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KGMC

Environmental Health

Learning Objectives

- •Explain the importance of environmental health
- •Define and classify environmental degradation
- •Explain the importance and daily requirements of water
- •Describe the qualities and criteria of different sources of water including surface water, ground water, shallow well, deep well.
- •Describe the different types of water pollution
- •Define water pollution and describe its importance for health

- •Classify different methods of purification of water
- •Describe natural methods of purification of water
- •Describe physical & chemical methods
- •Describe filtration methods both small scale and large scale
- •Describe purification of water in special circumstances
- •Enumerate different water quality parameters
- •Describe physical parameters
- •Describe different chemical parameters and its interpretation
- •Explain the permissible limits of chemical parameters

ENVIRONMENT

- The environment is all the physical, chemical and biological factors external to a person, and all the related behaviors.

- Environment - “external physical, chemical, and microbiological exposures and processes that impinge upon individuals and groups and are beyond the immediate control of individuals”

Importance of Environmental Health

- If you want to learn about the health of a population, look at the air they breathe, the water they drink, and the places where they live.

-- Hippocrates, the Father of Medicine, in the 5th century B.C.

- The health of the environment is connected to the health of people

Importance of Environmental Health

- Of the 102 major disease, disease groupings & injuries covered by the World Health Report in 2004, environmental risk factors contributed to disease burden in 85 categories.
- Globally, an estimated 24% of the disease burden (healthy life years lost) & an estimated 23% of all deaths (premature mortality) was attributable to environmental factors.
- Among children 0-14 years of age, the proportion of deaths attributed to the environment was as high as 36%.

Important contributors to Global burden of disease

- •Unsafe water, hygiene, and excreta disposal
- •Urban air pollution
- •Indoor smoke from household use of solid fuels
- •Leading causes of death in low- and middle-income countries linked with environmental factors:
- •3rd -Lower respiratory infection
- •6th -Chronic obstructive pulmonary disease
- •7th -Diarrheal disease

Environmental Health

- Efforts that are “concerned with preventing disease, death, and disability by reducing exposure to adverse environmental conditions and promoting behavior change. It focuses on the direct and indirect causes of disease and injuries and taps resources inside and outside the healthcare system to help improve health outcomes”

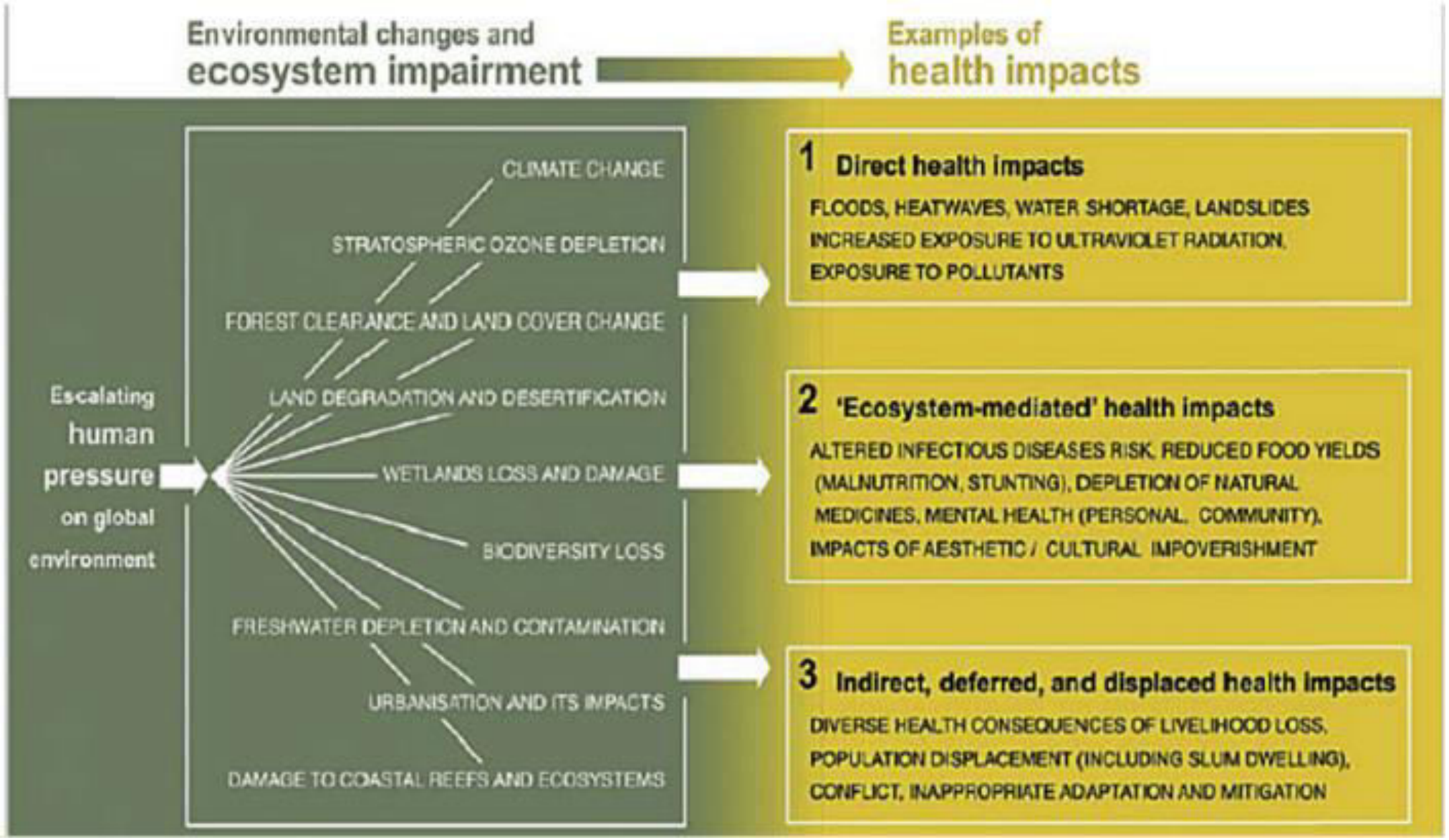
Environmental Degradation

- Environmental degradation is a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin, or it can be accelerated or caused by human activities.

- Many international organizations recognize environmental degradation as one of the major threats facing the planet, since humans have only been given one Earth to work with, and if the environment becomes irreparably compromised, it could mean the end of human existence.

- Land degradation: This refers to the loss of soil fertility, erosion, deforestation, and other forms of damage to the land caused by human activities, such as overgrazing, agriculture, mining, and urbanization.
- Water degradation: This refers to the pollution and contamination of water bodies, such as rivers, lakes, and oceans, caused by human activities, such as dumping of waste, oil spills, and agricultural runoff.
- Air pollution: This refers to the release of harmful substances into the atmosphere, such as gases, particulates, and chemicals, caused by human activities, such as burning fossil fuels, industrial processes, and transportation.

- Climate change: This refers to the long-term alteration of global weather patterns caused by human activities, such as burning fossil fuels, deforestation, and agriculture.
- Biodiversity loss: This refers to the decline of plant and animal species and the loss of their habitats, caused by human activities, such as deforestation, urbanization, and overfishing.
- Ozone depletion: This refers to the thinning of the ozone layer in the Earth's atmosphere, caused by human activities, such as the release of ozone-depleting substances, like chlorofluorocarbons (CFCs).


Environmental changes and
ecosystem impairment
Examples of
health impacts
Escalating
human
pressure
on global
environment
CLIMATE CHANGE
STRATOSPHERIC OZONE DEPLETION
FOREST CLEARANCE AND LAND COVER CHANGE
LAND DEGRADATION AND DESERTIFICATION
WETLANDS LOSS AND DAMAGE
BIODIVERSITY LOSS
FRESHWATER DEPLETION AND CONTAMINATION
URBANISATION AND ITS IMPACTS
DAMAGE TO COASTAL REEFS AND ECOSYSTEMS
1 Direct health impacts
FLOODS, HEATWAVES, WATER SHORTAGE, LANDSLIDES
INCREASED EXPOSURE TO ULTRAVIOLET RADIATION,
EXPOSURE TO POLLUTANTS
2 'Ecosystem-mediated' health impacts
ALTERED INFECTIOUS DISEASES RISK, REDUCED FOOD YIELDS
(MALNUTRITION, STUNTING), DEPLETION OF NATURAL
MEDICINES, MENTAL HEALTH (PERSONAL, COMMUNITY),
IMPACTS OF AESTHETIC / CULTURAL IMPOVERISHMENT
3 Indirect, deferred, and displaced health impacts
DIVERSE HEALTH CONSEQUENCES OF LIVELIHOOD LOSS,
POPULATION DISPLACEMENT (INCLUDING SLUM DWELLING),
CONFLICT, INAPPROPRIATE ADAPTATION AND MITIGATION

- Indirect health impacts can occur when the loss of environment leads to changes in the availability of resources that are important for human health, such as food, water, and clean air. For example, deforestation can reduce the availability of clean air, as trees are important for absorbing carbon dioxide and other pollutants from the atmosphere. This can increase the risk of respiratory illnesses, such as asthma and lung cancer, for people living in the affected areas.

- Deferred health impacts can occur when the effects of environmental damage are not immediately apparent, but emerge over time. For example, exposure to pollution can increase the risk of chronic diseases, such as heart disease and diabetes, which may not become apparent until many years after the exposure occurred.

- Displaced health impacts can occur when environmental damage affects one population, but the health impacts are felt by another population, often in a different geographic area. For example, the burning of fossil fuels in one country can contribute to climate change, which can have health impacts on people living in other countries, such as increased risk of infectious diseases and heat-related illnesses.
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S No.	Risk Factors	Related diseases
1	Outdoor air pollution	Respiratory infections, selected cardiopulmonary diseases, lung cancer
2	Indoor air pollution from solid fuel use	COPD, lower respiratory infections, lung cancer
3	Lead	Mild mental retardation, CVDs
4	Water, sanitation & hygiene	Diarrhoeal diseases, trachoma, schistosomiasis, ascariasis, trichuriasis
5	Climate change	Diarrhoeal diseases, malaria, selected unintentional injuries, protein-energy malnutrition
6	Noise	Hearing loss

Sustainable Development Goals (SDGs)

- The Sustainable Development Goals (SDGs) aim to transform our world. They are a call to action to end poverty and inequality, protect the planet, and ensure that all people enjoy health, justice and prosperity. It is critical that no one is left behind.

Sustainable Development goals (SDGs) related to environment

- Goal 6 : Clean Water & Sanitation
- Goal 7 : Affordable & Clean energy
- Goal 13 : Climate Action

Water & Health

Uses of water:

- Domestic: drinking, cooking, washing & bathing, flushing of toilets, gardening etc. The minimum amount of water needed for survival ranges from about 2 L/capita/day in temperate climates to about 4.5L for people living in hot climates.
- Public: cleaning streets, recreational purposes (swimming pools, public fountains & ornamental ponds, fire protection and public parks)
- Industrial & Agricultural uses; Hydropower production.

Importance of water:

- Water is essential for many bodily functions, including regulating body temperature, transporting nutrients and oxygen to cells, and removing waste products from the body.
- It helps to maintain proper hydration levels, which can affect energy levels, cognitive function, and physical performance.
- Water is also important for healthy skin, hair, and nails, as well as for maintaining a healthy digestive system.

Daily requirements of water:

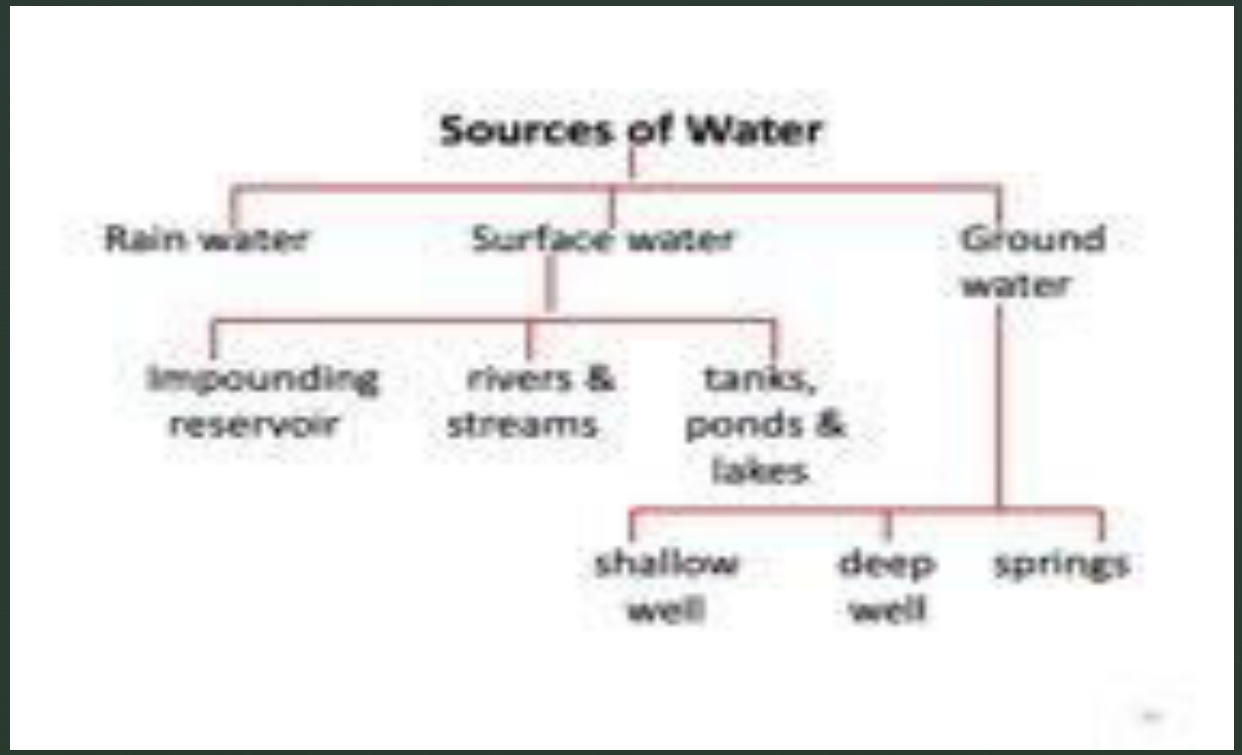
- The amount of water needed varies depending on factors such as age, gender, body weight, activity level, and climate.
- The general recommendation is to drink at least 8 cups (64 ounces) of water per day, but some people may need more.
- It's important to drink water throughout the day, rather than just when you're thirsty, in order to maintain proper hydration levels.
- In addition to water, other beverages and foods can contribute to overall hydration levels, such as herbal tea, milk, fruits, and vegetables.

- Overall, water is an essential nutrient that plays a vital role in maintaining good health and well-being. It's important to drink enough water every day to ensure that your body is properly hydrated and functioning at its best.

Sources of Water

- Surface Water: This is water that is found on the surface of the Earth, such as in rivers, lakes, and streams. Surface water can be collected and treated for drinking and other uses.
- Groundwater: This is water that is stored underground in porous rock and soil formations called aquifers. Groundwater can be accessed through wells and pumped to the surface for use.
- Rainwater: Rainwater is a natural source of water that falls from the sky and can be collected in rain barrels or other types of rainwater harvesting systems.

- Desalinated Water: This is water that is obtained by removing the salt and other minerals from seawater through a process called desalination. Desalinated water is often used in areas where freshwater is scarce.
- Municipal Water Supply: Many towns and cities have a municipal water supply system that provides treated drinking water to residents. This water is often sourced from nearby rivers, lakes, or groundwater sources.
- Bottled Water: Bottled water is sourced from various locations, such as springs, groundwater, or municipal water supplies, and is treated and bottled for consumption.
- Wastewater: Wastewater can be treated and reused for certain purposes, such as irrigation or industrial uses.


Sources of Water
Rain water
Surface water
Ground water
Impounding reservoir
rivers & streams
tanks, ponds & lakes
shallow well
deep well
springs

Ground water (GW)

- That portion of total precipitation which has percolated downward into the porous space in the soil and rock where it remains.
- GW is the most practical & safe in nature.
- Most important source of supply for most rural communities of the world.
- It has higher concentrations of dissolved solids, lower levels of color, higher hardness (as compared with surface water), dissolved gases and freedom from microbial contamination.

Shallow Wells

- Shallow wells: are dug into the uppermost permeable stratum up to a depth of 30m. Water is moderately hard, often grossly contaminated and may dry up in summer.

Deep Wells

- Deep wells: penetrate more than one water bearing stratum up to a minimum depth of 60m; therefore they provide a stronger flow. These wells are less affected by drought. Used for water supply in large communities. Chemically its water is much harder but bacteriologically pure.

Springs

- Springs: are occurrences of groundwater naturally issuing at points where the water table reaches the surface. Springs are normally found at the foot of mountains and hills, in lower slopes of valleys, and near the banks of major rivers. Yield varies with the position of water table, which in turn varies with the rainfall at that locality & season

Surface Water

- Surface Water: includes rivers, streams, lakes, ponds etc. the quantity and quality of surface water depend upon the conditions of the surface or catchment area over which it flows.

Rain Water

- Rainwater: In regions where rainfall is abundant & frequent, rainwater can be a good source of water supply for families & small communities. Storage of rainwater is important in areas with a long dry season. It can be stored in cisterns or ponds.

Water Pollution

Water Pollution

- Any biological, chemical, or physical change in water quality that has a harmful effect on living organisms or makes it unsuitable for desired uses.
- Causes:

Sewage, industrial, trade & agricultural pollutants,
physical pollutants and radioactive substances.

Sources of water pollution

- Direct sources include effluent outfalls from factories, refineries, waste treatment plants etc. that emit fluids of varying quality directly into urban water supplies.
- Indirect sources include contaminants that enter the water supply from soils/groundwater systems & from the atmosphere via rainwater. Soils and groundwater contain residue of fertilizers, pesticides etc. & improperly disposed off industrial wastes.

Pollutant Types

- 1.Pathogens including bacteria, viruses, protozoa, parasites; these come from raw sewage & animal waste & they may be responsible for 80% of the disease in developing countries (measured by the amount of colliform bacteria present)
- 2.Oxygen demanding organic wastes: cause a reduction in dissolved O2, suffocating O2-consuming organisms (fish).
- 3.Water-soluble inorganic chemicals, including acids, salts & metals; makes water unfit to consume & use for irrigation; can also harm organisms & cause material corrosion.

- 4. Inorganic plant nutrients (nitrates & phosphates) from fertilizers; cause excessive algal and plant growth that lower O2 levels when they decompose.
- 5. Organic chemicals, including oil, gasoline, plastics, pesticides, solvents, detergents; present health risks to humans and other organisms.
- 6. Water-soluble radioactive isotopes: These often accumulate in fish & other organisms and are hamrful for human consumption.

- 7. Thermal pollution: from the cooling of industrial & power plants; lowers solubility of O2 & makes organisms more susceptible to other pollution types.
- 8. Genetic pollution: caused by the introduction of nonnative or exotic species.
- All of the different pollutant types can be discharged from point (specific location) or nonpoint (no single location; large area) sources.

Water Pollution and its Importance for Health

- Waterborne diseases; caused by ingestion of water that is contaminated by human or animal excreta and contains pathogenic micro-organisms.
- Transmission
- Waterborne diseases include most of the enteric and diarrheal diseases caused by bacteria and viruses, including cholera, typhoid & bacillary dysentery. They also include diseases caused by protozoa such as giardiasis, amoebic dysentery & crytosporidiosis.

- Water-washed diseases are caused by poor personal hygiene, & skin & eye contact with contaminated water. They are also known as water-scarce disease because they occur when there is not enough water available for adequate personal hygiene. They include scabies, trachoma, typhus, and other flea, lice & tick-borne diseases.
- Water-related diseases are cause by insect vectors, especially mosquitoes, that breed or feed near water. They are not typically associated with lack of access to clean drinking water or sanitation services. Water-related diseases include dengue fever, filariasis, malaria, onchocerciasis, trypanosomiasis & yellow fever.

- Water-based diseases are caused by parasites that spend part of their lifecycle in water. For example, shistosomiasis and dracunculiasis are both water-based diseses caused by helminths (parasitic worms).
- Shistosomiasis is caused by a worm that spends part of its lifecycle in the body of a particular species of water snail. People can become infected from swimming or wading in infected water.
- Dracunculiasis or guinea worm is transmitted by drinking water that is contaminated with copepods (very small crustaceans) that contain the larvae of the worm.

Methods of Water Purification

Physical & Chemical Methods Of Water Purification

- physical processes: filtration, sedimentation, or distillation;
- biological processes: sand filters, active carbon;
- chemical processes: flocculation, chlorination, the use of ultraviolet light

Small-scale water treatment (community & household treatment)

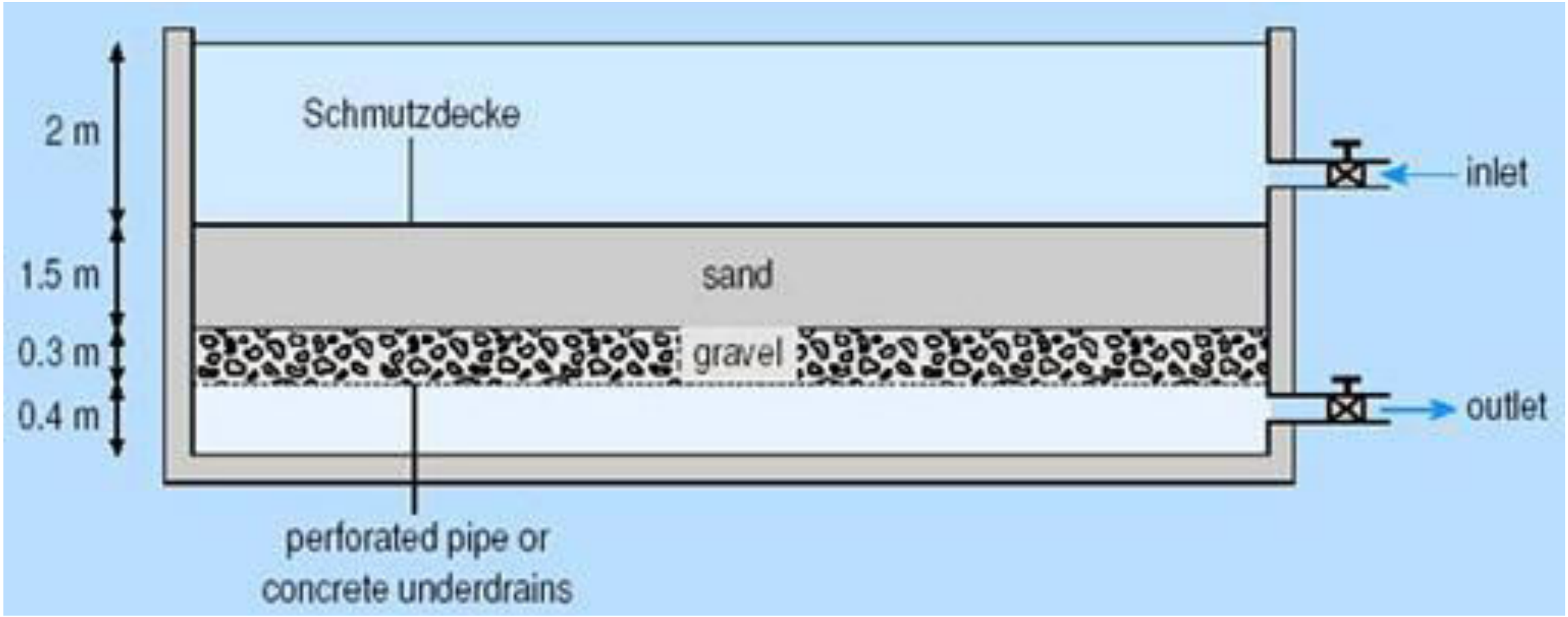
- Boiling
- Household slow sand filter
- Chemical disinfection (domestic chlorination)

Boiling:

- Bringing the water to boil will kill most pathogens, and many are killed at lower temperatures (e.g. 70 °C). This approach can be expensive, however, because fuel/charcoal is needed to boil the water.

Household slow sand filter:

- Water passes slowly downwards through a bed of fine sand at a steady rate. The water should not be too turbid, otherwise the filter will get clogged. Pathogens are naturally removed in the top layer where a biological film builds up. A potential problem is that some households do not use this technology effectively and the water can remain contaminated.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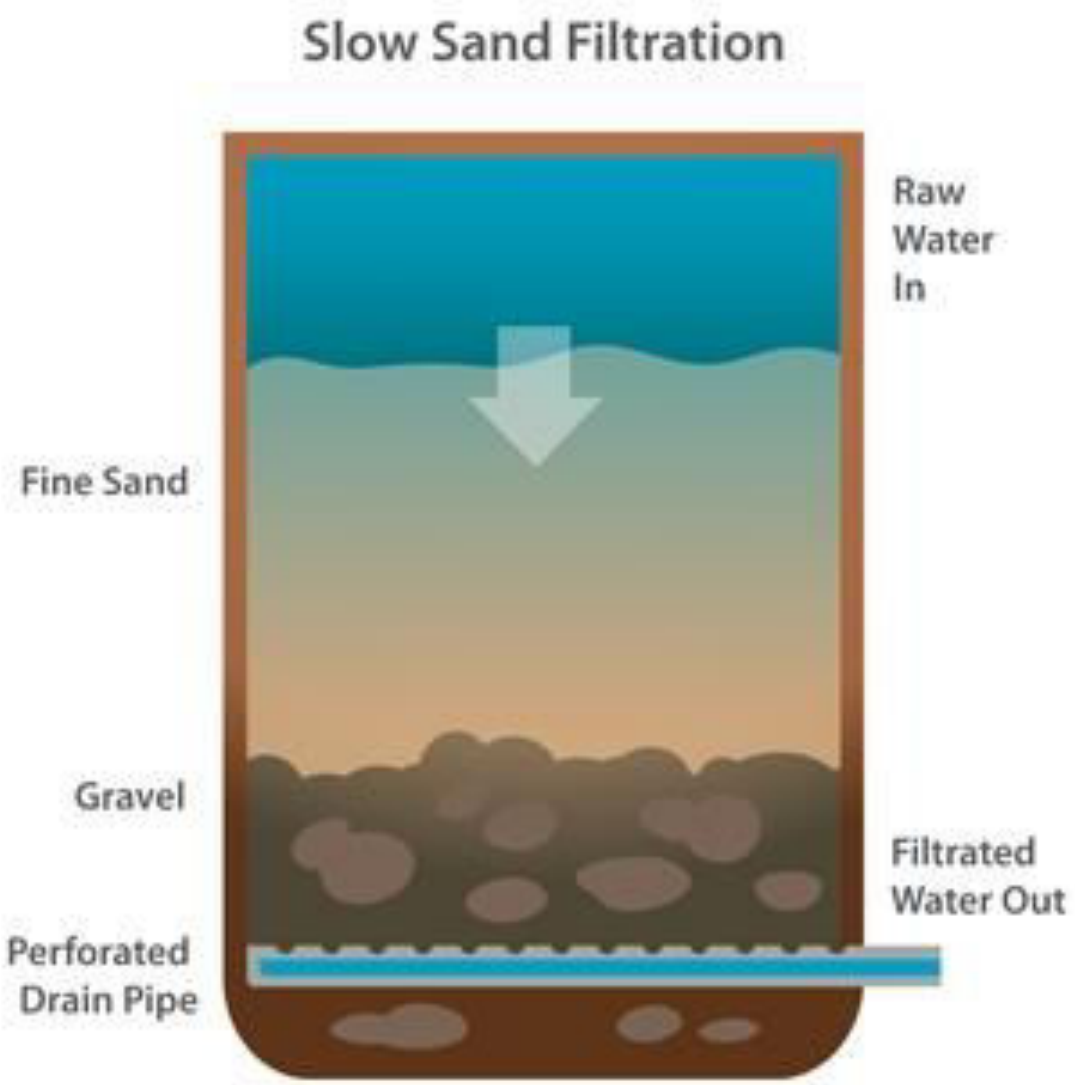
Slow Sand Filtration
Raw
Water
In
Fine Sand
Gravel
Filtrated
Water Out
Perforated
Drain Pipe

Chemical disinfection (domestic chlorination):

- Most widely used method of disinfecting drinking-water. Liquids (such as bleach), powders (such as bleaching powder), and purpose-made tablets can be used. Iodine can also be used as a chemical disinfectant. Deciding on the right amount of chlorine to use can be difficult, because the effectiveness of chlorination depends on the quality of the untreated water, which may vary according to the season.

2. Large-scale or Municipal water treatment (towns & cities)

- Preliminary water treatment
- Aeration & pre-chlorination
- Coagulation & flocculation
- Sedimentation
- Filtration
- Post-chlorination
- Supplementary treatment

- Preliminary water treatment: to protect the main units of a treatment plant & to aid in their efficient operation, it is necessary to remove any large floating and suspended solids like leaves, twigs, paper, rags etc. that cold obstruct flow or damage equipment in the plant.
- Aeration & pre-chlorination: Good aeration of the water is also important for slow, sand filtration to be effective, especially if there is not enough oxygen in the surface water. Water can easily be aerated by shaking it in a vessel, or by allowing it to trickle through perforated trays containing small stones.

- Pre-chlorination replaces aeration in some purification plants. It accomplishes a similar objective to aeration, & in addition, it helps to control the growth of algae, which cause the clogging of filter sand. Pre-chlorination should not be confused with the universal practice of chlorination or disinfecting; the latter practice is usually termed as post-chlorination.
- The addition of chlorine at the headworks of the water treatment plant before other treatment processes.
- Coagulation & flocculation: A liquid coagulant, such as aluminum sulfate, is added to the water to attract suspended particles. The water is then gently stirred to allow the particles to come together and form larger particles (flocculation), which can then be removed by sedimentation, settlement or filtration. The amount of coagulant needed will depend on the nature of the contaminating chemical compounds and solids.

- Sedimentation: is the settling out of comparatively heavy suspended material in water because of gravity. A minimum 24-hour retention time is necessary to have a significant reduction in suspended matter.
- Filtration: suspended matter is separated by passing water through a minute porous medium (sand, diatomaceous earth, or a finely woven fabric) and clear water is produced at the bottom of the medium.

- Post-chlorination: is considered to be a necessary final step before treated water is delivered to a municipal system. Chlorine dosage is the amount of chlorine added to the water system in mg/L. Chlorine demand is the amount of chlorine that combines with the impurities & therefore is no longer available as a disinfecting agent. The chlorine that remains in the water after the chlorine demand has been satisfied is called free chlorine residual.

- Supplementary treatment: In addition some water may need supplemental treatment e.g. fluoridation, softening of water etc. the need will depend upon the nature of the source of water.

Benefits of point-of-use chlorination:

- Proven effectiveness in the reduction of bacteria & most viruses
- Residual Cl is effective in protection against recontamination
- Easy to use
- Easily available at low cost.

Drawbacks

- Provides relatively low protection against some viruses & parasites.
- Lower effectiveness in water contaminated with organic and certain inorganic compounds.
- Potential objections to taste and odour.
- Some people have concerns about the potential long-term carcinogenic effects of chlorination byproducts.

Enumerate water quality parameters

1.Physical: turbidity, temperature, color, taste & odour, dissolved solids, electrical conductivity.

2.Chemical: pH, acidity, alkalinity, chloride, nitrogen, fluoride, iron & manganese, dissolved oxygen etc.

3.Biological: bacteria, algae, viruses, protozoa, Indicator organisms (Pathogenic coliforms) always exist in the intestinal system of humans, and millions are excreted with body wastes. Consequently, water that has been recently contaminated with sewage will always contain coliforms

References

- •Saira Afzal, Sabeena Jalal, Community Nutrition in Textbook of Community Medicine and Public Health. Pakistan: Paramount Books (Pvt.) Ltd. 2018. chapter 52. Introduction to Environmental Health.
- •Skolnik R, Global Health 101. Jones & Bartlett learning. 2011. chapter 7. The environment and health.
- •https://www.eionet.europa.eu/gemet/en/concept/15154#:~:text=Environmental%20degradation%20is%20a%20process,or%20caused%20by%20human%20activities