EWCE 331



SOURCE OF WATER SUPPLY

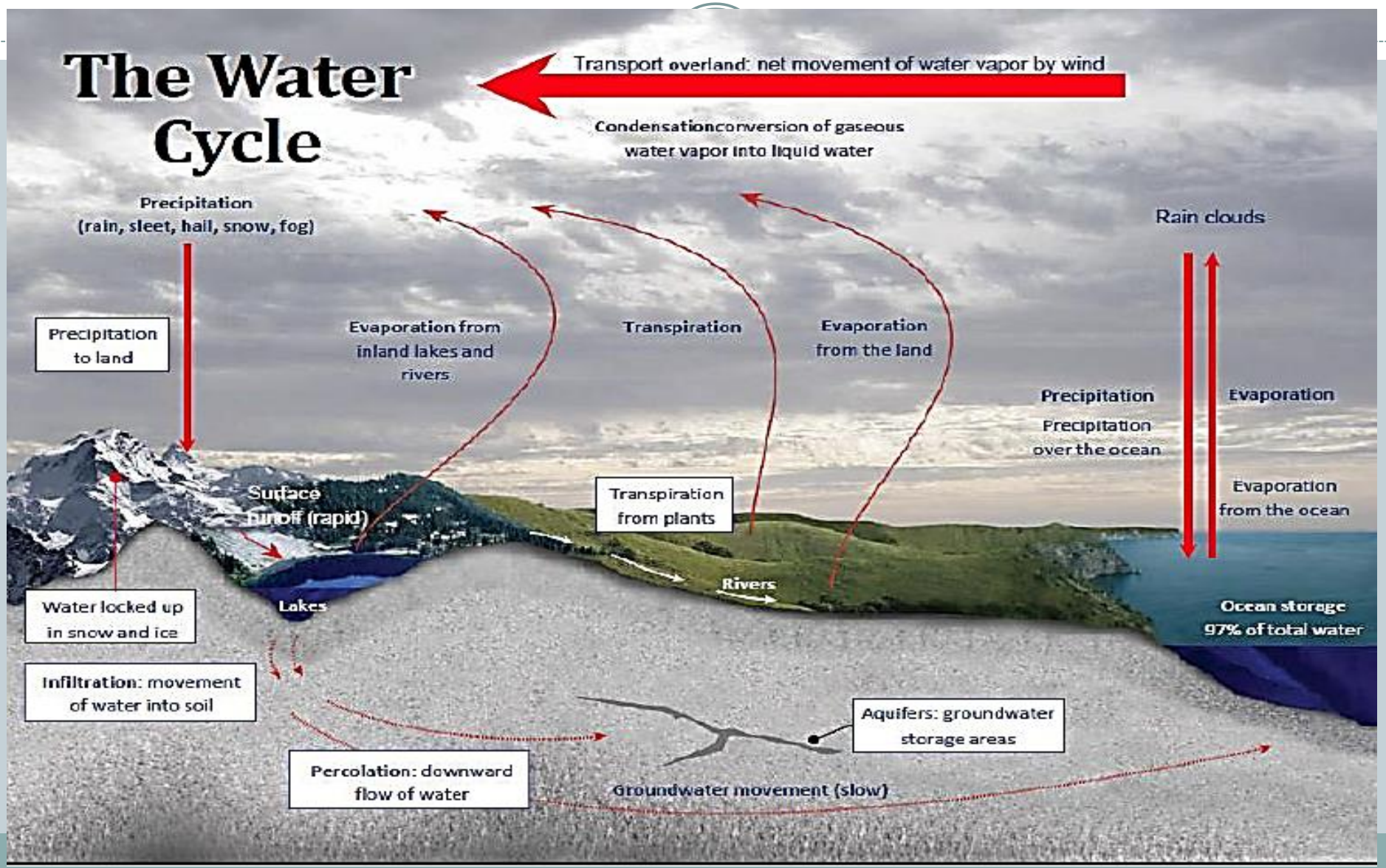
World Water Distribution

Location-land areas	Volume, (10^{12} m^3)	% of total
Freshwater lakes	125	0.009
Saline lakes and inland seas	104	0.008
Rivers	1.25	0.0001
Soil moisture	67	0.005
groundwater	8350	0.61
Ice caps and glaciers	29200	2.14
Total land area	37800	2.8
Atmosphere(water vapor)	13	0.001
Oceans	1,320,000	97.3
Total all locations	1,360,000	100

Hydrologic cycle/Water Cycle

- Role of Water?
  - Terrestrial ecosystems: major factor determining distribution of organisms
  - Aquatic ecosystems: literally matrix that surrounds & serves as environment of aquatic organisms
  - Water Is critical for human activities: agriculture, industry, and municipal use

Hydrologic cycle/Water Cycle



Water Cycle: Main Processes

- **Evaporation**: conversion from liquid to vapor(surface to atmosphere)
- **Transpiration**: evaporation of water from leaves.
- **Condensation**: conversion of vapor to liquid(droplets of water)
- **Precipitation**: movement as rain, sleet, hail, snow(atmosphere to surface)
- **Infiltration**: movement into soil.
- **Percolation**: downward flow through soil to aquifers.
- **Runoff**: surface flow down slope to ocean, lake or river.

Sources of Water Supply

- Surface water
  - Ponds and lakes
  - Streams and rivers
  - Storage reservoirs
  - Oceans
- Sub-surface water
  - Springs
  - Infiltration galleries
  - Infiltration wells
  - Wells and tubewells
- Groundwater

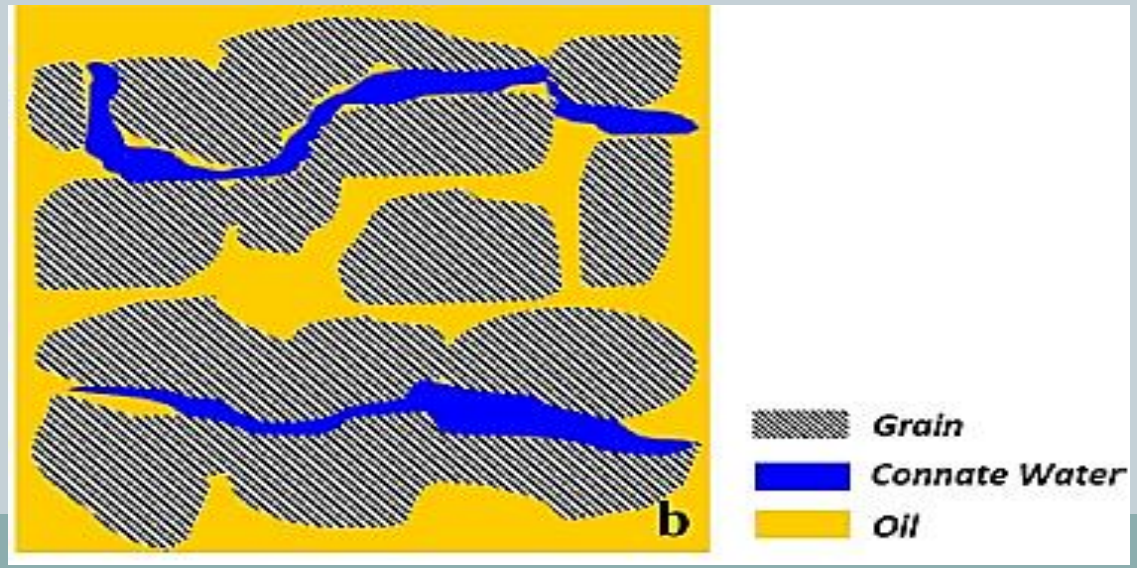
Surface water

- **Surface water**: categorized as rainfall, transboundary flow, water on standing water bodies (reservoir, river, lake and pond),water on seasonal wetlands, and in-stream storage.
- Average annual rainfall of the country is about **2360 mm**.
- Bangladesh shares **57 transboundary rivers** with India and Myanmar. Total annual volume of this water is about **1000 billion m^3**.
- Total volume of standing waterbodies (beels / baors) is about **0.61 billion m^3**.
- Estimated volume of water stored in seasonal wetlands/floodplains is about **2.69 billion m^3**.
- Estimated volume of channel storage is **0.5 billion m^3**.

Groundwater

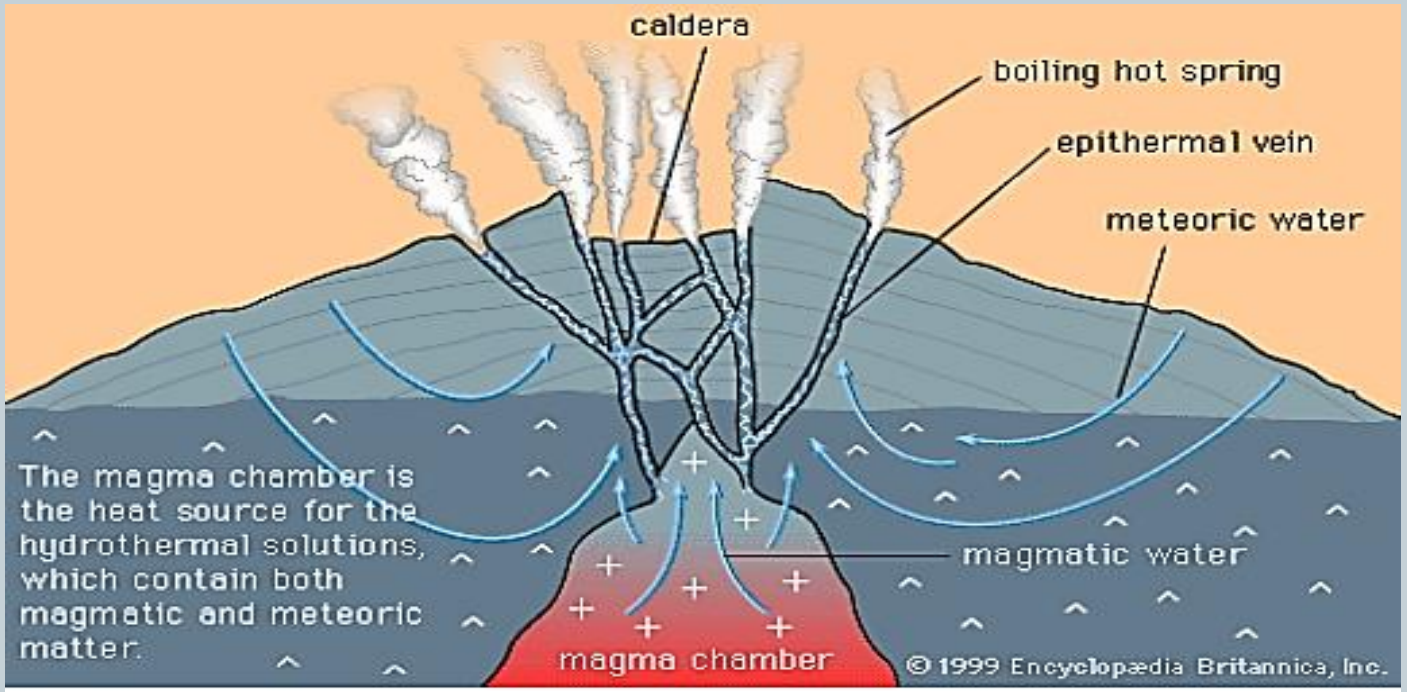
The main source of groundwater is the recharge from surface water. Three major sources are:

- **Meteoric water**: includes rain, sleet, snow, hail and other forms of precipitation.
- **Connate Water**: sea water or freshwater trapped in sediments when deposited on sea bottoms or lakes.



Groundwater

- **Juvenile Water (magmatic water):**produced from volcanic and magmatic activity and during crystallization of rock molecules.

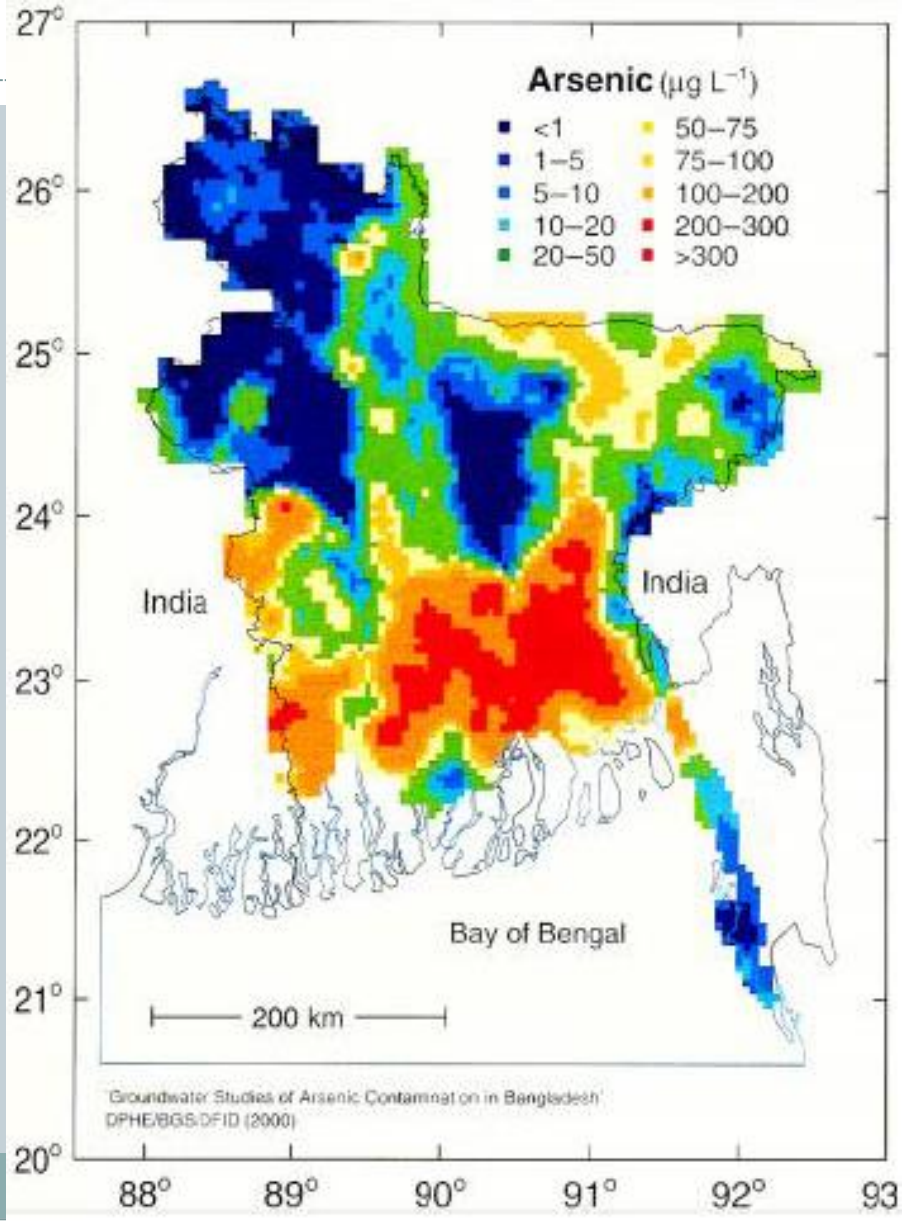


Problems in GW development

- Arsenic in groundwater
- Excessive dissolved iron
- Salinity in the coastal areas
- Lowering of groundwater level
- Rock/stony layers in hilly areas

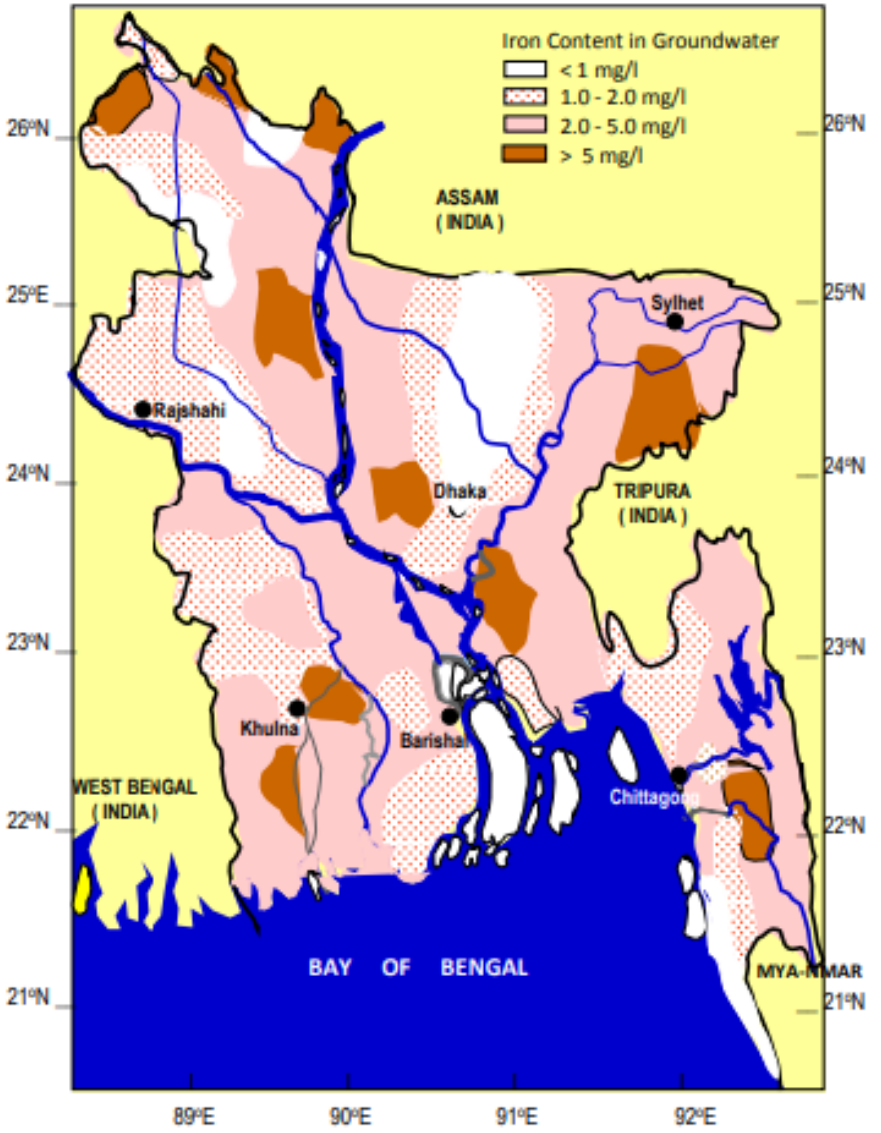
Arsenic (As)

- WHO guideline for maximum desirable arsenic concentration in drinking water– 0.01mg/L
- In Bangladesh–maximum acceptable concentration in drinking water– 0.05mg/L
- Arsenic toxicity leading to cancer occurs due to excessive intake over a longer period of time.
- Presence of arsenic in Bangladesh was first detected in 1993 at Chapai Nawabganj.
- One in every three shallow tubewells was found to produce arsenic contaminated water above acceptable limits.



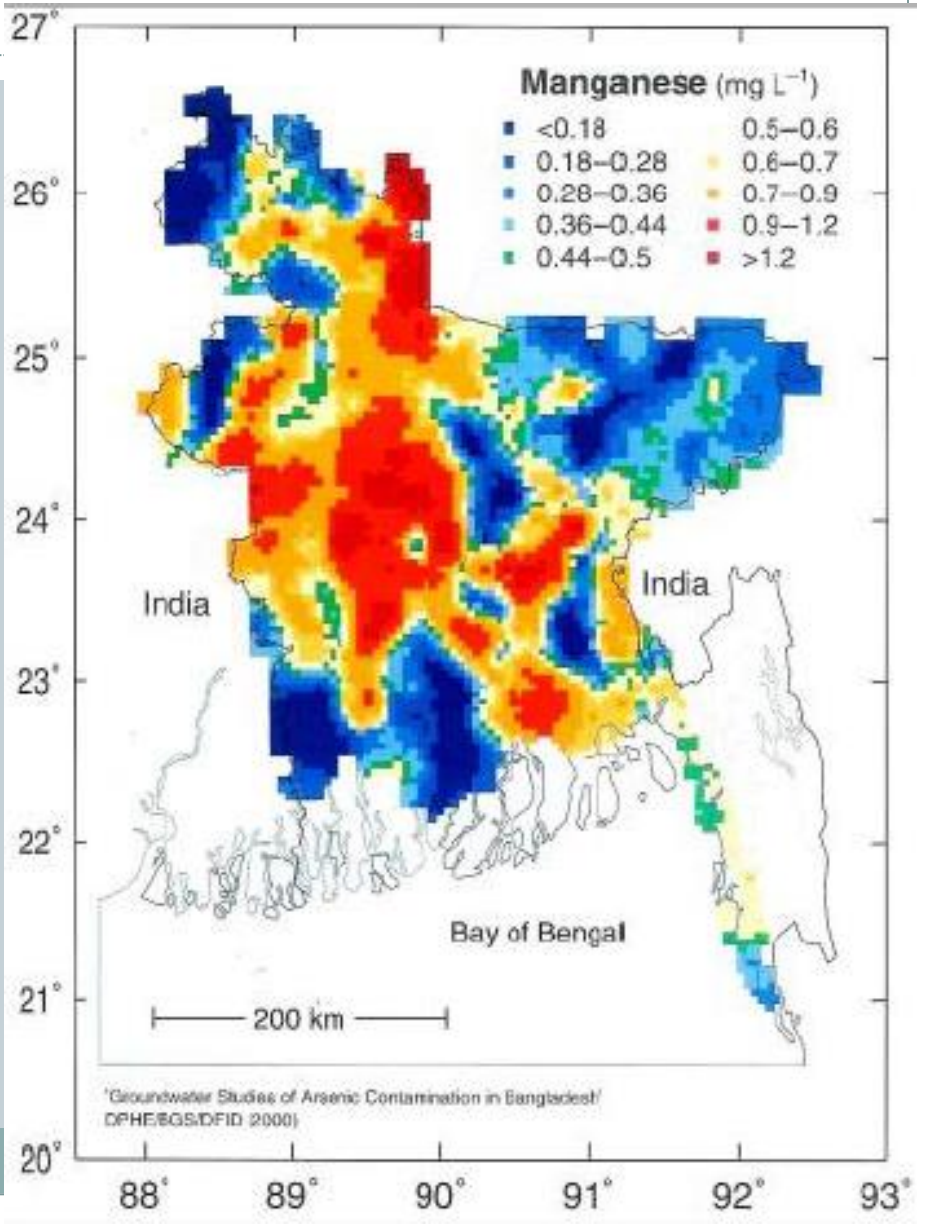
Excessive Dissolved Iron (Fe)

- In Bangladesh, the permissible limit of iron in ground water is 1 mg/l
- Iron content upto 5 mg/L is acceptable for rural water supply
- Dissolved iron in shallow tubewell water in about 67% areas of Bangladesh is in excess of 2 mg/l.
- Iron content in deep tubewell water is comparatively lower.



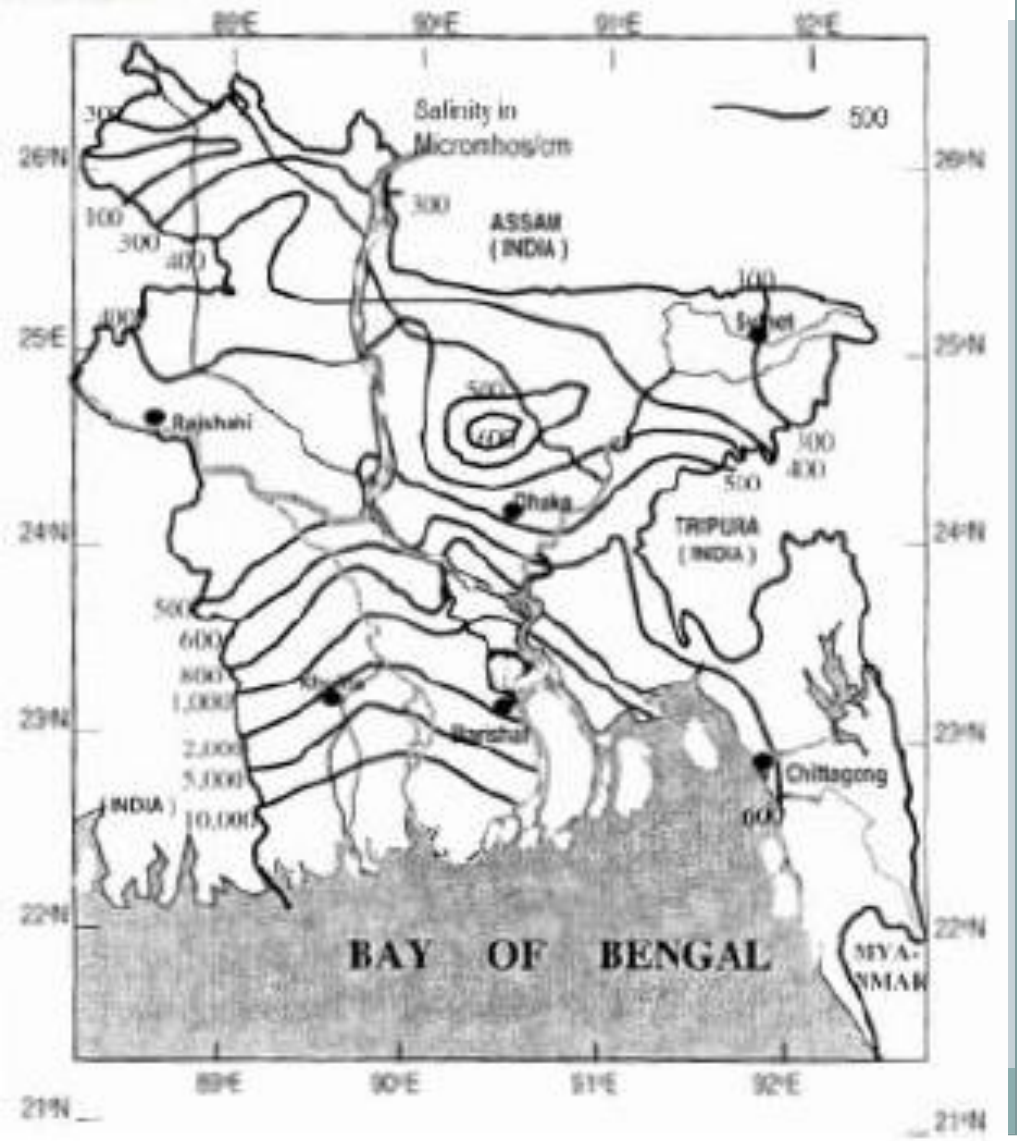
Manganese (Mn)

- Manganese in groundwater is very high.
- About 35% of the drinking water samples had manganese in excess of WHO health-based Guideline Value of 0.4 ppm;
- Bangladesh Standard for manganese in drinking water is 0.1 ppm and few samples meet this requirement



Salinity in Coastal Areas

- Concentration of dissolved minerals in ground water is higher than that in surface water
- The coastal belt of Bangladesh is identified as a problem area
- Scarcity of ground water of acceptable quality at coastal area from shallow depth
- Low salinity ground water is not available in many areas at coastal belts within a depth of 1100ft



Lowering of Groundwater Level

- A considerable area of the country faces scarcity of ground water within suction limit in the dry season
- Water level declines due to the over-exploitation of ground water for human consumption as well as irrigation purposes

Groundwater depletion situation in the capital

Year	Bellow the surface
1996	26.60m
1997	28.15m
1998	30.45m
1999	31.86m
2000	34.18m
2001	37.78m
2002	42.00m
2003	46.24m
2004	50.6m
2005	57.42m
2006	59.72m
2007	61.18m

Source: Groundwater monitoring survey project, BADC

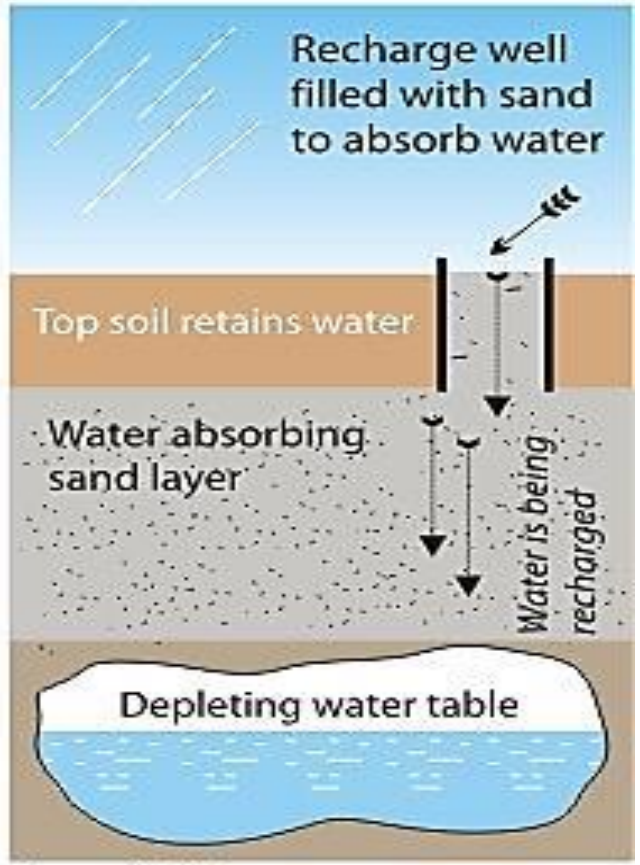


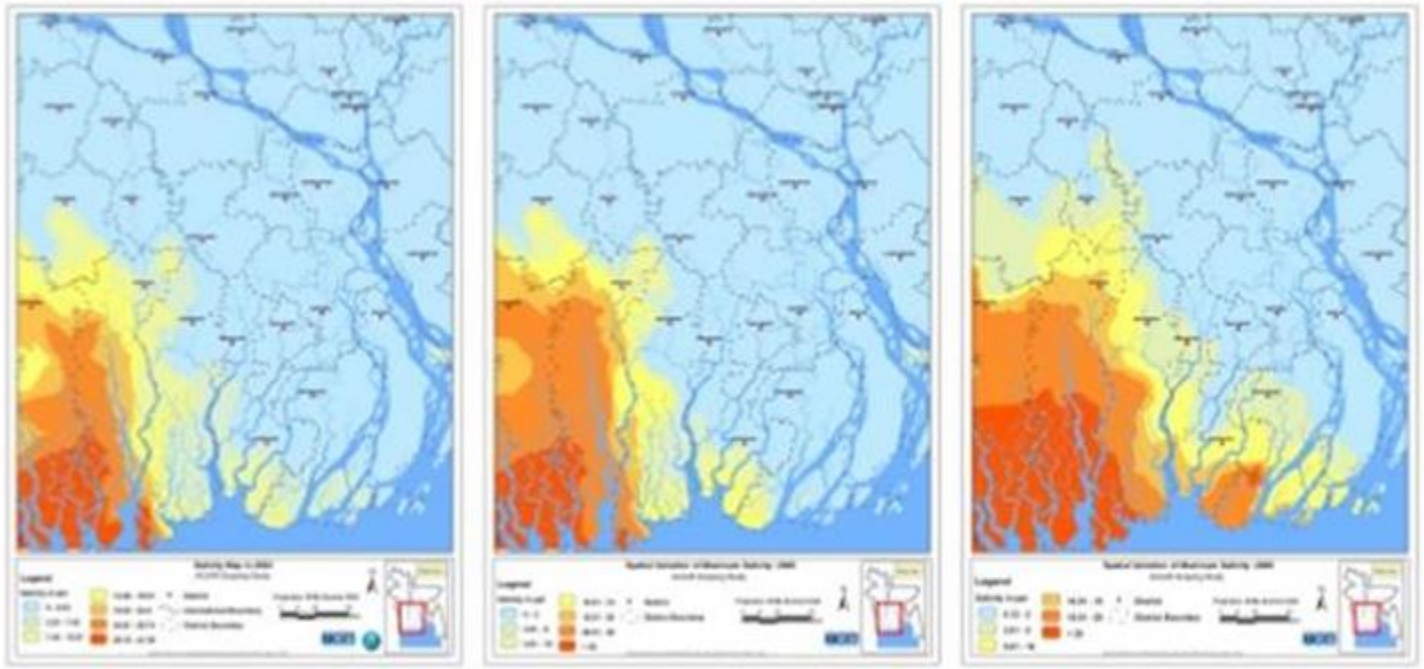
Diagram by Sharier

Rock/stony Layers in Hilly Areas

- Presence of hard formations in the subsurface of hill tracts districts make it difficult to drill tubewells
- Areas–Chittagong, Cox’sbazar, Sylhet, north of Mymensingh, Netrokona, Panchagar districts
- Mechanical drilling rigs are used to overcome the problem and provide potable water
- Installation cost increases of a water point

Water in Bangladesh (salinity problem)

Surface water salinity



Considerable increase in salinity over time both in concentration and area; saline front moved further inland through the stream