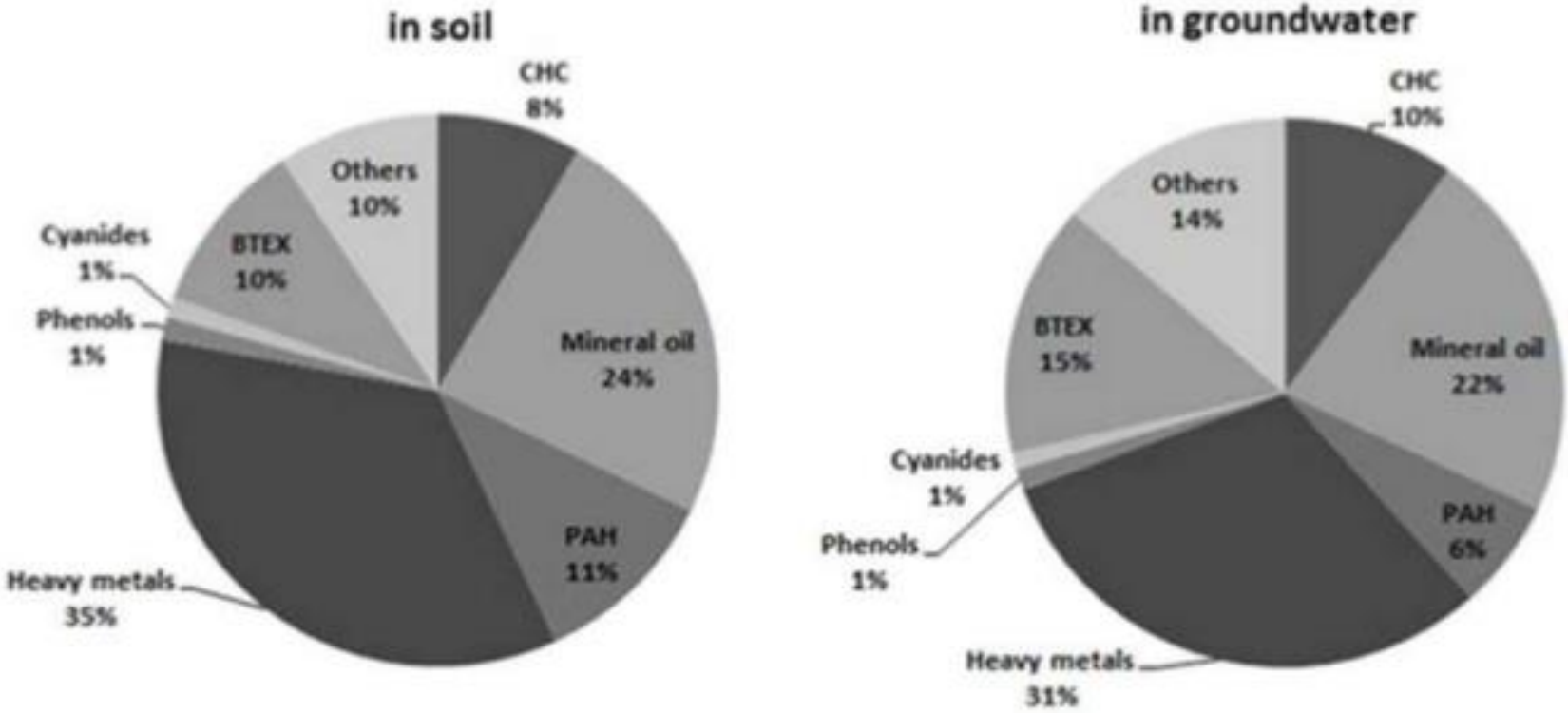
EFFECTS of SOIL POLLUTION

Effects of soil pollution on:

1. Abiotic ecosystem components
   - Groundwater
   - Air quality
   - Soil fertility
2. Human health and biotic ecosystem components
   - Human health
   - Plants

Most frequently occurring contaminants



The results of a questionnaire compiled recently by the Joint Research Centre in 27 European countries.

Soil pollution can lead to water pollution

Pesticides and fertilizers

Animal wastes

NAPLs spills
(leakage from oil refinery activities)

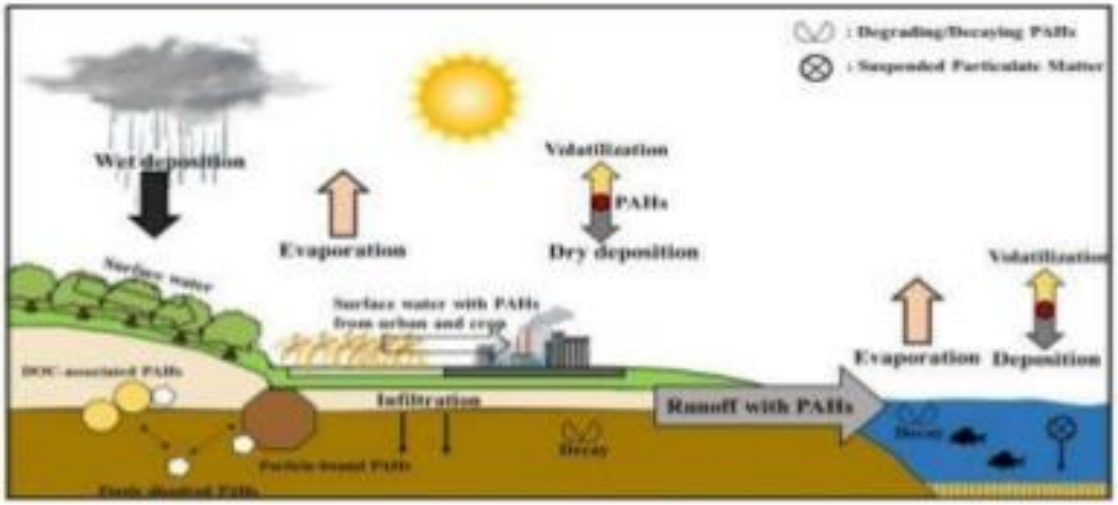
Non-aqueous Phase Liquids (NAPLs)

- A significant portion of contaminated soil and groundwater sites contains non-aqueous phase liquids (NAPLs).
- NAPLs are hazardous organic liquids that are immiscible with water and form a visible, separate oily phase in the subsurface.

- LNAPL= Light Non-Aqueous Phase Liquid
- Lighter than water so they float
- Retained on grain surfaces within the vadose (unsaturated) zone or float on water tables
- Fuels are examples of LNAPLs
  - Gasoline
  - Kerosine

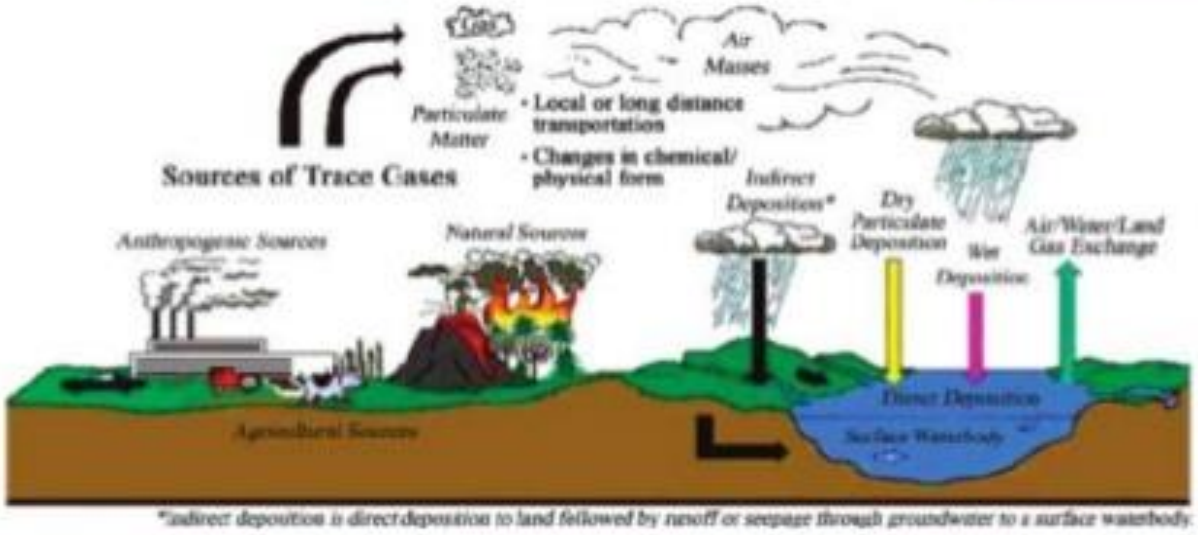
- DNAPL= Dense Non-Aqueous Phase Liquid
- Heavier than water so they sink
- May penetrate into the saturated zone
- Chlorinated solvents are examples of DNAPLs
  - Trichloroethylene (TCE) or dry-cleaning fluid
  - Trichloroethane (TCA) e.g., parts cleaner, degreaser

Effect of soil pollution on air quality

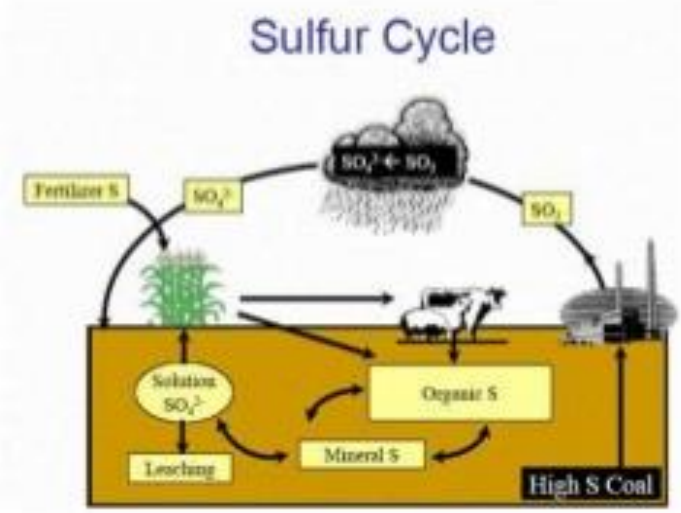


Some PAH particles can readily evaporate into the air from soil or surface waters.

Silicosis is a lung disease caused by breathing in (inhaling) silica dust. Silica dust forms during mining and quarrying.



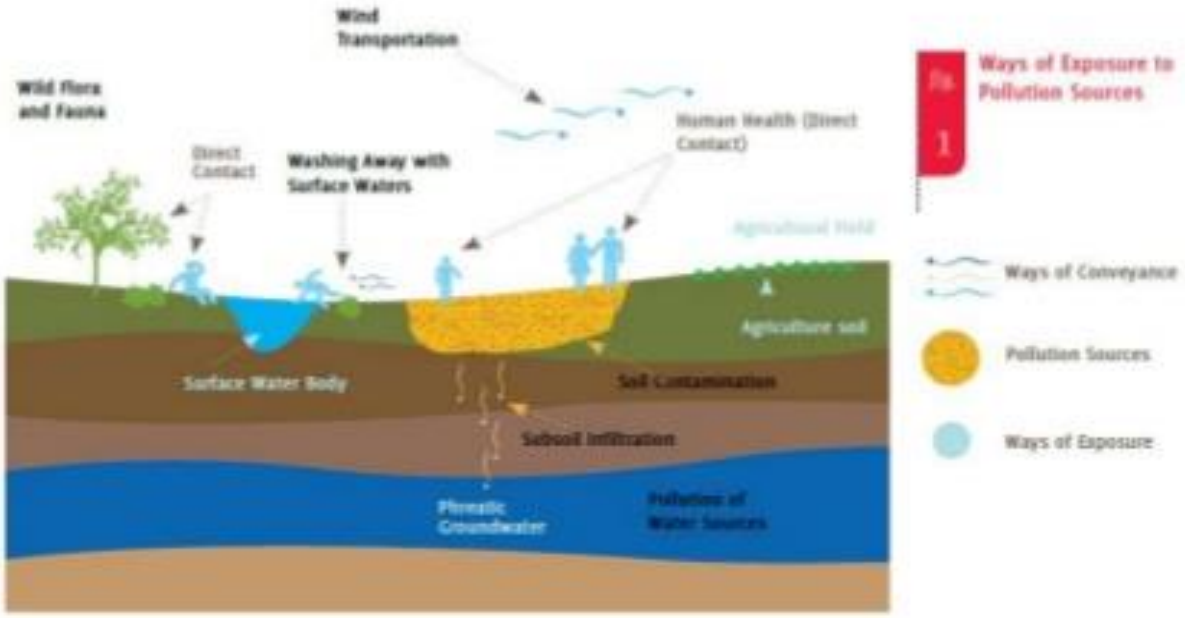
- Manure emits ammonia.
- Methane gas emission due to organic matter decomposition.



The decomposition of organic materials in soil can release sulfur dioxide and other sulfur compounds, causing acid rain.

Effect of soil pollution on human health

Generally, people can be exposed to contaminants in soil through ingestion (eating or drinking), dermal exposure (skin contact) or inhalation (breathing).



- Organ damage
- Bioaccumulation
- Cancer
- Economic loss

Heavy metals

Environmental pollution by heavy metals is of major health concerns all over the world even if it is at low concentrations due to their long-term cumulative health effects.

Intake of heavy metal through food materials:

- Impairs the function of other metal ions
- Decreases the immunology of body
- Retardation of growth
- Poor mental development

Pesticides

Major categories of pesticides and their persistence in the soil:

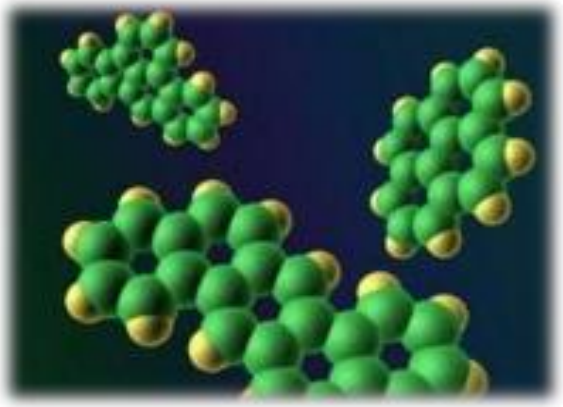
- Chlorinated hydrocarbons - DDT, heptachlor, etc—2-15 years
- Organophosphates - Malathion, methyl parathion—1-2 weeks
- Carbamates - Carbaryl, maneb, aldicarb—days to weeks
- Pyrethroids - Pemethrin, decamethrin—days to weeks

Some of the chronic and acute toxicological effects of pesticides are:

- Chronic liver damage
- Endocrine disorders
- Reproductive disorders
- Immune-suppression
- Various cancer
- Parkinson's and Alzheimer's diseases

PAHs

- Human exposure to PAHs has been associated with an increased risk of developing cancer in the variety of organs (such as lung, bladder, stomach, skin, larynx, scrotum, breast, oesophageal, prostate, kidney and pancreas).
- Furthermore, they are known to suppress the immune system and are suspected of being endocrine disrupters.



Effect on soil fertility

- Soil fertility refers to the ability of the soil to supply essential plant nutrients and water in adequate amounts and proportions required for plant growth and reproduction in the absence of toxic substances which may inhibit plant growth.
- A fertile soil has good physical and chemical environment for growth of plant roots as well as for beneficial soil microflora and fauna responsible for carrying out nutrient transformation leading to optimum supply of plant nutrients.
- Entry of pollutants in agroecosystem affects different soil properties (such as pH, available nutrients, soil enzyme activity, available and total heavy metal concentration, etc.) resulting in loss of soil fertility and hence crop productivity.

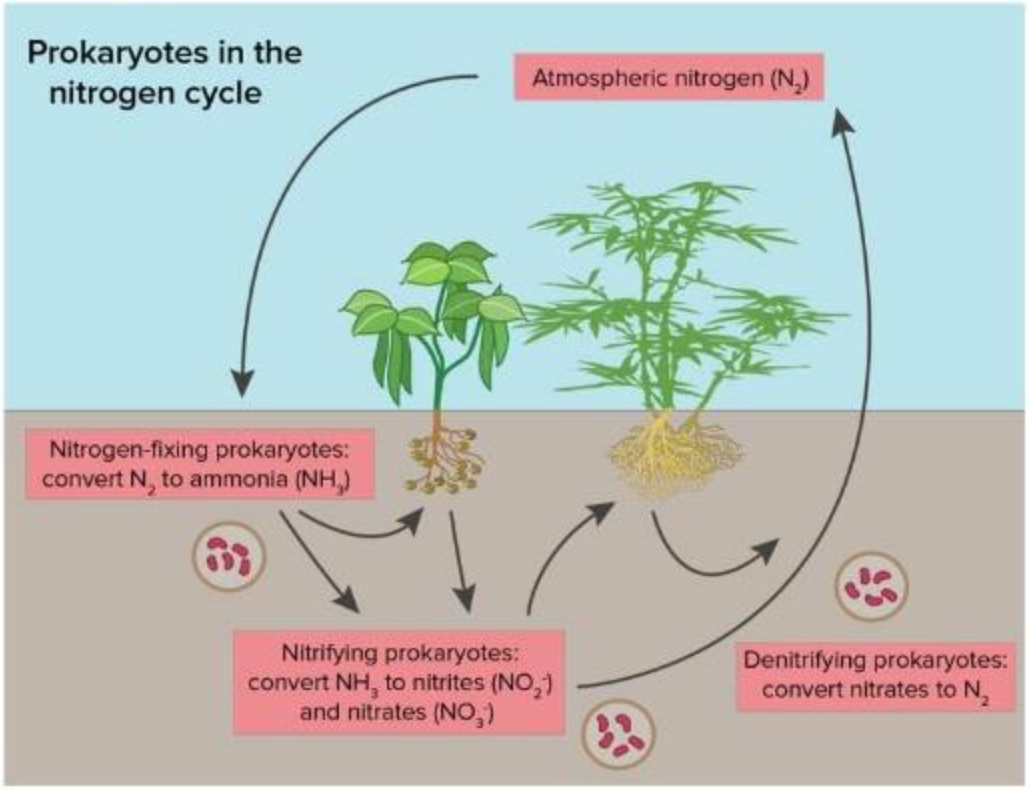
Phytotoxicity of Heavy Metals

- Significant part of the metal loaded effluents, generated particularly from small scale industries in developing and under-developed countries are released untreated into land and water bodies.
- Also, some of the metals are impurities/constituents of extensively used agrochemicals like fertilizers (e.g. Cd in phosphatic fertilizer), pesticides (e.g., Zn, Cu, Sn, Hg, organic pollutants) etc. and contaminate the rhizosphere when these are used in intensive agriculture.
- Some impacts of heavy metals toxicity in plants include:
  - Growth reduction (As, Cd, Cr, Pb, Ni, Hg, Cu)
  - Chlorosis (Cd, Ni, Hg, Cu)
  - Necrosis (As, Cd, Ni)

Socio-economic effects of soil pollution

- It can worsens the effects of poverty and dependence.
- It weakens populations and institutions.
- It reduces food security.
- Socio-economic development is disequilibrium.

Nitrogen cycle



Eutrophication

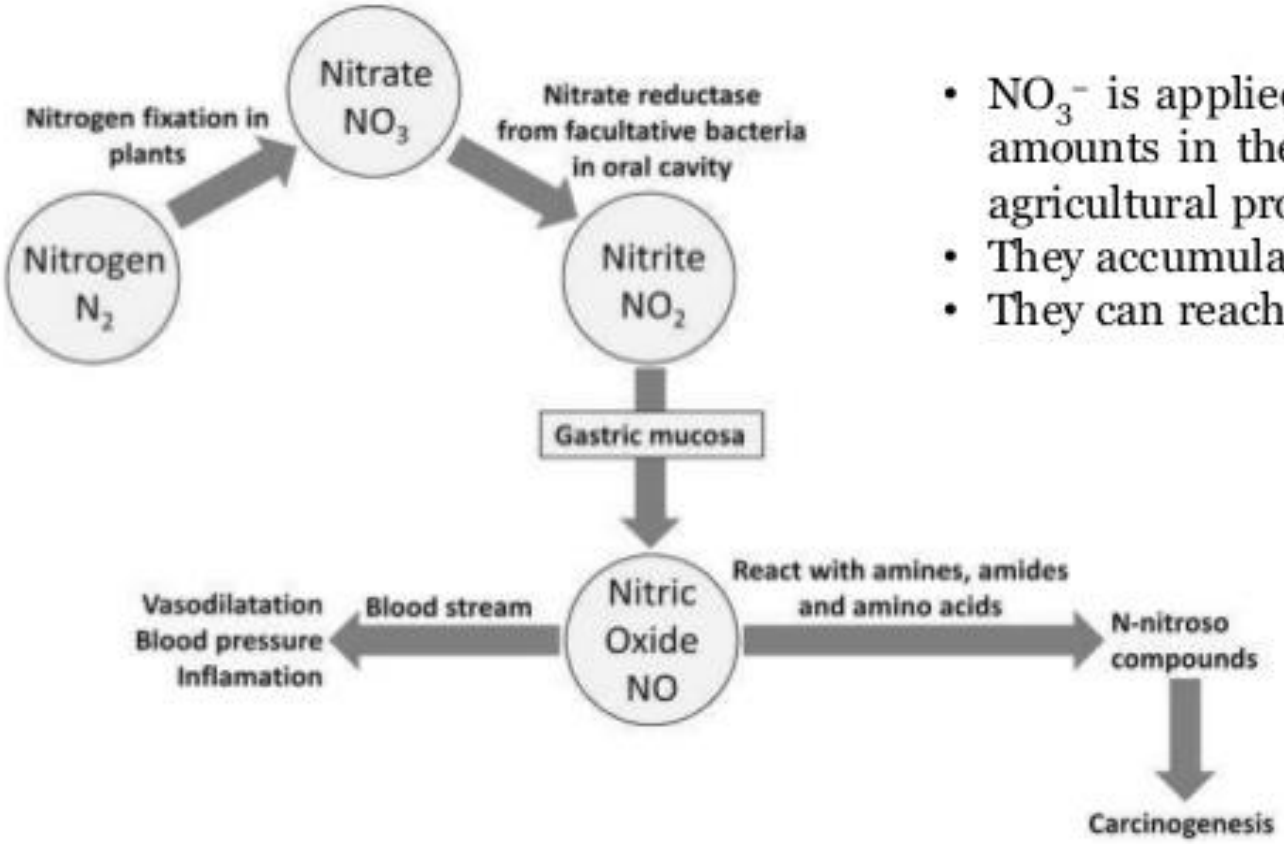
- We humans may not be able to fix nitrogen biologically, but we certainly do industrially!

(Fertilizers)

- Increase in nutrient levels

1. Algal blooms: block sunlight from photosynthetic marine plants under the water surface.
2. Decay of algae by MOs: use up all the oxygen in the water, leaving none for other marine life, and producing free toxic compounds , such as ammonia and hydrogen sulphide (H_2S).

NO toxicity



- NO_3^- is applied in increasing amounts in the fertilizers for agricultural production.
- They accumulate in the soil.
- They can reach groundwater.

Formation of N-nitroso compounds from NO_3^-, NO_2^-, NO, and their effects on human health.

Methemoglobinemia

- The ferrous iron of hemoglobin is exposed continuously to high concentrations of oxygen and, thereby, is oxidized slowly to methemoglobin, a protein unable to carry oxygen.

Impacts of radioactive pollution on soil

Effects of radioactive pollutants:

- Radiation affects the soil and soil fertility.
- The radioactive leaching or dumped into the soil is more complicated, because they remain in soil for thousands of years.
- Radioactive pollution in soil can lead to mutations, malformations, carcinogenicity, and abortion for animals as well as humans.