WATER QUALITY

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Importance of water quality

- The Quality of water is central to all of the roles that water plays in our lives.

- From the beauty of natural waterways teeming with wildlife, to the vital livelihoods that clean rivers and streams support, to the essential role that safe water plays in drinking water and health

  – ***good water quality is fundamental to the network of life and livelihood that water supports***.

Need for Quality water is not only limited to human beings !

- **Water is the source of life on earth, and human civilizations blossomed where there was reliable and clean freshwater.**

- **Use of water by humans – for drinking, washing, and recreation requires water free from *biological, chemical, and physical sources of contamination.***

- **Plants, animals, and the habitats that support biological diversity also need clean water.**

- **Water of a certain quality is needed to grow food, to power cities, and to run industries.**

- **Water quality is as important as water quantity for satisfying basic human and environmental needs.**

Contaminants in water

- **Both human activities and natural activities can change the *physical, chemical, and biological* characteristics of water, and will have specific impacts for human and ecosystem health.**

- **Water quality is affected by changes in *Nutrients, Sedimentation, Temperature, pH, Heavy metals, Non-metallic toxins, Persistent organics* & *Pesticides* and *Biological factors* among many other factors**

Specific examples

- **The extinction of all 24 species of fish endemic to the Aral Sea resulted from dramatic increases in salinity as inflows of freshwater dropped. While some still hold out hope that it may be possible to restore Aral Sea salinity to previous levels, there is no way to reverse the extinction events that occurred.**

- **Creation of toxic algal blooms in Lake Atitlan with direct and indirect economic impacts on local populations.**

Nutrients

- **Nutrient enrichment has become the planet's most widespread water quality problem (UN Report - 2009). Most often associated with nitrogen and phosphorus from agricultural runoff, but also caused by human and industrial waste.**

- **Nutrient enrichment can increase rates of primary productivity (the production of plant matter through photosynthesis) to excessive levels, leading to overgrowth of vascular plants (e.g. water hyacinth), algal blooms, and the depletion of dissolved oxygen in the water column, which can stress or kill aquatic organisms**

Nutrients contd..

- **Some algae (cyano-bacteria) can produce toxins that can affect humans, livestock, and wildlife that ingest or are exposed to waters with high levels of algal production. Nutrient enrichment can also cause acidification of freshwater ecosystems, impacting biodiversity.**

- **Over the long term, nutrient enrichment can deplete oxygen levels and eliminate species with higher oxygen requirements, such as many species of fish, affecting the structure and diversity of ecosystems.**

- **Some lakes and ponds have become so hyper - eutrophic (nutrient rich and oxygen poor) due to nutrient inputs that all macro-organisms have been eliminated**

Erosion and sedimentation

- ***Erosion is a natural process that provides sediments and organic matter to water systems.***

- In many regions, human activities have altered natural erosion rates and greatly altered the ***volume, rate, and timing of sediment*** entering streams and lakes, affecting physical and chemical processes and species' adaptations to pre-existing sediment regimes.

- Increased sedimentation can ***decrease primary productivity, decrease and impair spawning habitat***, and ***harm fish, plants***, and ***bottom dwelling invertebrates***.

Erosion and sedimentation contd..

- **Fine sediments can attract nutrients such as phosphorus and toxic contaminants such as pesticides, altering water chemistry.**

- **Dams and other infrastructure can dramatically degrade a stream's natural sediment transport function, starving downstream reaches of needed nutrient and chemical inputs.**

Water temperature

- **Water temperature plays an important role in signaling biological functions such as spawning and migration, and in affecting metabolic rates in aquatic organisms.**

- **Altering natural water temperature cycles can impair reproductive success and growth patterns, leading to long-term population declines in fisheries and other classes of organisms.**

- **Warmer water holds less oxygen, impairing metabolic function and reducing fitness.**

- **Such impacts can be especially severe downstream of thermal or nuclear power generation facilities or industrial activities, where the return of water to the streams may be substantially warmer than ecosystems are able to absorb.**

Acidification

- **The pH of different aquatic ecosystems determines the health and biological characteristics of those systems.**
- **A range of industrial activities, including especially mining and power production from fossil fuels, can cause localized acidification of freshwater systems.**
- **Acid rain, caused predominantly by the interaction of emissions from fossil fuel combustion and atmospheric processes, can affect large regions.**
- **Acidification disproportionately affects young organisms, which tend to be less tolerant of low pH.**

Acidification contd..

- **Lower pH can also mobilize metals from natural soils, such as aluminum, leading to additional stresses or fatalities among aquatic species.**

- **Acidification is widespread, especially downwind of power plants emitting large quantities of nitrogen and sulfur dioxides, or downstream of mines releasing contaminated groundwater.**

- **More than 90 percent of the streams in the Pine Barrens, a wetlands region in the eastern United States, are acidic as a result of upwind energy systems, particularly coal-fired power plants.**

Salinity

- **Freshwater plant and animal species typically do not tolerate high salinity. Various actions, often but not exclusively anthropogenic, can cause salts to build up in the water.**

- **These include agricultural drainage from high-salt soils, groundwater discharge from oil and gas drilling or other pumping operations, various industrial activities, and some municipal water-treatment operations.**

Salinity contd..

- **Additionally, the chemical nature of the salts introduced by human activities may differ from those occurring naturally; for example, there may be higher ratios of potassium than sodium salts.**

- **Rising salinity can stress some freshwater organisms, affecting metabolic function and oxygen saturation levels. Rising salinity can also alter riparian and emergent vegetation, affect the characteristics of natural wetlands and marshes, decrease habitat for some aquatic species, and reduce agricultural productivity and crop yields**

Pathogenic organisms

- **One of the most widespread and serious classes of water quality contaminants, especially in areas where access to safe, clean water is limited, is pathogenic organisms: bacteria, protozoa, and viruses.**

- **These organisms pose one of the leading global human health hazards. The greatest risk of microbial contamination comes from consuming water contaminated with pathogens from human or animal feces.**

- **In addition to microorganisms introduced into waters through human or animal fecal contamination, a number of pathogenic microorganisms are free-living in certain areas or are, once introduced, capable of colonizing a new environment.**

Pathogenic organisms contd..

- **These free-living pathogens, like some *Vibrio bacterial species and a few* types of amoebas, can cause major health problems in those exposed, including intestinal infections, amoebic encephalitis, amoebic meningitis, and occasional death (WHO 2008).**

- **Viruses and protozoa also pose human health risks, including *Cryptosporidium and Giardia, Guinea worm,* and others.**