

Effects of water pollution eutrophication biology essay

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It refers to the enrichment of fresh water bodies by inorganic nutrients like nitrates, phosphates which may occur naturally but more readily as the result of human activity. It is particularly apparent in sluggish rivers and shallow lakes. Sediment deposition over time can eventually raise the level of the lakes or river bed, allowing terrestrial plants to establish along the edges ultimately converting the area to dry land. Nutrient over amelioration of freshwater and coastal ecosystems is a rapidly growing environmental emergency. The number of coastal areas affected by eutrophication globally is over five hundred. Contaminants like sewage, organic matters and fertilizers contain high amount of nitrates and phosphates. Water bodies are being continuously polluted by throwing away of sewage that includes organic matter and also by the runoff from the agricultural fields containing fertilizers. A eutrophic water body has high primary productivity due to excessive nutrients and hence favors the growth of algal blooms resulting in poor water quality. The waters at depth are usually deficient in oxygen, ranging from hypoxic to anoxic condition. The nutrients augment the water promoting the algal growth. Only a limited number of phytoplankton species are involved. Some blooms may be known by the water discoloration due to the high density of pigmented cells. The water usually becomes greenish. This is known as 'algal bloom'. Rapid algal expansion leads to increased number of the decomposers. All forms of aquatic life like decomposers, other aquatic plants including the algae, Pisces and other aquatic animals, consume the dissolved oxygen in the water for respiration. This in turn seeks a great requirement for oxygen and results in depletion of oxygen. Algal blooms may occur both in freshwater as well as oceanic environments. Some

algal blooms are harmful involving harmful, for instance the dinoflagellates belong to the genus *Alexandrium* and *Karenia*. Such bloom often assumes a red or brown color and is conventionally known as red tides. Eutrophication also results in overgrowth of *Eicchornia* that may cover the entire water surface. This reduces the light penetration into the the lower layers in water and affects productivity.

Measurement of Water Pollution

Pollution in water is measured by estimating the biological oxygen demand (BOD). Low BOD indicates less pollution and high BOD values indicate higher pollution. Biochemical oxygen demand (BOD) is the amount of oxygen (in mg) required by aerobic bacteria to decompose the biodegradable organic material in 1 liter of an effluent for 5 days at 20 degree centigrade. It is an indirect measure of the concentration of biologically degradable material present in organic wastes. It usually reflects the amount of oxygen consumed in five days by biological processes breaking down organic waste. The BOD of drinking water should be less than 1. That of raw sewage may run to several hundred.

Chemical Oxygen Demand (COD)

Chemical Oxygen Demand (COD) is the measurement of the amount of oxygen in water consumed for chemical oxidation of pollutants. The test method is based on the chemical breakdown of organic and inorganic pollutants, dissolved or suspended in water. The result of a COD test indicates the ' amount of dissolved oxygen expressed as parts per million or milligrams per liter of water used up by the contaminants, during two hours

of decomposition from a solution of boiling potassium dichromate'. Higher value of COD indicates higher the quantity of pollution in the test sample.

Impacts of water pollution worldwide

Bioaccumulation and Bioconcentration

Bioaccumulation refers to the accretion of substances, such as pesticides, or other organic chemicals in an organism. Bioaccumulation of a chemical substance slowly builds up over time in a living organism. This occurs either because the chemical gains entry faster than it can be utilized, or because the chemical cannot be metabolized by the organism. Thus, the longer the biological life of the substance the greater is the risk of chronic poisoning, even if its level in the environment is not very high. Bioconcentration is a more precise term that refers to uptake and accumulation of a chemical substance from water alone. Whereas, bioaccumulation relates to uptake from all sources such as water, food, air, etc. Compounds like DDT and tetraethyl lead, being lipid soluble, are stored in the body's adipose tissues which are used for energy production, the compounds on being released cause acute poisoning. Metals such as Strontium-90, a radioactive fallout from atomic bombs, behaves similarly and replaces calcium that it is utilized in osteogenesis. The radiation from strontium can have a long time damage. Biomagnification, also known as bioamplification or biological magnification, on the other hand is the increase in concentration of a substance, such as the pesticide DDT, which occurs in a food chain as a result of it being persistent. Energetics of food chain: Low rate of internal metabolism and excretion of the substance. Biological magnification is the process whereby

particular substances such as pesticides or heavy metals move up the trophic level. They are often released into rivers or lakes, consumed by aquatic organisms such as crustaceans, rotifers, snails, fish, which in turn are consumed by large birds, animals or humans. Each time, as they go up the trophic levels in the food chain, the substances become deposited and concentrate in tissues or internal organs. The contaminants mound up and they cannot be excreted or metabolized easily by most organisms and therefore, they are accumulated in high levels. These pollutants are non-biodegradable; they accumulate in the organisms and cause severe health problems. The water on being contaminated with these pollutants results in their access into the phytoplanktons and zooplanktons. These organisms are fed upon by higher forms of aquatic life like the fish. The fish in turn are consumed upon by the terrestrial animals including birds and man. So the pollutant ultimately reaches the body of human. At each trophic level, the pollutant increases in magnitude. This is because a fish usually feeds on great amount of smaller plants and human consumes fish. These contaminants remain in the fats and are not metabolised in the body. Over the years the quantity intensifies in the body. This is called biomagnification. Pollutants like DDT may also enter the human body through milk if the bovines are exposed to DDT sprayed grass or contaminated water. This results in serious blood and nervous disorders. Substances that exhibit biomagnification are DDT, Toxaphene, Poly chlorinated biphenyls, mercury, arsenic, cadmium etc. biomagnification stages in detail Bio-magnification

El nino, La nina and Southern Oscillation

El Nino means ' Christ child' and derives its name as it occurs sometime around Christmas. It lasts from few weeks to few months. It is the name given to the warm ocean current along the coast of Peru and Ecuador in South America. Development of an El Nino is found to be related with the cycling of a Pacific Ocean movement known as the Southern Oscillation. Normally, in parts of North Australia and Indonesia a low pressure develops in contrast to the development of high pressure along Peru's coast. Consequently, trade winds blow from east to west across the Pacific. This drives the warm waters towards the west which outcomes as storms in Australia and Indonesia. On the other hand, along Peru's coast there is upwelling of the cold bottom water to replace the warm water. The year when El Nino is to happen the pressure falls over vast areas in Central Pacific and South American coast. This low pressure is counteracted by high pressure in western Pacific. The trade winds are consequently reduced and permit the equatorial counter current to gather warm current along Peru and Ecuador coast. This warm water cuts off the gushing of cold deep marine water along the coastline of Peru. Development of an El Nino fetches drought to the western Pacific, rainfall to the equatorial coastlines of South America, and squalls and tempests to the central Pacific. Weather conditions usually return back to normal post the El Nino phenomenon. Sometimes, the trade winds can become exceedingly strong resulting in an unusual accretion of cold water in the central and eastern Pacific. Such an event is the La Nina. La Niña in the middle of 1998 lasted upto the winter of 2000. Atlantic Ocean experienced active hurricane seasons in 1998 and 1999. In 1998, out of ten

tropical storms, six has become full-scale hurricanes. One such hurricane was the Mitch, which was the strongest hurricane to develop in about 100 years of record. Other weather effects include aberrantly heavy rainfall in India and Southeast Asia; colder, wet winter in southeastern regions of Africa, wet weather in eastern part of Australia, cold winter in western part of Canada and northwestern USA, winter drought in the southern USA, warm and soaked weather in northeastern United States, and an exceptionally wet winter in southwestern Canada and northwestern USA. The El Niño of 1982-83 resulted in extreme heating to the equatorial Pacific. Surface temperature of the sea in certain parts of the Pacific Ocean rose by 6° Celsius above normal. This warmer current had a devastating effect on marine life along the coast of Peru and Ecuador. Peruvian economy depends on fishing particularly and selling of guano. The warm waters killed the teeming fishes and fish catches were 50% lower than the previous year. Moreover they failed to collect the bird dung guano also. Severe droughts occurred in Australia, Indonesia, India and southern Africa. Australia incurred a 2 billion dollar loss in crops, millions of sheep and cattle died in the scorching heat. California, Ecuador, and the Gulf of Mexico experienced heavy rains.

elninomapFigure 7z-5: Global climatological effects of the El Niño.

Water borne diseases

Waterborne diseases are caused by pathogenic microorganisms can directly transmit can be the source of foodborne disease through consumption of the same microorganisms. The most common water borne diseases are -

Protozoal Infections

Disease and Transmission

Pathogen

General Symptoms

Amoebiasis *Entamoeba histolytica* Abdominal discomfort, tiredness, weight loss, diarrhea, bloating, pyrexia
 Cryptosporidiosis *Cryptosporidium parvum* Flu-like symptoms, watery diarrhea, loss of appetite, anorexia, bloating, increased gas, queasiness
 Cyclosporiasis *Cyclospora cayentanensis* spasms, nausea, vomiting, muscle aches, pyrexia, and tiredness
 Giardiasis *Giardia lamblia* Diarrhea, abdominal discomfort, bloating, and flatulence
 Microsporidiosis *Microsporidia* Diarrhea

Parasitic Infections (Kingdom Animalia)

Disease and Transmission

Parasite

General Symptoms

Schistosomiasis *Schistosoma* Rash or itchy skin. Fever, chills, cough, and muscle aches
 Dracunculiasis Guinea Worm
 Disease *Dracunculus medinensis* Allergic reaction, urticaria rash, nausea, vomiting, diarrhea, asthmatic attack.
 Taeniasis Tapeworms *Taenia* Intestinal disturbances, neurologic manifestations, loss of weight,
 cysticercosis
 Fasciolopsiasis *Fasciolopsis buski* GIT disturbance, diarrhea, liver enlargement, cholangitis, cholecystitis, obstructive jaundice.
 Hymenolepiasis *Hymenolepis nana* Abdominal pain, anorexia, itching around

the anus, nervous manifestation Echinococcosis Echinococcus granulosus Liver enlargement, hydatid cysts press on bile duct and blood vessels; if cysts rupture they can cause anaphylactic shock Ascariasis Ascaris lumbricoides Mostly, disease is asymptomatic or accompanied by inflammation, fever, and diarrhea. Severe cases involve Löffler's syndrome in lungs, nausea, vomiting, malnutrition, and underdevelopment. Enterobiasis Enterobius vermicularis Peri-anal itch, nervous irritability, hyperactivity and insomnia

Bacterial Infections

Disease and Transmission

Pathogen

General Symptoms

Botulism Clostridium botulinum Thirsty mouth, blurred vision, difficulty swallowing, muscle weakness, difficulty breathing, slurred speech, vomiting and sometimes diarrhea. Death usually by respiratory failure. Cholera Vibrio cholerae watery diarrhoea, nausea, cramps, nosebleed, rapid pulse, vomiting, and hypovolemic shock. E. coli Infection Escherichia coli Diarrhea, dehydration. Dysentery Shigella dysenteriae passage of feces with blood and/or mucus and in some cases vomiting of blood. Legionellosis Legionella pneumophila) acute influenza without pneumonia. fever, chills, pneumonia, ataxia, anorexia, muscle aches. Salmonellosis Salmonella diarrhea, fever, vomiting, and abdominal cramps Typhoid fever Salmonella typhi Characterized by sustained fever up to 40°C (104°F), profuse sweating, diarrhea, less commonly a rash may occur. Symptoms progress to delirium and the spleen

and liver enlarge if untreated. In this case it can last up to four weeks and cause death.

Viral Infections

Disease and Transmission

Pathogen

General Symptoms

Adenovirus infection Adenovirus common cold symptoms, pneumonia, croup, and bronchitis Gastroenteritis Astrovirus, Calicivirus, Enteric Adenovirus, and Parvovirus diarrhea, nausea, vomiting, fever, malaise, and abdominal pain SARS (Severe Acute Respiratory Syndrome) Coronavirus fever, myalgia, lethargy, gastrointestinal symptoms, cough, and sore throat Hepatitis A Hepatitis A virus (HAV) acute fatigue, fever, abdominal pain, nausea, diarrhea, weight loss, itching, jaundice and depression. Poliomyelitis (Polio) Poliovirus delirium, headache, fever, and occasional seizures, and spastic paralysis, rarely aseptic meningitis; serious symptoms is paralysis or death Pollution of water by organic matter is a prime cause for epidemics outbreaks like cholera, gastroenteritis in India. The microbes causing these ailments access the water bodies through the organic wastes matter and then into the bodies of healthy persons causing diseases. In fact, a good indication of aquatic pollution is the existence of E. coli in the human intestines.

Acid Rain

Refer to Unit 6

Occupational Health Hazards

Itai-itai disease was the renowned case of cadmium poisoning in Toyama Prefecture, Japan. The disease is because of the severe pains in the joints and backbone. The term itai-itai disease was coined by local people.

Cadmium was released into rivers primarily by mining companies. Itai-itai disease is known as one of the major pollution related diseases of Japan. The consequences are softening of the bones and kidney failure. Minamata disease, often referred to as Chisso-Minamata disease, is a neurological syndrome caused by stark mercury poisoning. Symptoms manifested include ataxia, lack of sensation in the hands and feet, muscular weakness, reduction of the field of vision and damage to hearing and speech. insanity, paralysis, coma and death in extreme cases followed within weeks of the inception of symptoms. The disease can also affect fetuses in utero. The disease was first discovered in the city of Minamata in Kumamoto prefecture, Japan in 1956 and is caused by the release of methyl mercury from the Chisso Corporation's chemical factory from 1932 to 1968. This highly hazardous chemical continued to be bio-accumulated in shellfish and fishes in Minamata Bay and Shiranui Sea. When local people consumed, it resulted in mercury poisoning. Death of cats, dogs and other pets, pig and human continued for more than 30 years, the government and company actions were little to avert the pollution. As of 2001, over 2, 260 victims had been formally recognised of which 1, 784 had died and over 10, 000 had received monetary reimbursement from Chisso. By the year 2004, Chisso Corporation

had given \$ 86 million as compensation, and in the same year Chisso was ordered to clean up its pollution. On March 29, 2010, an agreement was signed to compensate as yet to be uncertified victims. A second outbreak of Minamata disease occurred in Niigata Prefecture in 1965. Blackfoot disease (BFD) is an endemic peripheral vascular disease confined to the southwestern coast of Taiwan. Black Foot Disease, with gangrene-like symptoms, affects the feet and occasionally the fingers due to arsenic poisoning. It is a rare peripheral vascular disease found only in the Province of Taiwan in China. Black pustules appear mostly on the feet, but can also be found on other parts of the body. The pustules are painful and if opened, drain pus and blood along with a foul odor. Along with swelling and itching, a black layer forms over the pustule wounds. If left untreated the infected tissues decay.

Methaemoglobinemia

Excess release of nitrates from fertilizers enters the human body through water. When nitrates are ingested or intaken, they are transformed into nitrites in the alimentary system. The nitrites react with the hemoglobin of the blood to form methaemoglobin. The haemoglobin being preoccupied by nitrites cannot bind to the oxygen. The body is thus deprived of oxygen supply. This is fatal especially in the infants as they have very little amount of methaemoglobinreductase which could revert such effect. The syndrome is called blue baby syndrome or methaemoglobinemia. The symptoms are shortness of breath, vomiting and diarrhea. After confirming the test for the

syndrome , an injection of required dose of methylene blue can help the baby's blood to return to normal.

Steps to prevent or control water pollution

It is not easy way to solve the problem of water pollution. Largely speaking, there are three approaches that can assist us to tackle the problem— education, laws, and economics which have to be treated synergistically.

Awareness

Making people aware of the problem is the foremost step towards preventing and controlling water pollution. People walking along the world's most polluted beaches often express their resentment and often ensemble together to organize themselves in beach cleaning sessions. Many NGOs have campaigned against over harvesting of fish and for tougher penalties against factories that dispense pollution into our water bodies. Greater public awareness can surely raise concern, bring responsibilities and make a positive difference.