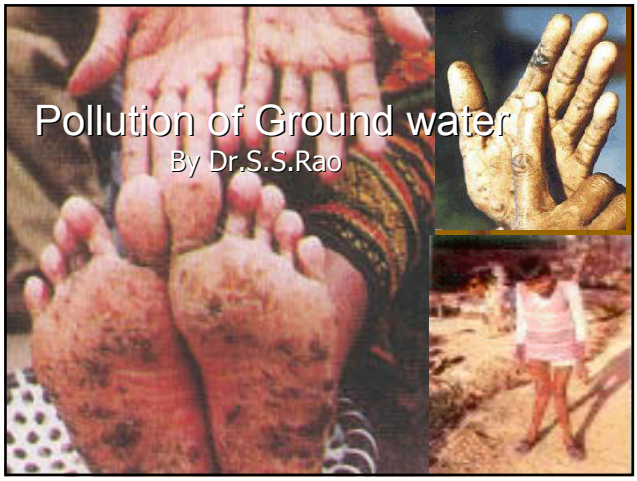
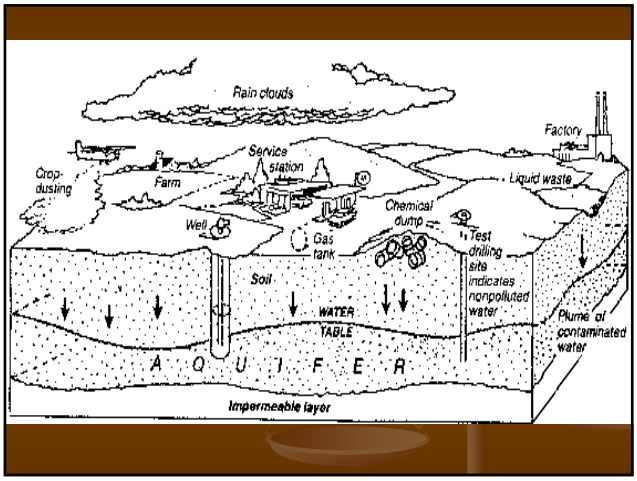
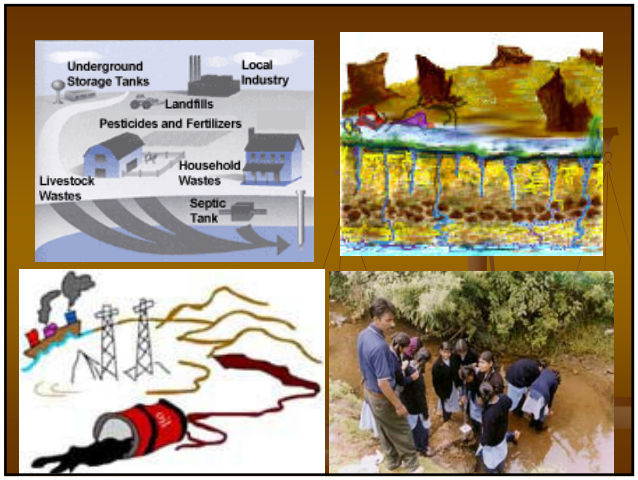

Pollution of Ground water
By Dr.S.S.Rao


Rain clouds
Factory
Service station
Crop-dusting
Farm
Liquid waste
Chemical dump
Well
Gas tank
Test drilling site indicates nonpolluted water
Soil
WATER TABLE
Plume of contaminated water
A Q U I F E R
Impermeable layer


Underground Storage Tanks
Local Industry
Landfills
Pesticides and Fertilizers
Household Wastes
Livestock Wastes
Septic Tank


Spencer Grant

Visible effects of ground water pollution

Visible

- Scale or scum from calcium or magnesium salts in water
- Unclear/turbid water from dirt, clay salts, silt or rust in water
- Green stains on sinks or faucets caused by high acidity
- Brown-red stains on sinks, dishwasher, or clothes in wash points to dissolved iron in water
- Cloudy water that clears upon standing may have air bubbles from poorly working pump or problem with filters.

Tastes

- Salty or brackish taste from high sodium content in water
- Alkali/soapy taste from dissolved alkaline minerals in water
- Metallic taste from acidity or high iron content in water
- Chemical taste from industrial chemicals or pesticides

Visible effects of ground water pollution

- *Smell*
- A rotten egg odor can be from dissolved hydrogen sulfide gas or certain bacteria in your water. If the smell only comes with hot water it is likely from a part in your hot water heater.
- A detergent odor and water that foams when drawn could be seepage from septic tanks into your ground water well.
- A gasoline or oil smell indicates fuel oil or gasoline likely seeping from a tank into the water supply.
- Methane gas or musty/earthy smell from decaying organic matter in water.
- Chlorine smell from excessive chlorination.
- Note: Many serious problems (bacteria, heavy metals, nitrates, radon, and many chemicals) can only be found by laboratory testing of water.

Ground water pollution by human activities

- In addition to natural contaminants, ground water is often polluted by human activities such as
- Improper use of fertilizers, animal manures, herbicides, insecticides, and pesticides
- Improperly built or poorly located and/or maintained septic systems for household wastewater
- Leaking or abandoned underground storage tanks and piping
- Storm-water drains that discharge chemicals to ground water
- Improper disposal or storage of wastes
- Chemical spills at local industrial sites

What are Some Naturally Occurring Sources of Pollution?

- **Microorganisms:** Bacteria, viruses, parasites and other microorganisms are sometimes found in water. Shallow wells - those with water close to ground level - are at most risk. Runoff, or water flowing over the land surface, may pick up these pollutants from wildlife and soils.

What are Some Naturally Occurring Sources of Pollution?

- **Radionuclides:**
  - Radionuclides are radioactive elements such as uranium and radium.
- **Nitrates and Nitrites:**
  - Although high nitrate levels are usually due to human activities ,they may be found naturally in ground water. They come from the breakdown of nitrogen compounds in the soil. Flowing ground water picks them up from the soil. Drinking large amounts of nitrates and nitrites is particularly threatening to infants

What are Some Naturally Occurring Sources of Pollution?

- **Heavy Metals:**
  - Underground rocks and soils may contain arsenic, cadmium, chromium, lead, and selenium. However, these contaminants are not often found in household wells at dangerous levels from natural sources.
- **Fluoride:**
  - Fluoride is helpful in dental health, so many water systems add small amounts to drinking water. However, excessive consumption of naturally occurring fluoride can damage bone tissue. High levels of fluoride occur naturally in some areas. It may discolor teeth, but this is not a health risk.

What Human Activities Can Pollute Ground water?

- **Bacteria and Nitrates:**
  - These pollutants are found in human and animal wastes. Septic tanks can cause bacterial and nitrate pollution. So can large numbers of farm animals
- **Heavy Metals:**
  - Activities such as mining and construction can release large amounts of heavy metals into nearby ground water sources. Some older fruit orchards may contain high levels of arsenic, once used as a pesticide. At high levels, these metals pose a health risk.

What Human Activities Can Pollute Ground water?

- **Fertilizers and Pesticides:**
  - Farmers use fertilizers and pesticides to promote growth and reduce insect damage
- **Industrial Products and Wastes:**
  - Many harmful chemicals are used widely in local business and industry. These can become drinking water pollutants if not well managed :
- *Local Businesses:*
  - These include nearby factories, industrial plants, and even small businesses such as gas stations and dry cleaners. All handle a variety of hazardous chemicals that need careful management. Spills and improper disposal of these chemicals or of industrial wastes can threaten ground water supplies.

What Human Activities Can Pollute Ground water?

- *Leaking Underground Tanks & Piping:*
  - Petroleum products, chemicals, and wastes stored in underground storage tanks and pipes may end up in the ground water.
- *Landfills and Waste Dumps:*
  - Modern landfills are designed to contain any leaking liquids. But floods can carry them over the barriers. Older dumpsites may have a wide variety of pollutants that can seep into ground water.

Arsenic poison(Bangladesh)

- Arsenic contamination occurs mainly in the top aquifer (40 m) that is recharged from the surface.
  - Arsenic concentration in ground water occurs in extreme diverse nature but one thing is common - area surrounded by rice fields and the concentration correlates with phosphate. - Bangladesh

Calcutta

- South Calcutta, located in a thickly populated area manufacturing copper acetoarsenite (Paris-Green) an arsenical pesticide for the past 25 years.
- Soil around the effluent dumping point of the factory was exceptionally contaminated, with arsenic, copper and chromium concentrations of 20,100-35,500 mg kg-1, 33,900-51,100 mg kg-1 and 5300- 5510 mg kg-1.
- Arsenic and copper concentrations in bore-hole soils collected up to a depth of 24.4 m at the effluent dumping point, decreased with depth.

Animal waste

- Animal waste is often collected in impoundments from which the wastes may infiltrate the ground water. Runoff could also enter an aquifer through a poorly sealed well casing.
- Livestock waste is a source of:
  - **Nitrate**
  - **Coliform Bacteria**
  - **Total Dissolved Solids**
  - **Sulfates**

Garage or Farm house

- Within the garage or farm equipment shed, chemicals that are improperly stored or disposed of that could potentially contaminate ground water
- They include:
  - **Paint containing lead and barium**
  - **Gasoline and oils containing volatile organic compounds**
  - **Barium from diesel fuel combustion**
  - **Rinsate containing residues of pesticides or fertilizers**

Houses

- Many sources of ground water contamination can originate in the house or other farm residences such as
- Leaks, spills, overloading, or poor maintenance of septic systems can result in the following contaminants entering ground water:
  - **Coliform Bacteria**
  - **Nitrate**
  - **Total Dissolved Solids**
  - **Chloride**
  - **Sodium**
  - **Sulfates**
  - **Detergents**
  - **Chromium**

Environmental Quality Standards for Ground Water Pollution

Item	Standard Values
cadmium	0.01 mg/liter or less
total cyanogen	in no detectable amounts
lead	0.01 mg/liter or less
chromium (VI)	0.05 mg/liter or less
arsenic	0.01 mg/liter or less
total mercury	0.0005 mg/liter or less
alkyl mercury	in no detectable amounts
PCB	in no detectable amounts
dichloromethane	0.02 mg/liter or less
carbon tetrachloride	0.002 mg/liter or less
1,2-dichloroethane	0.004 mg/liter or less
1,1-dichloroethylene	0.02 mg/liter or less
cis 1,2-dichloroethylene	0.04 mg/liter or less
1,1,1-trichloroethane	1.0 mg/liter or less
1,1,2-trichloroethane	0.006 mg/liter or less
trichloroethylane	0.03 mg/liter or less
tetrachloroethylene	0.01 mg/liter or less
1,3-dichloro propane	0.002 mg/liter or less
thiram	0.006 mg/liter or less
simazine	0.003 mg/liter or less
thiobencarb	0.02 mg/liter or less
benzene	0.01 mg/liter or less
selenium	0.01 mg/liter or less
fluorine	0.8 mg/l or less
boron	1 mg/l or less

Source : Environment Agency

Major sources of contamination

- Municipal,
- Industrial,
- Agricultural.

Municipal water pollution consists of waste water from homes and commercial establishments including factories

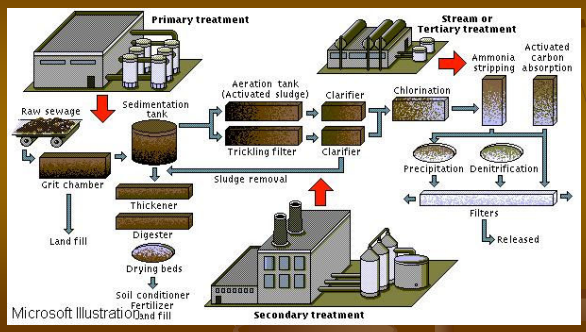
Treatment

- For many years, the main goal of treating municipal wastewater was simply to reduce its content of suspended solids, dissolved inorganic compounds, and harmful bacteria.
- In recent years, however, more stress has been placed on improving means of disposal of the solid residues from the municipal treatment processes.

Water Treatment

- The basic methods of treating municipal wastewater fall into three stages:
- primary treatment,
  - including grit removal, screening, grinding, and sedimentation;
- secondary treatment,
  - which entails oxidation of dissolved organic matter by means of using biologically active sludge, which is then filtered off;
- and tertiary treatment,
  - in which advanced biological methods of nitrogen removal and chemical and physical methods such as granular filtration and activated carbon absorption are employed.
- The handling and disposal of solid residues can account for 25 to 50 percent of the capital and operational costs of a treatment plant.

Waste water treatment



GROUNDWATER CONTAMINATION BY AGRICULTURE

- Pesticides, fertilizers, herbicides and animal waste are agricultural sources of ground water contamination. The means of agricultural contamination are varied and numerous, but some examples as follows:
- Spillage of fertilizers and pesticides during handling;
- Runoff from the loading and washing of pesticide sprayers or other application equipment;
- Using chemicals uphill from or within a few hundred feet of a well

Excess application of fertilizers and pesticides

- Mixing and distributing pesticides and fertilizers with irrigation water can cause ground water contamination if more chemicals are applied than crops can use. Irrigation also poses a problem if chemicals back-siphon from the holding tank directly into the aquifer through an irrigation well.
- Fields with over applied or misapplied fertilizers, herbicides, insecticides and fungicides could introduce these contaminants into the ground water

Industrial

- The characteristics of industrial waste waters can differ considerably both within and among industries. The impact of industrial discharges depends not only on their collective characteristics, such as biochemical oxygen demand and the amount of suspended solids, but also on their content of specific inorganic and organic substances.
- Three options are available in controlling industrial wastewater.
  - Control can take place at the point of generation in the plant;
  - wastewater can be pretreated for discharge to municipal treatment sources; or
  - wastewater can be treated completely at the plant and either reused or discharged directly into receiving waters.

Biochemical oxygen Demand (BOD)

- **Biochemical oxygen demand, or BOD The amount of organic material that can rot in the sewage is measured by the biochemical oxygen demand.**
  - **BOD is the amount of oxygen required by micro-organisms to decompose the organic substances in sewage. Therefore, the more organic material there is in the sewage, the higher the BOD.**
  - **BOD levels of industrial sewage may be many times that of domestic sewage.**
- **Dissolved oxygen is an important factor that determines the quality of water in lakes and rivers. The higher the concentration of dissolved oxygen, the better the water quality.**
- **When sewage enters a lake or stream, micro-organisms begin to decompose the organic materials. Oxygen is consumed as micro-organisms use it in their metabolism. This can quickly deplete the available oxygen in the water.**
- **When the dissolved oxygen levels drop too low, many aquatic species perish. In fact, if the oxygen level drops to zero, the water will become septic.**

Chemical oxygen Demand (COD)

- Amount of carbon in organic matter of sewage
- COD test determines the oxygen required for chemical oxidation of organic matter
- While BOD takes 5 days to estimate the COD takes only 5 hours

Some questions to consider in protecting your drinking water and maintaining your well are:

- What distance should my well be from sources of human wastes such as septic systems?
- How far should it be from animal feedlots or manure spreading?
- What are the types of soil and underlying rocks? Does water flow easily or collect on the surface?
- How deep must a well be dug to avoid seasonal changes in ground water supply?
- What activities in my area (farming, mining, industry) might affect my well?
- What is the age of my well, its pump, and other parts? Is my water distribution system protected from cross connections and backflow problems?