth defects and miscarriages.

Dumping of wastes specially glass, harmful chemicals, industrial effluents, packaging, salts and garbage renders the soil useless. Rain water percolates to the soil carrying the pollutants to the ground and the ground water also gets contaminated.

5. Wildlife extinction

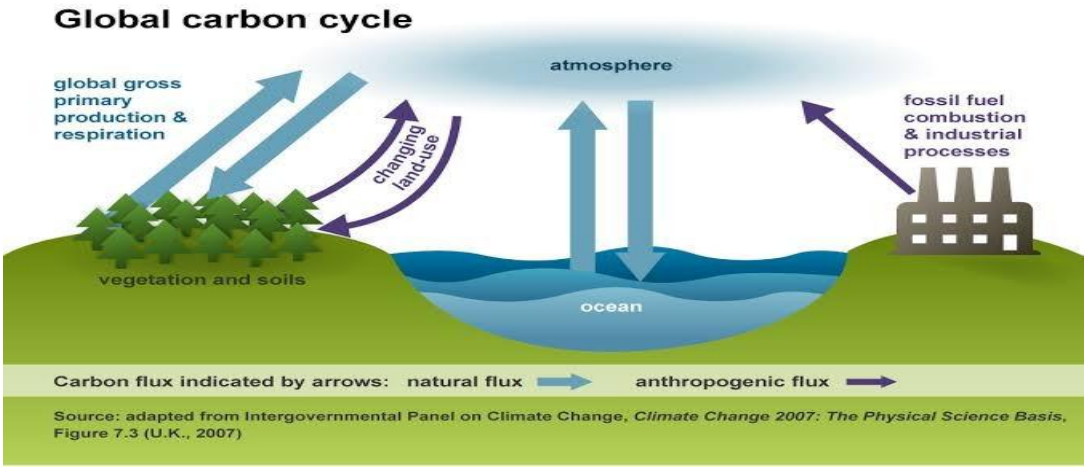


By and large, the issue of industrial pollution shows us that it causes natural rhythms and patterns to fail, meaning that the wildlife is getting affected in a severe manner.

Habitats are being lost, species are becoming extinct, and it is harder for the environment to recover from each natural disaster.

Major industrial accidents like oil spills, fires, the leakage of radioactive materials and damage to property are harder to clean-up as they have a higher impact in a shorter timeframe.

6. Global warming



With the rise in industrial pollution, global warming has been increasing at a steady pace.

Smoke and greenhouse gases are being released by industries into the air, which causes an increase in global warming.

Melting of glaciers, extinction of polar bears, floods, tsunamis, hurricanes are few of the effects of global warming.

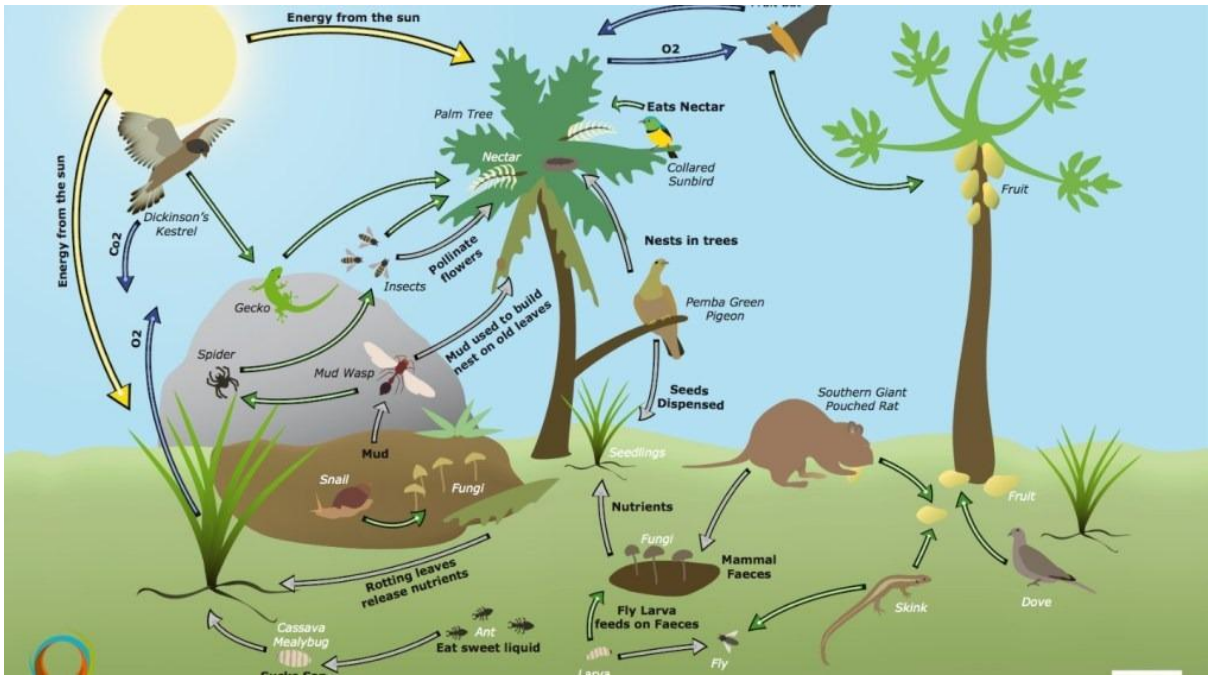
7. Biodiversity loss

Industrial pollution continues to cause significant damage to the earth and all of its inhabitants due to chemical wastes, pesticides, radioactive materials etc.

It affects wildlife and ecosystems and disrupts natural habitats. Animals are becoming extinct, and habitats are being destroyed.

The increasing liquid, solid and hazardous wastes undermine ecosystem health and impact on food, water and health security. Industrial pollution disasters, including oil spills and radioactive leakage, take years to decades to clean up.

8. Atmospheric deposition



Cadmium enrichment of soil can also be associated with industrial pollution. Topsoils contaminated by mine spoil showed a wide range of Cd concentrations.

Broadly the industrial wastes may be divided into two groups:

(A) Process waste

The waste generated in an industry during washing and processing of raw materials is known as process waste. The process waste may be organic or inorganic in nature depending upon the raw materials used and nature of the industry.

The organic process wastes are liberated from food processing units, distilleries, breweries, paper and pulp industry, sugar mills etc. The inorganic process wastes may be the effluents of chemical industries; caustic soda industry, paint industry, petroleum industry, pesticide industry etc. Both organic and inorganic process wastes are toxic to living organisms.

The solid wastes released by different industries can be divided in to two different groups i.e.

(a) Process wastes,

(b) Packing wastes.

Since different industries use different raw materials, the quality and quantity of solid wastes differ from industry to industry. Industries releasing the solid wastes in the form of fly ash is dumped on the ground which leads to soil pollution.

Some amount of fly ash also contaminate atmospheric tract causing respiratory tract disorders. Metallic industries produce a lot of solid metallic waste and large quantities of slag. In addition to the release of hazardous chemical pollutants, the industries may also cause thermal pollution and noise pollution. The thermal pollution is due to release of hot water from industries into aquatic bodies. The noise pollution is due to running of heavy machinery producing a lot of noise.

(B) Chemical wastes

The chemical substance generated as a by-product during the preparation of a product is known as chemical waste product. The chemical waste include heavy metals and their ions, detergents, acids and alkalies and various other toxic substances.

These are usually produced by the industries like fertiliser factories, paper and pulp industries, iron and steel industries, distilleries, sugar mills etc. These are usually liberated into nearby water bodies like rivers, lakes and seas and sometimes into lands. The entry of these chemicals into bodies may alter the pH, BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand).

The loading of suspended solids (ss), heavy metals and their ions brings about a drastic change in physiochemical nature of the water. The aquatic animals and plants absorb, accumulate and bio-concentrate the chemical wastes leading to bio magnifications and finally destroying the trophic levels and food chains of the eco-system. Hence these disturb the eco-system dynamics and eco-system balance of the nature.

Pharmaceutical pollutentes

Different classes of drug have been documented as environmental pollutants such as analgesics, antibiotics, antiepileptic, antihypertensive, antiseptics, beta-blocker heart drugs, contraceptives, hormones, and psychotherapeutics.

- **Antibiotics**

While the evolution of antibiotic resistance pre-dates the human use of antibiotic, the increased frequency of antibiotic-resistant bacteria and antibiotic resistance mechanisms in the environment is now referred to as “antibiotic resistance pollution”

As humans, our concern does not usually cover resistance genes present in environmental bacteria, but instead focuses on instances when environmental resistance genes are

transferred horizontally into pathogens, limiting our ability to fight infectious diseases with antibiotics.

❖ **Antidepressant**

Drugs such as antidepressants have been found in the United States Great Lakes. Researchers from the University of Buffalo have found high traces of antidepressants in the brains of fish. Fish behavior on antidepressants have been noted to have similar impacts and reducing risk-averse behavior, and thereby reducing survival through predation.

❖ **Antiepileptic**

Antiepileptic drugs have shown to transform to more toxic substances, their behavior in these treatment processes and resulting effects on ecotoxicity should be investigated.

❖ **Beta blockers**

The presence of beta blockers in the environment can affect the aquatic organisms and lead to chronic contamination and toxicological effects on nontarget organisms.

β-blockers compounds may have deleterious effects on different organisms such as fish (Japanese medaka, rainbow trout), invertebrates (Dapnia magna, Hyalella azteca, Daphnia lumholtzi, Ceriodaphnia dubia), and green algae (Pseudokirchneriella subcapitata) .

❖ **Contraceptive**

Birth control pills, on the other hand, can pollute waterways by introducing synthetic estrogen hormones into wastewater through a pill-user's urine.

Because many aquatic animals have hormone receptors similar to those of humans, fish and other species can take up this estrogen, become feminized, and experience reproduction problems.

❖ **Metal contaminants**

pollution of heavy metals is increasingly becoming a problem and has become of great concern due to the adverse effects it is causing around the world.

These inorganic pollutants are being discarded in our waters, soils and into the atmosphere due to the rapidly growing agriculture and metal industries, improper waste disposal, fertilizers and pesticides.

❖ **Steroids hormones**

Steroid estrogens are widespread in the aquatic environment and therefore pose a potential risk, as exposure to these compounds has adverse impacts on vertebrates.

Excessive exposure to steroid estrogens causes endocrine disruption in aquatic vertebrates, which affects the normal sexual life of these animals.

Causes of pharmaceutical pollution

1. The drugs we Use and How they are Ingested and Expelled!

Our bodies metabolize only a fraction of the majority of the drugs we swallow. The remaining part can be sweated out, but the large part is excreted from the body through urine or fecal matter, meaning the excreta will be part of the wastewater and eventually will be in the environment.

Some medication can also be applied as creams or lotions and the unabsorbed portions of the medication will be washed off the body and find its way into the environment. For instance, one man's use of testosterone cream can wind up putting as much of the hormone into the water as the natural excretions from 300 men.

2. Healthcare institutions

Hospitals and nursing homes also contribute to pharmaceutical pollution. Hospitals, in particular, might be less of a problem as they have on-site pharmacies with arrangements to return the unused drugs to the manufacturers for credit or disposal.

Nursing homes, on the other hand, are particularly guilty of flushing medications down the toilet or drain, especially if a patient dies or is transferred to another facility, mainly because in most cases, they do not have a similar return policy with drug manufacturers as hospitals.
See also Sources of Noise Pollution and Tips for Prevention of Noise Pollution.

The rule of getting rid of the opioid painkillers is to flush them down the drain as it is an acceptable option, encouraging them to flush down all their leftover medications.

3. Drug manufacturers

Although some factories are bigger than others, they are all guilty of contributing to pharmaceutical pollution. Some will dispose of the drugs in a landfill, and some will flush them, among many other ways of disposing of the drugs.

A US Geological Survey study revealed contamination levels downstream from two drug manufacturing plants in the state of New York, which were between ten and 1,000 times higher than those at comparable facilities in the country.

4. Agriculture and Agro-products

Like humans, not all the drugs fed to domesticated animals are metabolized by their bodies. For this reason, they excrete parts of the drugs that remain undigested. About 2 trillion pounds of animal waste, which is generated by large-scale poultry and livestock operations in the United States, was found to be laced with hormones and antibiotics fed to animals.

The drugs and hormones were meant to make the livestock and poultry grow faster as well as keeping them from getting sick. As such, and inevitably, some of those hormones and antibiotics will leach into groundwater or get into waterways and contribute to pharmaceutical pollution.

5. Human domestic drug Use and Disposal behavior

We as consumers are responsible for a significant amount of the pharmaceutical and personal care products that end up in streams, groundwater, lakes, and rivers. It is not uncommon to find a home cabinet full of unused and expired drugs. The problem is that out of all these drugs, only a fraction is disposed of properly.

For instance, data collected in 2007 from a medication collection program in California, suggested that only about 50% of all medications, prescription and over-the-counter, were discarded properly. Even if that figure is a huge estimate, and the real proportion could be lower, the conclusion is that there is a lot of unused and mostly expired medication that potentially gets into the water systems.

Potential sources of contamination in pharmaceutical products

To effectively prevent contamination and ensure high levels of safety in the pharmaceutical industry, it is crucial to identify the sources of contaminants.

1. Personnel

People who are performing or supervising pharmaceutical manufacturing and packaging processes can be a strong source of contamination. This primarily happens due to:

- Lack of training

- Inadequate cleanliness and hygiene standards
- Direct contact with the materials & products
- Lack of personnel protective equipment
- Malpractices like eating or drinking in the manufacturing or storage areas
- Entry or use of key manufacturing units by unauthorized personnel

2. Manufacturing facility

The facility or the building may be another primary source of contamination:

- Poor design and inadequate space that can lead to cross-contamination and mix-ups
- Lack of adequate pest control and waste management measures
- Improper ventilation, lighting and air filtration system
- Inadequate cleanliness and sanitisation practices

3. Materials

The quality, handling and control of raw materials can also cause pharmaceutical contamination

- Improper handling and storage
- Poor labelling, sampling and testing of raw materials
- Degradation of materials due to environmental conditions
- Using materials that do not meet acceptance guidelines

4. Manufacturing process

There are high chances of contamination throughout the manufacturing process:

- Lack of dedicated production facility for each product
- Absence of statutory-compliant hygiene and cleanliness standards
- Lack of proper zoning, resulting into mix-up or cross-contamination
- No/insufficient cleaning & maintenance status labelling on materials and equipment used in the manufacturing process

These are some potential causes of contamination in the pharmaceutical industry which must be efficiently addressed to manufacture high-quality and safe products for all.

Effects of pharmaceutical pollution

1. On human health

Pollution causes irritation of eye, nose, throat respiratory tracts, etc. It increases mortality rate and morbidity rate. A variety of particulates mainly pollens, initiate asthmatic attacks.

Chronic pulmonary diseases like bronchitis and asthma are aggravated by high concentration of SO2, NO2, particulate matter and photo-chemical smog. Certain heavy metals like lead may enter the body through lungs and cause poisoning.

2. On animal health

In case of animals, the pollutants enter in two steps.

(i) Accumulation of the airborne contaminants in the vegeta-tion forage and prey animals.

(ii) Subsequent poisoning of the animals when they eat the contaminated food. In case of animals, three pollutants namely fluorine, arsenic and lead are responsible for most livestock dam-age.

3. On plants

Industrial pollution have been shown to have serious adverse effects on plants. In some cases, it is found that vegetation over 150 Km. away from the source of pollutants have been found to be affected. The major pollutants affecting plants are SO2, O3, MO, NO2, NH3, HCN, Ethylene, Herbicides, PAN (Peroxy Acetyl ni-trate) etc. In the presence of pollutants, the healthy plants suffer from neurosis, chlorosis, abscission, epinasty etc.

4. Effects on Fish and Aquatic life

A number of studies have indicated that Oestrogen and chemicals that behave like it, have a feminizing effect on male fish and can alter female-to-male ratios. Such Oestrogen can be found in birth control pills and postmenopausal hormone treatments.

Because of the higher Oestrogen levels in the downstream water from the river, there are more female and intersex fish downstream from the plants that pollute it. Popular antidepressant medications have also been found concentrated in the brain tissue of fish downstream from wastewater treatment plants.

5. Effect on drinking water

The chemicals present in these pharmaceuticals, find a way into waterways, after being excreted from the body or after being flushed down the toilet. Most municipal sewage

treatment facilities do not remove these pharmaceutical compounds from your drinking water and as such, we end up consuming the same compounds.

They are found in very minimal concentration in rivers and streams as compared to the normal dose, but there is a growing concern that chronic exposure to these compounds could result in serious health issues. It is also speculated that these compounds, could act synergistically to cause more severe health issues.

6. Long-term effects on the environment

Some pharmaceutical compounds last a long time in the environment and in water supplies. Once the concentration reaches a certain level, usually around one part per million, the chemicals begin to affect the environment. Some drugs, like antiepileptics, are persistent, with some being pseudo-persistent, meaning, they degrade eventually, but after quite some time.

This means they continue to affect the environment long after they are disposed of. Some, have about 30% high fat solubility, meaning they can bioaccumulate, enter a cell and move up food chains, becoming more concentrated in the process.

7. Effects on wildlife

Pharmaceuticals, flushed into the environment by humans, or through the sewage are also affecting wildlife. These animals are consuming water that contains these particles, or are preying on fish which swim in such waters.

Studies on the effects of pharmaceuticals on wildlife are little and have not led to conclusive results, but it is believed that these effects will soon affect the natural world massively. The little known results have shown that antidepressants reduce feeding in starlings and a contraceptive drug is decreasing fish populations in lakes.

Control & Mangment

1. Lack of policies to control pollution

Lack of effective policies and poor enforcement drive allowed many industries to bypass laws made by the pollution control board, which resulted in mass-scale pollution that affected the lives of many people.

2. Unplanned industrial growth

In most industrial townships, unplanned growth took place wherein those companies flouted rules and norms and polluted the environment with both air and water pollution.

3. Use of outdated technologies

Most industries still rely on old technologies to produce products that generate a large amount of waste. To avoid high cost and expenditure, many companies still make use of traditional technologies to produce high-end products.

4. Presence of a large number of small scale industries

Many small scale industries and factories that don't have enough capital and rely on government grants to run their day-to-day businesses often escape environment regulations and release a large number of toxic gases in the atmosphere.

5. Inefficient waste disposal

Water pollution and soil pollution are often caused directly due to inefficiency in the disposal of waste. Long term exposure to polluted air and water causes chronic health problems, making the issue of industrial pollution into a severe one. It also lowers the air quality in surrounding areas, which causes many respiratory disorders.

6. Leaching of resources from our natural world

Industries do require a large amount of raw material to make them into finished products. This requires the extraction of minerals from beneath the earth. The extracted minerals can cause soil pollution when spilled on the earth. Leaks from vessels can cause oil spills that may prove harmful to marine life.

7. Natural resource use

Raw material is a must for industries, which often requires them even pulling out underground elements. One of the most common forms of leaching from natural resources is fracking for oil.

When industries extract minerals, the process causes soil pollution and also causes oil leaks and spills that are harmful and even deadly to people and animals.

Solutions to pharmaceutical pollution

1. **Proper drug disposal**

The easiest, cheapest, and most effective solution to pharmaceutical pollution is keeping the drugs from reaching the waterways in the first place. We should invest in public education on the proper disposal of drugs, as part of the drug take-back programs.

This way, people will know how to properly get rid of old or expired medicine without contributing to pharmaceutical pollution. awareness can also create initiatives that mitigate the effects already caused by pharmaceuticals on the environment.

2. **Tougher regulations**

If tougher regulations are in place, they would help limit large-scale medicine flushing in hospitals, nursing homes and other healthcare institutions. Tougher regulations can be installed by the nation or state's department of health, or by the national body that handles health matters.

The institutions would restrict themselves from disposing of the drugs without proper procedure and would also ensure their relationship with drug manufacturers is in a way that they can return the drugs if they are expired.

3. **Additional research pertaining to the potential dangers of pharmaceutical pollution**

More research is desperately required to assess the potential human effects of pharmaceutical pollution. it will also address the best methods for removing the compounds at treatment plants in a way that is not hazardous or dangerous to the environment in general.

If a significant long-term risk to public health is identified, more aggressive efforts can then be taken to control the problem as required.

4. **Limit bulk purchases**

Another solution is to limit the bulk purchases of pharmaceuticals. The majority of institutions and individuals purchase them in bulk since large volumes attract discounts, which makes the overall price more attractive.

However, it gives rise to a situation where there are large bottles of unused pills which ultimately end up being flushed or disposed of in the wrong way. Limiting bulk purchases will ensure only the required amount is supplied and therefore, less pharma pollution.

5. Trashing is better than flushing

Throwing unused medication into the trash leads to them being incinerated or buried in landfills. It is a better way of disposing them than flushing or pouring them down the drain. However, if you are to trash them, do it properly. Remove them from their packaging, crush them, and seal them in a plastic bag with water.

More to that, add sawdust, coffee grounds, or cat litter or any other material that is unappealing. Although this is not for environmental reasons, it cuts down the chances that a child or animal might ingest the contents.

Minimization and Reduction

Public awareness

This play very important role in prevention of pollution. Increase public's sense against environmental responsibility by showing how their actions as individuals collectively contribute the impact of pharmaceuticals in the environment.

Patient Compliance & Education

Patient's awareness which is related about the importance of completing their treatments and following physician's directions carefully and also awareness about expired medicines.

Healthy life style

Preventive health measures like: exercise, stress management, nutrition, and medications are to maintain our bodies and souls in good health.

Practitioner's education

Health care practitioners are properly educated and fully understand the importance of selecting the rightbmedication and therapy for each patient and also the implications of improper use and disposal of pharmaceuticals.

Pollution control Act's & Regulations of india

- **The water (Prevention and Control of pollution) act, 1974 and its amendments**

The purpose of this act is "to provide for the prevention and control of water pollution and the maintenance or restoring wholesomeness of water for the establishment, with a view to carrying out the purpose of aforesaid of boards for the prevention and control of water pollution, for conferring on and assigning to such boards powers and functions relating thereto and for matters connected therewith.

❖ **The water (Prevention and Control qf pollution) less act, 1977**

Law provides for the levy and collection of a cess on water consumed by persons carrying on certain industries and by local authorities, with a view to augment the resources of the central and state boards for the prevention and control of water pollution constituted under the water (prevention and control of pollution) act, 1974.

❖ **The air (Prevention and Contrql of pollution) act, 1981**

Act was passed for the "prevention, control ". This law defined an air pollutant as "any solid, liquid or gaseous substance present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment."

❖ **The environment (Protection act, 1986)**

Act was enacted to "provide for the protection and improvement of environment and for matters connected therewith." °this act defined environment which includes "water, air, and land and the inter-relationship which exists among and between "water, air and land, and human beings, other living creatures, plants, micro-organisms and property."

❖ **National environmental tribunals act of 1995**

National environmental tribunal act of 1995 was enacted to provide for strict liability for damages arising out of any accident occurring while handling any hazardous substance.

❖ **National appellate authority act of 1997**

Act has been enacted to "hear appeals with respect to restriction of areas in which any industries, operations or processes or class of industries, operations or process shall not be carried out or shall be carried out subject to certain safeguards under the environment (protection) act, 1986 and for matters connected therewith or incidental thereto."

❖ **Hazardous waste (Management and Handling) rules, july 1989**

Main purpose for promulgation of these rules was for management and handling of hazardous substances. The basis of any environmental pollution has been the generation and disposal of hazardous substances.

❖ **The public liability insurance act, 1991**

Purpose of this Act is "to provide for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto.

CONCLUSION

Pharmaceuticals are biologically active compoundsused daily by the public. Concentrations of wastepharmaceuticals have been found to be at their highest in wastewater and sludge associated with sewagetreatment works. It is clear that pharmaceuticals have a major impact on the nature, particularly capable of affecting host immunology and physiology leading tochanges in susceptibility and associated pathological symptoms. Due to the high number of pharmaceutical drugs used in human medicine throughout the world, it is necessary to select the pharmaceuticals to search for, prior to implementing any environmental measurements and any extensive environmental riskassessment (ERA).

The pharmaceutical industry currently uses reverse distributors for the collection of unwanted pharmaceuticals from Pharmacies and health Care Centers. This system could be used as a foundation for an integrated pharmaceutical product take back program that would cover general public as well. This initiative could also be seen as an extension of the product stewardship programs already fostered by the pharmaceutical industry.

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