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# The Effect of Eutrophication on Drinking Water

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## Abstract

The effects of eutrophication on the environment may have deteriorated consequences of health of exposed animal and human populations through various path ways. When fresh water, extracted from eutrophic areas, is used for the production of drinking water severe impacts can also occur during watering in eutrophic waters. Eutrophication is complex processes which occurs both in fresh and marine waters, where certain types of algae disturbs the aquatic ecosystem and become a threat for animals and human health the primary cause of eutrophication is an excessive concentration of plant nutrient's originating from agriculture of sewage treatment. The main cause of eutrophication is the large input of nutrient mixed to water body and the main effect is imbalance in the food web that results in the high levels of phytoplankton, zooplankton, and algae biomass in stratified water bodies. This can lead algal blooms. The direct consequences is in an excess of oxygen consumption near bottom of the water body .eutrophication processes can be divided in to two categories depending on weather they are linked to the nutrients dispersion and phytoplankton growth to oxygen cycle near the bottom of the water body. Various effects can be observed depending upon the severity of the eutrophication treatment of eutrophic water for producing drinking water. Algae disturbs the aquatic ecosystems a threat for animal and human health. Eutrophication concerns the availability of oxygen's. Some species of algae may also contain toxins but incidents where fresh water algae or the origin of cause human or animal illness. Some cyanobacteria have capacity to produces toxins dangerous to human beings. A variety of symptoms depending on toxins implicated our observed such as fatigues, headache, diarrhea, vomiting, and some throat fever skin irritations. Good practices to inform people about risks of bathing or sporting activity in normally colored or turbid waters allergic bathers of people walking along shore of water body affected by algae blooms any allergies releasing not only toxin but also allergic compounds.

In some specific case; local authorities must rely on eutrophic water for producing drinking water.

**Keywords:** Eutrophic water; Phytoplankton; Algae; Drinking water

## Introduction

"Eutrophication" is the enrichment of surface waters with plant nutrients. While eutrophication occurs naturally, it is normally associated with anthropogenic sources of nutrients. The "trophic status" of lakes is the central concept in lake management. It describes the relationship between nutrient status of a lake and the growth of organic matter in the lake. Eutrophication is the process of change from one trophic state to a higher trophic state by the addition of nutrient. Agriculture is a major factor in eutrophication of surface waters. Municipal solid waste (MSW) disposal is a major global concern particularly in developing countries across the world. Rapid population growth, higher urbanization and cites have efficient waste management policies and infrastructure place land filling is the waste in lowing areas. Ground water under flow through waste or rainwater infiltration picks 'up a variety of inorganic and organic compounds in organic compound such as Al, Ca, magnesium, sodium, iron, sulphate, chlorides and Heavy metal likes Cadinium, Chromium, Copper etc. toxic metal leatches from the solid waste dump's is major environmental problem in the towns and cities and pose serious contamination risk both ground water surface water.

The most complete global study of eutrophication was the Organization for Economic Cooperation and Development (OECD) Cooperative Program on Eutrophication carried out in the 1970s in eighteen countries [1]. The sequence of trophic state, from oligotrophic (nutrient poor) to hypertrophic (= hyper eutrophic [nutrient rich]) is shown in Table 1.

Although both nitrogen and phosphorus contribute to eutrophication, classification of trophic status usually focuses on that nutrient which is limiting. In the majority of cases, phosphorus is the limiting nutrient. While the effects of eutrophication such as algal blooms are readily visible, the process of eutrophication is complex and its measurement difficult. This is not the place for a major discussion on the science of eutrophication, however the factors noted in

Because of the complex interaction amongst the many variables that play a part in eutrophication, Janus and Vollenweider (1981) concluded that it is impossible to develop strict boundaries between trophic classes. They calculated, for example, the probability (as %) of classifying a lake with total phosphorus and chlorophyll-a concentration of 10 and 2.5 mg/m3 respectively, as:

| | Phosphorus | Chlorophyll |
|---|---|---|
| Ultra-oligotrophic | 10% | 6% |
| Oligotrophic | 63% | 49% |
| Mesotrophic | 26% | 42% |
| Eutrophic | 1% | 3% |
| Hypertrophic | 0% | 0% |

The symptoms and impacts of eutrophication are:

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**Table 1:** Relationship between trophic levels and lake characteristics (Adapted from Janus and Vollenweider 1981).

| Trophic status | Organic matter mg/m³ | Mean total phosphorus¹ mg/m³ | Chlorophyll maximum 1 mg/m3 | Secchi depth 1m |
|---|---|---|---|---|
| Oligotrophic | low | 8 | 4.2 | 9.9 |
| Mesotrophic | medium | 26.7 | 16.1 | 4.2 |
| Eutrophic | high | 84.4 | 42.6 | 2.45 |
| Hypertrophic | very high | 750-1200 | | 0.4-0.5 |

1. Increase in production and biomass of phytoplankton, attached algae, and macrophytes.
2. Shift in habitat characteristics due to change in assemblage of aquatic plants.
3. Replacement of desirable fish (e.g. salmonids in western countries) by less desirable species.
4. Production of toxins by certain algae.
5. Increasing operating expenses of public water supplies, including taste and odour problems, especially during periods of algal blooms.
6. De-oxygenation of water, especially after collapse of algal blooms, usually resulting in fish kills.
7. Infilling and clogging of irrigation canals with aquatic weeds (water hyacinth is a problem of introduction, not necessarily of eutrophication).
8. Loss of recreational use of water due to slime, weed infestation, and noxious odour from decaying algae.
9. Impediments to navigation due to dense weed growth.
10. Economic loss due to change in fish species, fish kills, etc.

## Algal and cyanobacterial blooms

Cultural eutrophication causes excessive algal bloom in water bodies, with consequent algal overload. Under certain conditions of darkness and warm temperatures these blooms may die, decompose and produce offensive sewage-like odor. If the receiving water is used as a raw water supply for some public or private agency, algae may be difficult to remove and hence add certain objectionable tastes to the delivered water. Algae also have the tendency to absorb and concentrate mineral nutrients in their cells. When they die, at the end of the growing season, they settle to the stream or lake bottom, from which they release these mineral and organic nutrients at the beginning of the next growing season. In this way they serve as a form of secondary pollution.

One of the most common symptoms of Lake Eutrophication is the development of blue-green algal (Cyanobacteria) blooms. They can be generated by human activity: for example, sediment runoff from construction sites may greatly diminish water clarity and therefore decrease the amount of light available for phytoplankton. Cyanobacteria are able to maintain themselves near the surface of the water by means of special gas-filled vacuoles that give the plants slight positive buoyancy. Once cyanobacteria or more generally algal blooms reach high concentrations, problems can occur: they have a negative impact on water quality, creating taste and odorous problems and interfering with certain water treatment processes. When certain bacteria populations reach very high proportions, they can also produce toxins that can render water unsafe for consumption.

## Excessive aquatic macrophyte growth

Increased nutrient levels can stimulate other forms of primary production, in addition to algae and cyanobacteria. The littoral zones of many nutrient-enriched water bodies are often chocked with excessive growths of aquatic macrophytes, which can influence recreational and industrial activity and alter the structure of the food web. Excessive growth of phytoplankton and macroscopic plants in the water create aesthetic problem and reduce the value of the body water as a recreational resource. From a purely aesthetic point of view, crystal clear water characteristic of oligotrophic systems is most attractive for swimming and boating. High phytoplankton concentrations cause the water to appear turbid and aesthetically unappealing. Macroscopic plants can completely cover the entire surface of eutrophic lakes making the water almost totally unfit for swimming and boating.

Plankton ecosystem of global ocean profoundly affect and life on earth about half the carbon dioxide ends up in the ocean and plankton absorbs and marine ecosystem study (NAAMES) studied the world largest plankton bloom and how it raises to small organic particles that live on ocean surface and end up in the atmosphere ultimately influencing clouds and climate.

## Deep water oxygen depletion

Oxygen is required for all life forms on this planet, with the exception of some bacteria. For this reason oxygen depletion is considered to be a serious lake management problem often associate with eutrophication: this causes an increased organic matter production, so more material is sedimenting down into the pro-fundal waters, consuming oxygen. Since it is impossible for some organisms to function efficiently unless the oxygen concentration in the water is near saturation, such organisms are often absent from eutrophic environments. This problem can preclude fish or other biota from inhabiting deep-water regions of anoxic lakes. It may be a seasonal or nocturnal phenomenon.

## The cause; the impact and management of eutrophication

The word 'eutrophic' comes from the Greek word eutrophics meaning well fed. Eutrophication is the processes of nutrients enrichment of waters which results in the stimulation of an array of symptomatic changes, amongst which increased production of algae and aquatic macrophytes deterioration of water quality and other symptomatic changes are found to undesirable and interfere with water uses [2].

## Eutrophication management strategies

Control of major eutrophication sources. In order to control eutrophication and restore water quantity, it is necessary to check and restrict phosphorus inputs, reduce soil erosion, and develop new technologies to limit phosphorus content of over- riched soil (Carpenter and Lathrop 2008). Fresh water algal blooms are the results of an excess of nutrients particularly phosphorus [3]. Industrial agricultural, with its reliance on phosphate –rich fertilizers, is the primary source of excess phosphorus responsible for degrading lake (carpenter 2008). The routine application of chemical fertilizer and phosphorus-laden manure has resulted in the gradual accumulation of phosphorus in soil, which washes in to lakes of the watershed where it is applied on a global basis; researcher have demonstrated a strong correlation between total correlation between total phosphorus input and algal biomass in takes [4]. According to an estimate 400 grams of phosphates could potentially induce an algal blooms to the extent of 350 tons (Sharma 1999).Eutrophication is the processes of excessive nutrients enrichment of waters that typically result in problems associated with macrophyte, algal or cyanobacterial growth. The cause and effect of eutrophication is complex. The current state of knowledge, much research work is progress that aims at furthering our knowledge of the intricate interrelationship involved in eutrophication of water resources [5]. Eutrophication causes in natural lakes a distinction is sometimes made between 'natrual' and 'cultural' (anthropagenic) eutrophication processes [6]. Natural eutrophication is associated with human activities which accelerate the eutrophication processes beyond the rate associated with natural processes (e.g. by increasing nutrients loads in to aquatic ecosystems). Increased nutrients enrichment can arise from both point and non-point sources external to the impoundment as well as internal sources like the impoundment's own sediments (that release phosphate). Impact's eutrophication is concern because it has numerous negative impacts increased productivity in an aquatic system can sometimes be beneficial Fish and other desirable animals. However deter mental ecological impacts can in turn have other adverse impact's which vary from aesthetic ecological impacts can turn have other adverse impacts which vary from aesthetic and recreational to human health and economic impacts.

Impacts of eutrophication are complex and interrelated. The excessive growth of aquatic plants and cyanobacterial have multitude of impacts on an ecosystem. The specific impacts depends on plants are stimulated to grow.

Ecological impact's macrophyte invasions and algal and cyanobacterial (blue-green) blooms are themselves direct impacts on an ecosystem. However; their presence causes a number by other ecological impacts. Of critical concern is the impact of eutrophication on biodiversity macrophytes invasions impede or prevent the growth of other aquatic plants.

Cyanobacterial can maintain a relatively higher growth rate compared to other phytoplankton organisms when light intensities are low. They will therefore have a comparative advantage in waters that are turbid due todense growths of other phytoplankton maximum growth rates are attained by most cyanobacteria at temperature above 25°C. Growth rates days per doubling.

These optimum temperatures are higher than for green algae and diatoms (Chorus and Bartam1999). Cyanobacteria can form sums (like microcytis), be distributed homogeneously throughout eppilimnion (like oscillatoria) or grow on submerged surfaces. Cyanobacteria are particularly problematic because when their cells are- ruptured 9e.g. by decay or by aligicides) they release toxic substances (cyano toxins) water, through passive release can also occur. These cyanotoxins falls into three broad groups of cyclic peptides, alkaloids and lipopolysaccharides. Cyanotoxins are recognized to have caused the deaths of Wilds animals, farm livestock pets, fish and birds in many countries [7]. The primary target organ of most cyanotoxin in mammals in liver (i.e. they are hepatoxic). Some cyanotoxins are neurotoxic (target the nerves system) and others determatotoxic (target the skin). Ecological impacts include various waters quality impacts like increased cynotoxin levels and lowering of oxygens levels (due to decay of algae and cyanobacteria). Decreased oxygen's levels can have a number of other secondary water quality impacts. Anaerobic conditions allow reduced chemical species (like ammonia and sulphide) to exist's. These chemical can be particularly toxic to animals and plant.

Human health impacts an infectation of water hyacinth (eichhonia crassipes) can be a health hazards. It can provide an ideal breeding habitat for mosquito larvae and it can protect the small vector of biliharzia [8]. A number of adverse consequences have been documented for swimmers exposed to cyanobacteria blooms.

Chronic exposure to low doses may promote the growth of liver and other tumours. Nevertheless many cyanobacterial blooms are apparently not Hazardous to animals (Carmichael 1992).It also possible exposed to odours from waterways contaminated with decaying algae of cyanobacteria may suffer chronic ill-health effects economic impacts. Human and domestic and wild animal's health impacts due to cyan toxins in water have obvious direct economic impacts. A drinking water supply safe from cyanotoxins should be free of cyanotoxins, or have treatment in place that will remove cyanobacterial cell (without rupturing them) and released cyanotoxins (chorus and Bartram, 1999). The impacts of cultural eutrophication on lakes: review of damage and nutrients control measures.

The assignment was to explore a significant issue relating to water bodies, to study the extent to which it has an impact on or alters the ecosystem, and to analyze the future implication for clean water and society in general. Excess of nutrients in water can cause widespread deterioration of water quality; severely harming the environment. The numerous actions take prevent eutrophication through human activities, aquatic plants need two essential nutrients for growth phosphorous and nitrogen.

For growth phosphorous and nitrogen they receive these nutrients through process known as eutrophication, in which water bodies accumulate plant nutrients; typically from nutrients-rich land drainage (smith 2003). In healthy lake, both nutrients occur in limiting amounts; anthropogenic (human) factors can dramatically increase the concentration of plant nutrients in water bodies, a phenomenon known as "cultural eutrophication" (Haseler 1947). Human – induced pollution through the impacts of excessive fertilizers use, untreated waste water effluents, and detergents significantly increase nutrients loading in to lakes, accelerating eutrophication beyond natural levels and generating deleterious changes to natural ecosystems (litke 1999). Over past 50 years, a large body literature has been developed to identify the principal impacts and sources of increased nutrients levels on the quality of receiving waters [9].

It is now generally accepted that cultural eutrophication can stimulate the rapid growth of plant and algae, clogging water ways and potentially creating toxic algae blooms. Hypoxic (very low oxygen) conditions may result when these plants and algae die and decompose stripping water of dissolved oxygen; leading to kills fish and degrading the aesthetic and recreational value of the lake (ESA 2008). Cultural eutrophication is in an increasingly global problem as the deterioration of water quality and excessive biological productivity in Lake Inflicts significant environmental and societal damage. In identifying sources a strong relationship between algal biomass and nutrients loading with phosphorous being the prime ship between algal biomass and nutrients loading with phosphorous being primarily limiting nutrients in freshwater bodies. Therefore, most efforts to control algal biomass in lakes concentrate on reducing phosphorous levels in water (smith 1999).The strategies developed to reducing phosphorous levels in water the strategies developed to mitigate eutrophication, integrated approaches focusing on nutrients loading restriction's should be essential cornerstone of effective. This approach would incorporate nutrients loading restrictions with bio manipulation to limit the levels of phosphorous and nitrogen in lakes as well as to alter the food web to control phytoplankton population; the major contributor to eutrophication. Run off especially from urban and agricultural areas, carries fertilizers, pesticides, sediments, and/or industrial effluents that accelerate eutrophication when discharged into water body (Smith et al .1999). With severe eutrophication; hypoxic conditions often result, disrupting normal food web and ecosystem processes food web and ecosystem processes by creating "deadzone" where no animal life can be sustained (Smaya 2008). In 1960's lake Washington (Seatels, USA), was one of the most publicized examples of anthropogenic eutrophication. At the maximum eutrophication lakes Washington received 20 million gallons of waste water effluent each day (Edmondson 1991). from developed agricultural and water lands sewage the lake; stimulating plant and algae growth that choked out most other species (Edmondson 1970). Lakes and reservoirs deteriorates through excessive additions of plants nutrients; organic matters and slit, which combine to produced increased algae and rooted plant biomass, reduced water claring and usually decreased water volumes (Harper 1992).if lake serves as a drinking water sources excessive algal growth clog intake increases corrosion of pipes, make filtration more expensive and often causes taste and odur problems [10]. Algal removal also increase filtration costs for industries using eutropic waters. People generally find clear waters enter aesthetically pleasing then turbid cloudy waters both Social impacts and economic are important and eutrophication control necessary. When phosphates are introduced into water systems, higher concentration cause increased growth of algae and plants. As the nutrients sources higher levels persist and conditions remains favorable, algal blooms can become long-terms events that have an impact on ecosystem.

Algae tend to grow very quickly under high nutrients availability, but each algae is short lived, and the result is high concentration of dead organic matter that start decay. The decay process consumes dissolved oxygen in water, animals, and plants die off in large numbers. Additionally; sustained blooms reduce or block out sunlight penetrating the water, stressing or killing aquatic plants.in severe eutrophic conditions harmful algal blooms (HAB) are blooms that can have negative impact on the other organisms due to the production of natural toxins, the infliction of mechanical damage or other means.

## Clean water plants design and construction of drinking water system

### Removing pollution from water ways

When protecting natural environment people live in, we must prevent contamination from entering the water ways and protect their natural corridors.

These rivers, lakes and streams are the life hood of communities, especially in developing countries. Pollutants of these water ways are identified in categories: point source contamination such as industrial/manufacturing facilities and non-point sources storm water runoff from building areas. Contaminates include oil and grease from roads. Fertilizers/pesticides from arms and lawns, and contamination come through chemical from industrial/commercial areas to remove pollution from water ways.

Geo-life designs systems that use filtration industrial contamination and retention systems that use filtration for industrial contamination and retention pond system with biological planting schemes, such as bio-sewage and open retention pond systems for organic contaminates. These systems are designed to remove pollution before it flows to lakes, streams, rivers and eventually the oceans.

These systems are not expensive and can be part of natural corridor through communities that provides safe drinking water for people to use a place for wild life to live and fresh water filtered air for all life. Vegetation along these restored water ways removes contaminates from water ways and carbon- di- oxide from atmosphere.

Clean water Plant design and construct drinking water systems.

As an example, our Arsenic Removal Filter Design is being used (free of charge) by more than 35 Nonprofits and NGOs around the world, to build filters in communities in rural areas where arsenic poisoning is a problem. Providing clean drinking water is what we have been trained for as civil engineers and planners. We have decades of experience in cleaning contaminated drinking water and stopping pollution from flowing to our water sources here in the United States. Now we are putting this expertise to work in developing countries where it is needed the most. On the average it cost about $20 per person to build a water pump or water filter system in a community. These systems produce clean, safe drinking water for approximately 12 to 24 years.

We work with partners in developing countries, to design and construct drinking water systems. With our civil engineering / land use planning background we approach the problem with state of the art designs and with realistic construction methods that can be easily implemented in the host country:

- Step 1: For immediate problems we provide filtering systems that are purposely designed and constructed to be simple. They are made from local materials so local people, who need filtering systems the most, can reproduce these filters on their own.

- Step 2: We install fresh water wells with hand pumps for entire communities, so no one has to go without clean water.

- Step 3: We investigate the causes of waterway pollution, which could be from industrial sources or local farms and ranches. Once we locate where the pollution is coming from, we design low cost water treatment systems that are simple to build and effective. When toxic pollution flowing to local waterways is stopped, entire communities will benefit with clean rivers, lakes and streams. The health of everyone connected to these waterways improves.

## Bio-Sand Water Filters

A bio-sand water filter is a simple technology which is well suited for developing countries where other clean water systems are not available. These systems cost approximately $20 per person served. The Bio-sand filter is a container that holds sand and gravel to produce clean drinking water naturally. It is constructed of locally available materials (sand, gravel). These systems are great because they do not require electricity to work, and they do not have expensive parts to be replaced. Maintenance is simple and can be done by the bio-sand filter owner. It's so simple everyone in the household can use it. The bio-sand filter treats polluted water with a biological layer covering the top layer of the sand bed. The "good microbes" in the bio-layer feeds off of the "bad organisms / microbes" and develop an active organic community. Organisms like worms and protozoa can't pass through the sand bed so there is a natural "die off" process that happens too. The bios and water filter can effectively filter out up to 99% of all waterborne diseases caused by bacteria, protozoa, viruses and worms, giving local families an affordable solution for their clean water needs.

A typical bio-sand filter can produce about 6 gallons or 23 liters every hour and provide enough water to meet the needs of 10 people or 3 or 4 families.

Provide filtering systems that are purposely made to be simple and designed from local materials so that the local people, who need it the most, can reproduce this system on their own.

Also we help to install freshwater wells with hand pumps for the entire community so no one has to go without. And we investigate the causes of waterway pollution, which could come from industrial sources or local farms. Once we find where the pollution is coming from we design low cost water treatment systems that are simple but effective when toxic pollution flowing to local waterways is stopped, the entire community benefits with clean water. Everyone in the area becomes healthier. This is what we have been trained for as civil engineers and planners. We have decades of experience in stopping pollution from flowing to our waterways.

## Solar powered pumps

Solar water systems use the power of the sun to drive a submersible electric pump and are ideal for boreholes with a high yield. The pumps Geo-Life uses - helical rotor pumps - are among the most efficient and simple pumps in the world with only one moving part. The system can pump water all day and excess water is stored in an overhead tank. Solar pumps are low maintenance, require no manual operation, and use clean, renewable energy.

## Water Filters

In emergency situations or in remote areas where Geo-Life is not able to install a pump because of technical limitations, surface water filtration systems are a viable option. The Life Straw® Personal, for example, is a portable water filter which can be carried for easy access to safe and clean drinking water. This water filtration system makes it possible to drink from surface water sources that would not otherwise be safe. The straw kills and removes 99.999% of waterborne bacteria and 98% of waterborne viruses.

## Rain Water Harvesting

Geo-Life supports rainwater harvesting systems for schools and communities with solar pumps. A PVC gutter channels rainwater to a 1000 to 2500 litre water tank, with a tap fitted directly to the outlet of the tank. The water is then used for irrigation, cleaning, and other grey water needs.

## Removing Pollution from Waterways

When protecting natural environments people live in, we must prevent contamination from entering the waterways and protect their natural corridors. These rivers, lakes and streams are the lifeblood of communities especially in developing countries. Pollutants of these waterways are identified in two categories: point source contamination such as industrial / manufacturing facilities and nonpoint source storm water runoff from built areas. Contaminates include oil and grease from roads, fertilizers / pesticides from farms and lawns, and contamination / chemicals from industrial / commercial areas.

To remove pollution from waterways, Geo-Life designs systems that use filtration for industrial contaminants and retention pond systems with biological planting schemes, such as Bio-Swales and open retention ponds for organic contaminants. These systems are designed to remove pollution before it flows to lakes, streams, rivers and eventually the oceans. These systems are not expensive and can be a part of a natural corridor through communities that provide safe water for people to use, a place for wildlife to live and fresh filtered air for all life. Vegetation along these restored waterways removes contaminates from the waterway and carbon dioxide from the atmosphere.

The main effects caused by eutrophication can be summarized as follows

- Species diversity decreases and the dominant biota changes
- Plant and animal biomass increase
- Turbidity increase
- Rate of sedimentation increases, shortening the lifespan of the lake
- Anoxic conditions may develop

The changes in nutrient levels and biology can directly affect human activities. The main occurring problems can be summarized as follows:

- The water can be injurious to health
- The amenity value of the water may decline
- Increased vegetation may impede water flow and navigation
- Commercially important species of fish may disappear
- Treatment of drinking water may be difficult and supply can have an unacceptable taste or odour

Eutrophication can give rise undesirable Aesthetic impacts in the form of increased turbidity, discolouration, unpleasant odours, slimes and Foam formation. Eutrophication ultimately destroys from biodiversity, through proliferation and dominance of Nutrients – tolerant plants and algael species. These tend to displace more sensitive species of higher conservation value, changing the structure of ecological communication.

Eutrophication can also adversely affect a wide variety of water uses such as water supply (e.g. algae, clogging filters in treatment works) some bacteria harmful to underground water pipeline.

## Role of agriculture in eutrophication

In their summary of water quality impacts of fertilizers, FAO/ECE (1991) cited the following problems:

Fertilization of surface waters (eutrophication) results in, for example, explosive growth of algae which causes disruptive changes to the biological equilibrium [including fish kills]. This is true both for inland waters (ditches, river, and lakes) and coastal waters Groundwater is being polluted mainly by nitrates. In all countries groundwater is an important source of drinking water. In several areas the groundwater is polluted to an extent that it is no longer fit to be used as drinking water according to present standards. While these problems were primarily attributed to mineral fertilizers by FAO/ECE (1991), in some areas the problem is particularly associated with extensive and intensive application of organic fertilizers (manure).The precise role of agriculture in eutrophication of surface water and contamination of groundwater is difficult to quantify. Where it is warranted, the use of environmental isotopes can aid in the diagnosis of pollutant pathways to and within groundwater [11], calculated that European agriculture is responsible for 60% of the total rive rine flux of nitrogen to the North Sea, and 25% of the total phosphorus loading. Agriculture also makes a substantial contribution to the total atmospheric nitrogen loading to the North and the Baltic Seas. This amounts to 65% and 55% respectively. Czechoslovakia reported that agriculture contributes 48% of the pollution of surface water; Norway and Finland reported locally significant eutrophication of surface waters arising from agriculture; high levels of usage of N and P are considered to be responsible for proliferation of algae in the Adriatic; similar observations are made in Danish coastal waters; substantial contamination of groundwater by nitrate in the Netherlands was also reported (FAO/ECE, 1991). Lake Erie (one of the North American Great Lakes) was declared "dead" by the press due to the high levels of nutrients accompanied by excessive growth of algae, fish kills, and anaerobic bottom sediments. The situation for nitrogen, as for phosphorus, was quite variable from country to country. Danish statistics indicated that manure contributes at least 50% of the leaching of inorganic N (Joly, 1993). Nitrogen from agricultural non-point sources in the Netherlands amounted to 71% of the total N load generated from within the Netherlands (ECE, 1992). A study by Ryding (1986) in Sweden demonstrated how lakes which were unaffected by industrial or municipal point sources, underwent long-term change in nutrient status as a result of agricultural activities in the watershed. Over the period 1973-1981 the nutrient status of Lake Oren increased from 780 to 1000 mg/m3 for Total-N and from 10 to 45 mg /m3 for Total-P. Lake transparency declined from 6.2 to 2.6 m and suffered periodic (heavy) algal blooms. The US-EPA regards agriculture as the leading source of impairment of that nation's rivers and lakes with nutrients ranking second only to siltation as the pollutant most affecting rivers and lakes. Agricultural uses associated with poor land management practices that lead to erosion also produce significant nutrient losses. Wastes, manures and sludges, through biological concentration processes, can supply soils with 100 times more hazardous products than fertilizers for the equivalent plant nutrient content (Joly, 1993). This is considered a major environmental (and water quality) problem in periurban areas of many developing countries.

## Eutrophication in water

Eutrophication is when the environment becomes enriched with nutrients. This can be a problem in marine habitats such as lakes as it can cause algal blooms. Fertilizers are often used in farming, sometimes these fertilizers run-off into nearby water causing an increase in nutrient levels.

- This causes phytoplankton to grow and reproduce more rapidly, resulting in algal blooms.
- This bloom of algae disrupts normal ecosystem functioning and causes many problems.
- The algae may use up all the oxygen in the water, leaving none for other marine life. This results in the death of many aquatic organisms such as fish, which need the oxygen in the water to live.
- The bloom of algae may also block sunlight from photosynthetic marine plants under the water surface.
- Some algae even produce toxins that are harmful to higher forms of life. This can cause problems along the food chain and affect any animal that feeds on them.

Eutrophication is a condition in an aquatic ecosystem where high nutrient concentrations stimulate blooms of algae (e.g., phytoplankton). Although eutrophication is a natural process in the aging of lakes and some estuaries, human activities can greatly accelerate eutrophication by increasing the rate at which nutrients and organic substances enter aquatic ecosystems from their surrounding watersheds. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, eroded stream banks, and similar sources can increase the flow of nutrients and organic substances into aquatic systems.

These substances can overstimulate the growth of algae, creating conditions that interfere with the recreational use of lakes and estuaries, and the health and diversity of indigenous fish, plant, and animal populations. Algal blooms hurt the system in two ways.

- First, they cloud the water and block sunlight, causing underwater grasses to die. Because these grasses provide food and shelter for aquatic creatures (such as the blue crab and summer flounder), spawning and nursery habitat is destroyed and waterfowl have less to eat when grasses die off.
- Second, when the algae die and decompose, oxygen is used up. Dissolved oxygen in the water is essential to most organisms living in the water, such as fish and crabs. Increased eutrophication from nutrient enrichment due to human activities is one of the leading problems facing some estuaries in the mid-Atlantic.

## Organic fertilizers

Chemical fertilizers has been adversely affecting the flora, fauna as well as soil quality more ever every plant pathogens are causing loss of 10 to 20% of agricultural production worldwide. Verimi compositing is natural process by micro-organism that turns organic/ biodegradable material in to a dark. Earthy, smelling substances called compost or humus.

The importance and, in some cases, the major problems associated with organic fertilizers, deserve special mention. Manure produced by cattle, pigs and poultry are used as organic fertilizer the world over. To this are added human excreta, especially in some Asian countries where animal and human excreta are traditionally used in fish culture as well as on soils. However, intensive livestock production has produced major problems of environmental degradation, In addition to problems associated with excessive application of manure on the land, is the problem of direct runoff from intensive cattle, pig and poultry farms. Although this is controlled in many western countries, it constitutes a serious problem for water quality in much of the rest of the world.

- Fertilization of surface waters, both as a result of direct discharges of manure and as a consequence of nitrate, phosphate and potassium being leached from the soil.
- Contamination of the groundwater as a result of leaching, especially by nitrate. Phosphates are less readily leached out, but in areas where the soil is saturated with phosphate this substance is found in the groundwater more and more often.
- Surface waters and the groundwater are being contaminated by heavy metals. High concentrations of these substances pose a threat to the health of man and animals. To a certain extent these heavy metals accumulate in the soil, from which they are taken up by crops. For example, pig manure contains significant quantities of copper.
- Acidification as a result of ammonia emission (volatilization) from livestock accommodation, manure storage facilities, and manure being spread on the land. Ammonia constitutes a major contribution to the acidification of the environment, especially in areas with considerable intensive livestock farming.

## Environmental chemistry

The key hydrological processes that link rainfall, runoff and leaching, and which give rise to erosion and transport of chemically enriched soil particles, are important components of the environmental chemistry, transport and fate of fertilizer products.

The environmental dynamics of nitrogen and phosphorus are well known although the detailed transformations of nitrogen that occur in soil and water are difficult to study and document. The nitrogen cycle is depicted in Table.

Nitrogen is comprised of the forms: soluble organic N, NH4-N (ammonium), NO3-N (nitrate), NO2-N (nitrite), and N associated with sediment as exchangeable NH4-N or organic-N. Nitrogen cycling is extremely dynamic and complex, especially the microbiological processes responsible for mineralization, fixation and de-nitrification of soil nitrogen. Generally, in soils that are not waterlogged, soil N (held as protein in plant matter) and fertilizer-N are microbiologically transformed to NH4 (ammonium) through the process of ammonification. The ammonium ion is oxidized by two groups of bacteria (Nitrosomonas and Nitrobacteria) to NO3 with an unstable intermediate NO2 product in a process called nitrification. Urea is readily hydrolyzed to ammonium. De-nitrification occurs under anoxic conditions such as wetlands where NO3 is reduced to various gaseous forms. The N cycle is largely controlled by bacteria; hence the rate of N cycling is dependent upon factors such as soil moisture, temperature, pH, etc. NO3 is the end-product of aerobic N decomposition and is always dissolved and mobile.

From a water quality perspective, the ammonium ion (NH4) can be adsorbed to clay particles and moved with soil during erosion. More importantly, however, NH4 and NO3 are soluble and are mobilized through the soil profile to groundwater during periods of rain by the process of leaching. NO3 is also observed in surface runoff during rainfall events. Prevention of nitrogen pollution of surface and groundwater depends very much on the ability to maintain NO3 in soil only up to the level that can be taken up by the crop, and to reduce the amount of NO3 held in the soil after harvesting.

## Mineral fertilizers

The response to the need to control leaching and runoff of nutrients and contamination of soils and water by heavy metals has been variable in Europe. Control measures are part of the larger issue of mineral and organic fertilizer usage. FAO/ECE (1991) summarized the types of voluntary and mandated controls in Europe that apply to mineral fertilizers as:

- Taxes on fertilizer.
- Requirement for fertilizer plans.
- Preventing the leaching of nutrients after the growing season by increasing the area under autumn/winter green cover, and by sowing crops with elevated nitrogen
- Promoting and subsidizing better application methods, developing new, environmentally sound fertilizers, and promoting soil testing.
- Severely limiting the use of fertilizers in e.g. water extraction areas and nature protection areas.
- In any location where intensive agriculture and/or livestock farming produces serious risks of nitrogen pollution, Ignazi (1993) recommended the following essential steps that are taken at the farm level:
- Rational nitrogen application: To avoid over-fertilization, the rate of nitrogen fertilizer to be applied needs to be calculated on the basis of the "crop nitrogen balance". This takes into account plant needs and amount of N in the soil.
- Vegetation cover: As far as possible, keep the soil covered with vegetation. This inhibits build-up of soluble nitrogen by absorbing mineralized nitrogen and preventing leaching during periods of rain.
- Manage the period between crops: Organic debris produced by harvesting is easily mineralized into leachable N. Steps to reduce leachable N includes planting of "green manure" crops, and delaying ploughing of straw, roots and leaves into the soil.
- Rational irrigation: Poor irrigation has one of the worst impacts on water quality, whereas precision irrigation is one of the least polluting practices as well as reducing net cost of supplied water.
- Optimize other cultivation techniques: Highest yields with minimum water quality impacts require optimization of practices such as weed, pest and disease control, liming, balanced mineral fertilizers including trace elements, etc.
- Agricultural Planning: Implement erosion control techniques that complement topographic and soil conditions.

## Organic fertilizers

- Voluntary and legislated control measures in Europe are intended to have the following benefits:
- Reduce the leaching of nutrients
- Reducing emissions of ammonia
- Reducing contamination by heavy metals
- The nature of these measures varies by country; however FAO/ECE (1991) have summarized the types of voluntary and mandated control as:
- Maximum numbers of animals per hectare based on amount of manure that can be safely applied per hectare of land.
- Maximum quantities of manure that can be applied on the land is fixed, based on the N and P content of the manure.
- Holdings wishing to keep more than a given number of animals.
- The periods during which it is allowed to apply manure to the land have been limited, and it is obligatory to work it into the ground immediately afterwards.
- Establishment of regulations on minimum capacity for manure storage facilities.
- Establish fertilizer plans.
- Levies (taxes) on surplus manure.
- Areas under autumn/winter green cover were extended, and green fallowing is being promoted.
- Maximum amounts established for spreading of sewage sludge on land based on heavy metal content.
- Change in composition of feed to reduce amount of nutrients and heavy metals.
- Research and implementation of means of reducing ammonia loss.

## Sludge management

Sludge is mentioned here only insofar as the spreading of sludge from municipal wastewater treatment facilities on agricultural land is one method used to get rid of municipal sludge in a way that is perceived to be beneficial. The alternatives are incineration and land fill. FAO/ECE (1991) includes sludge within the category of organic fertilizers but note that sludge often contains unacceptable levels of heavy metals. Pollution of water by sludge runoff is otherwise the same as for manure noted above.

## Economics of control of fertilizer runoff

Nutrient loss is closely associated with rainfall-runoff events.

For phosphorus, which tends to be associated with the solid phase (sediment), runoff losses are directly linked to erosion. Therefore the economics of nutrient control tend to be closely tied to the costs of controlling runoff and erosion. Therefore, this will be treated briefly here. In particular, it is useful to examine the economic cost of nutrient runoff which must be replaced by fertilizers if the land is to remain productive.

The link between erosion, increasing fertilizer application, and loss of soil productivity is very direct in many countries. In the Brazilian state of Paraná where agriculture is the base of the state economy, Paraná produces 22% of the national grain production on only 2.4% of the Brazilian territory. Agricultural expansion in Paraná occurred mainly in the period 1950-1970 and was "characterized by short-term agricultural systems leading to continuous and progressive environmental degradation as a result of economic policies and a totally inappropriate land parcelling and marketing system" [12]. Erosion has led to extensive loss of top soil, large-scale gullying (Table 1), and silting of ditches and rivers. The use of fertilizers has risen as a consequence, up 575% over the period 1970-1986 and without any gain in crop yields. Loss of N-P-K from an average erosion of 20 t/ha/yr represents an annual economic loss of US$242 million in nutrients.

## Aquaculture

Aquaculture is a special case of agricultural pollution. There are two main forms: land-based and water-based systems. Effluent controls are possible on land-based systems; however water-based systems present particular problems. Aquaculture is rapidly expanding in most parts of the developed and developing world, both in freshwater and marine environments. In contrast, coastal fisheries in most countries are declining.

The environmental impact is primarily a function of feed composition and feed conversion (faecal wastes), plus assorted chemicals used as biocides, disinfectants, medicines, etc. Wastage of feed (feed not taken up by the fish) is estimated to be 20% [13] in European aquaculture. Waste feed and faecal production both add substantial nutrient loadings to aquatic systems.

Additional environmental problems include risk of disease and disease transfer to wild fish, introduction of exotic species, impacts on benthic communities and on the eutrophication of water, interbreeding of escaped cultured fish with wild fish with consequent genetic change in the wild population.

Traditional integrated aquaculture systems, as in China, where sewage-fish culture is practiced, can be a stabilizing influence in the entire ecosystem [14]. This is recommended, especially in developing countries where water and resources are scarce or expensive.

## Problems of restoration of eutrophic lakes

Eutrophic and hypertrophic lakes tend to be shallow and suffer from high rates of nutrient loadings from point and non-point sources. In areas of rich soils such as the Canadian prairies, Lake Bottom sediments are comprised of nutrient-enriched soil particles eroded from surrounding soils. The association of phosphorus with sediment is a serious problem in the restoration of shallow, enriched lakes. P-enriched particles settle to the bottom of the lake and form a large pool of nutrient in the bottom sediments that is readily available to rooted plants and which is released from bottom sediments under conditions of anoxia into the overlying water column and which is quickly utilized by algae. This phosphorus pool, known as the "internal load" of phosphorus, can greatly offset any measures taken by river basin managers to control Lake Eutrophication by control of external phosphorus sources from agriculture and from point sources. Historically, dredging of bottom sediments was considered the only means of remediating nutrient-rich lake sediments; however, modern technology now provides alternative and more cost-effective methods of controlling internal loads of phosphorus by oxygenation and by chemically treating sediments in situ to immobilize the phosphorus. Nevertheless, lake restoration is expensive and must be part of a comprehensive river basin management program.

# Conclusions

Human reduced eutrophication have heavily degraded fresh water system worldwide reducing water quality and altering ecosystem structure and function, population growth rapid industrialization and excessive use of fertilizers have resulted in disproportionate amounts of phosphorous in lake stimulating plant and algae over growth. With the demand for fresh water resources expected to increase substantially (Jorgenson et al 2001). These anthropogenic influences have severe environmental and economic repercussions. Ultimately, it is imperative to increase public awareness and the environmental education of citizen and also developed an integrated strategy to abate eutrophication [15]. Only collective community effort can more effectively reduce nutrient input to lake (e.g. by reduction in detergent use) and bring cultural eutrophication under control. Double food Yield in latter require a tenfold increase in fuel, fertilizers and pesticides [16]. The blue - green algae some of which have gelatinous capsules and thrives on organic pollution, thus clogging public water supplies and creating nuisance in recreational lakes. Ecology is concerned not only with organism but with energy flows and material cycles on the land, in the oceans, into air, and in fresh waters, ecology.

Water pollution control specialist have, in the past failed to understand these relationship and have attempted to single out one factor as the cause of undesirable but unstable algal blooms resulting from pollution. (One problem one solution syndrome) the strategy of water pollution control must involve reducing the input of all enriching and toxic materials, not just one or two item banned.as geographer M.G. Wolmann 1971. Has concluded that; demand on water resources are increase a rate that exceeds the rate of installation of waste treatment facilities. Change in freshwater availability will consequences of global climate change. Water management must adapt to effect of climate change by adopting a hostalic approach to management ecosystems on a regional basis. Inorganic fertilizers in sewage treatment effluent entering lakes increase their primary production rates and change the composition of the aquatic community. Eutrophic water requires cool clear oxygen rich water may disappear; growth algae and aquatic plant may become so great as to interfere with swimming or un-decomposed dissolved organic may impact a bad taste to water even after it has passed through water purification systems. Effort to divert municipal wastes from certain lakes has demonstrated that cultural eutrophication can be reserved in the sense that some lakes will return to less fertile condition with improved water quality in terms of human use (Edmondson, 1968).

Sources of phosphorous – Agriculture =62%, major town=-9%, industry=1%, Septic Tank=14%

## Water pollution

1. Change in water quality that can harm organisms or make unfit for Human uses
2. Contamination with Chemicals
3. Excessive Heat.

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