Wise use of Water

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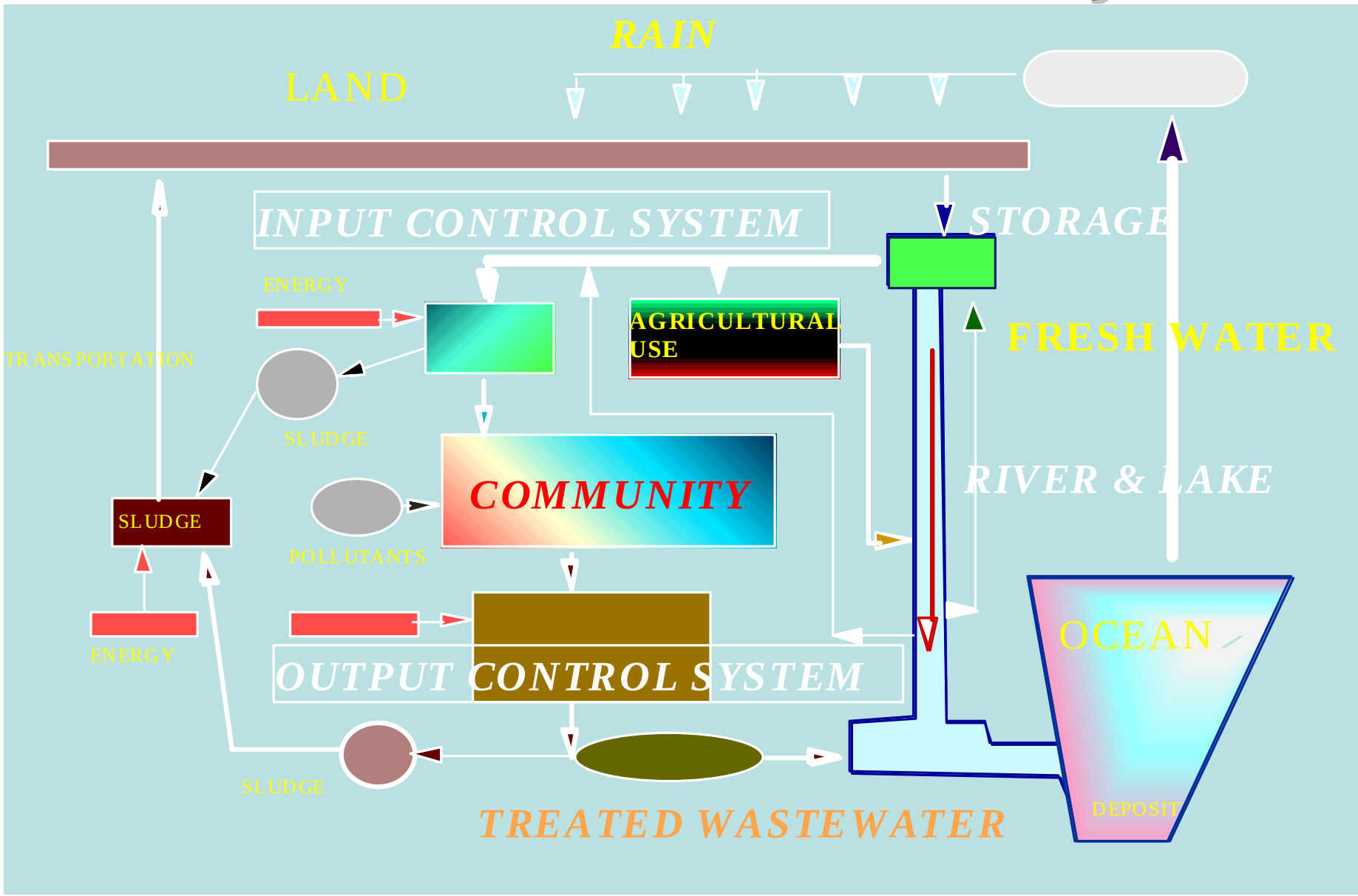
Natural & manmade water cycle

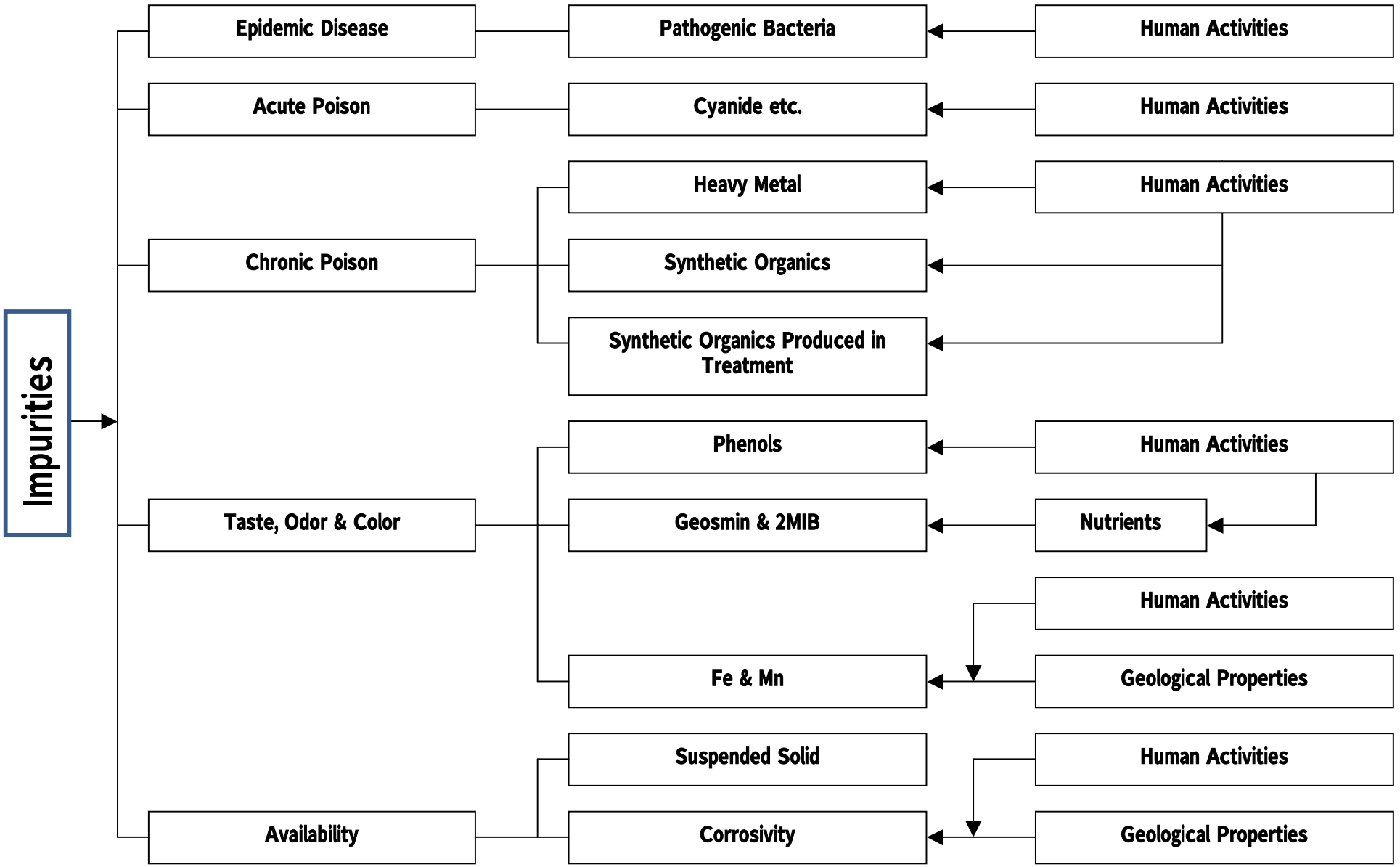


150 X$10^{12}$$m^3$ of fresh water resource/ a week

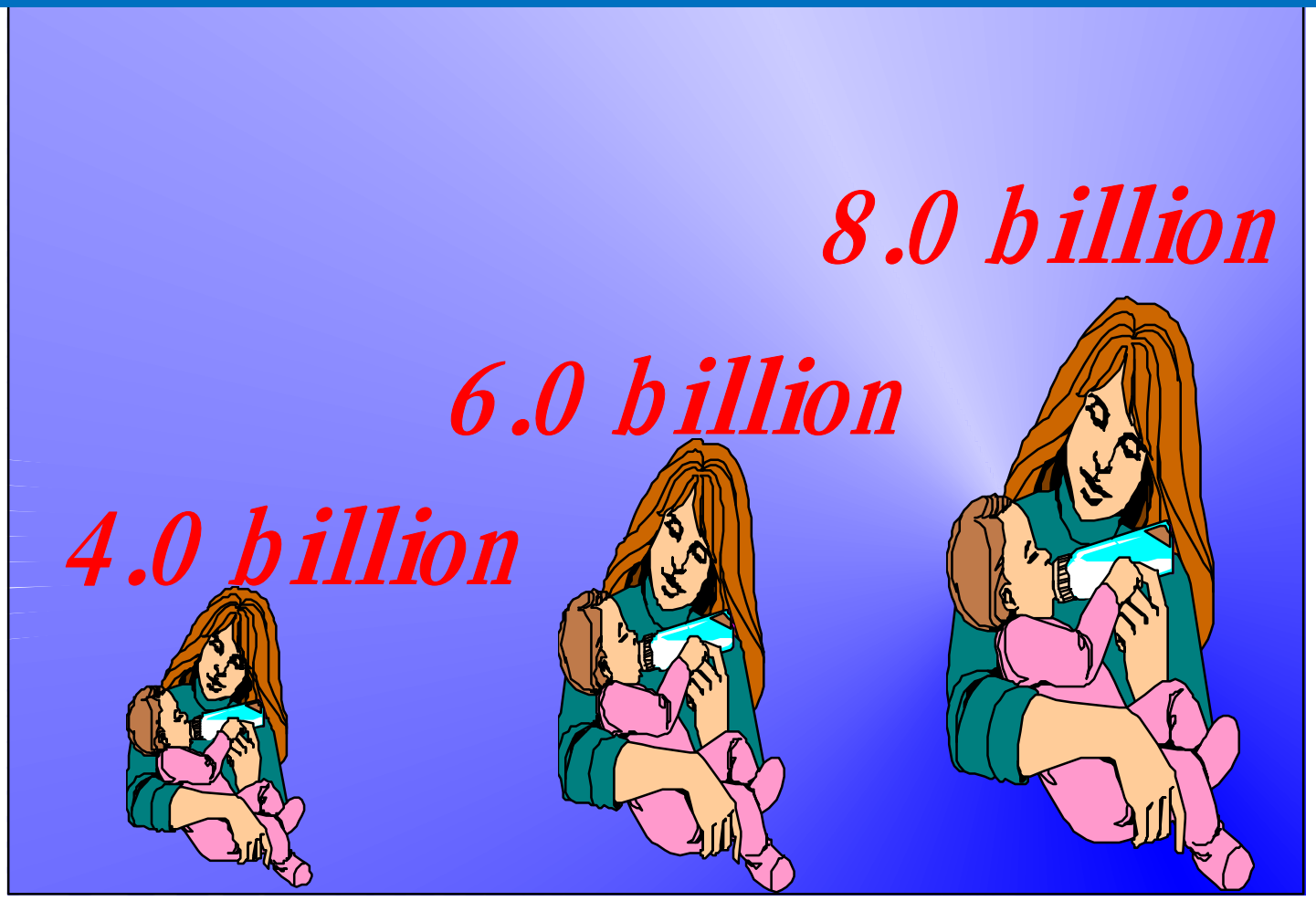
Surface fresh water is safe or not ?

- Rainwater captures pollutants during precipitation , flowing processes on ground surface.
- Groundwater is the most appropriate for water source, since the pollutants are reduced by the soil, unless some hazardous substances exist in the soil and elude into the water.
- Most of the freshwater resources cannot be used without treatment, or much worse,
- Most of them may even cause various health damages including infectious diseases.

Impurities and their effects and sources in water

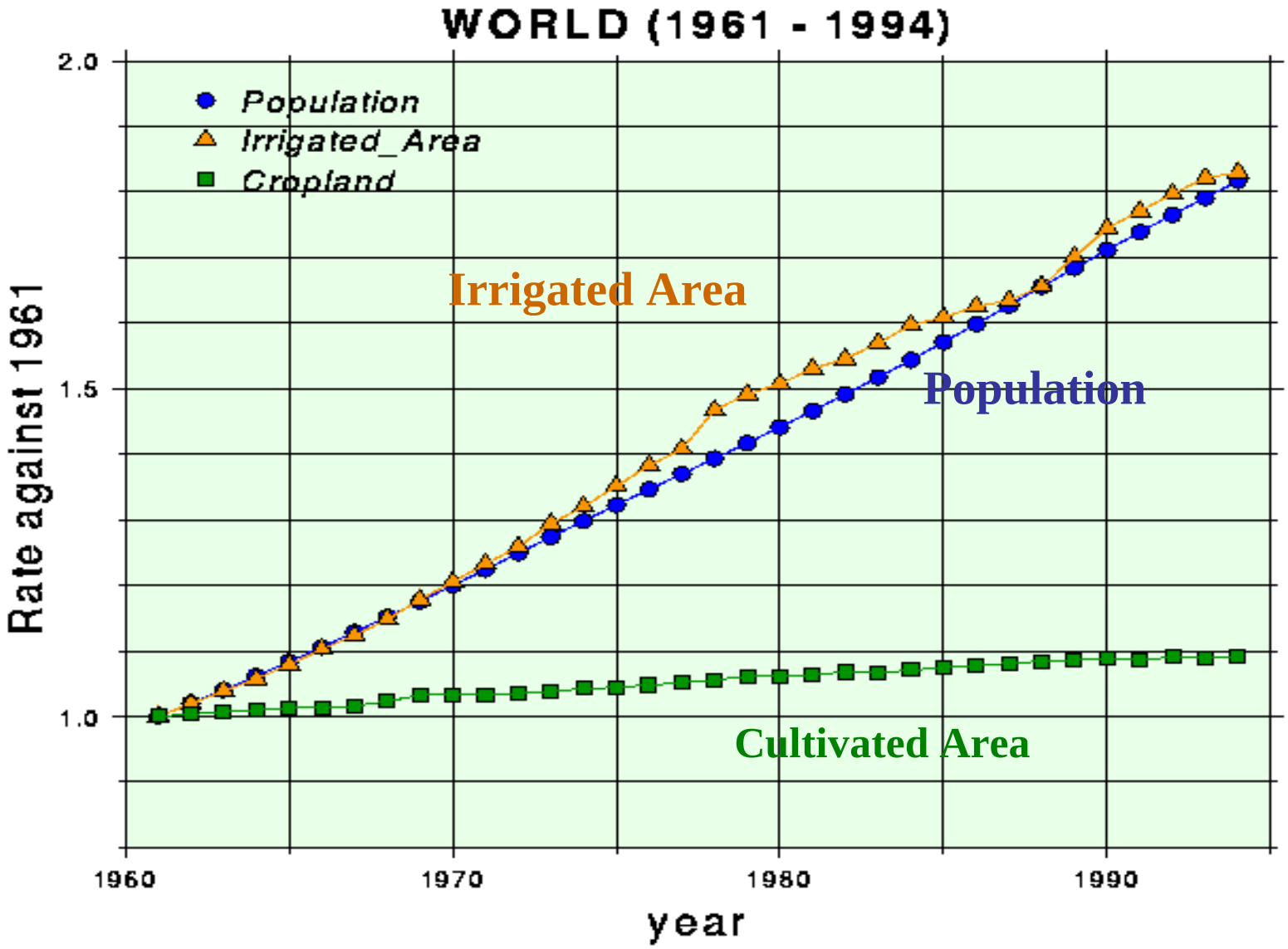


WORLD POPULATION



We must share 150 X$10^{12}m^3$ of fresh water resource/ a week

Demand of irrigation water

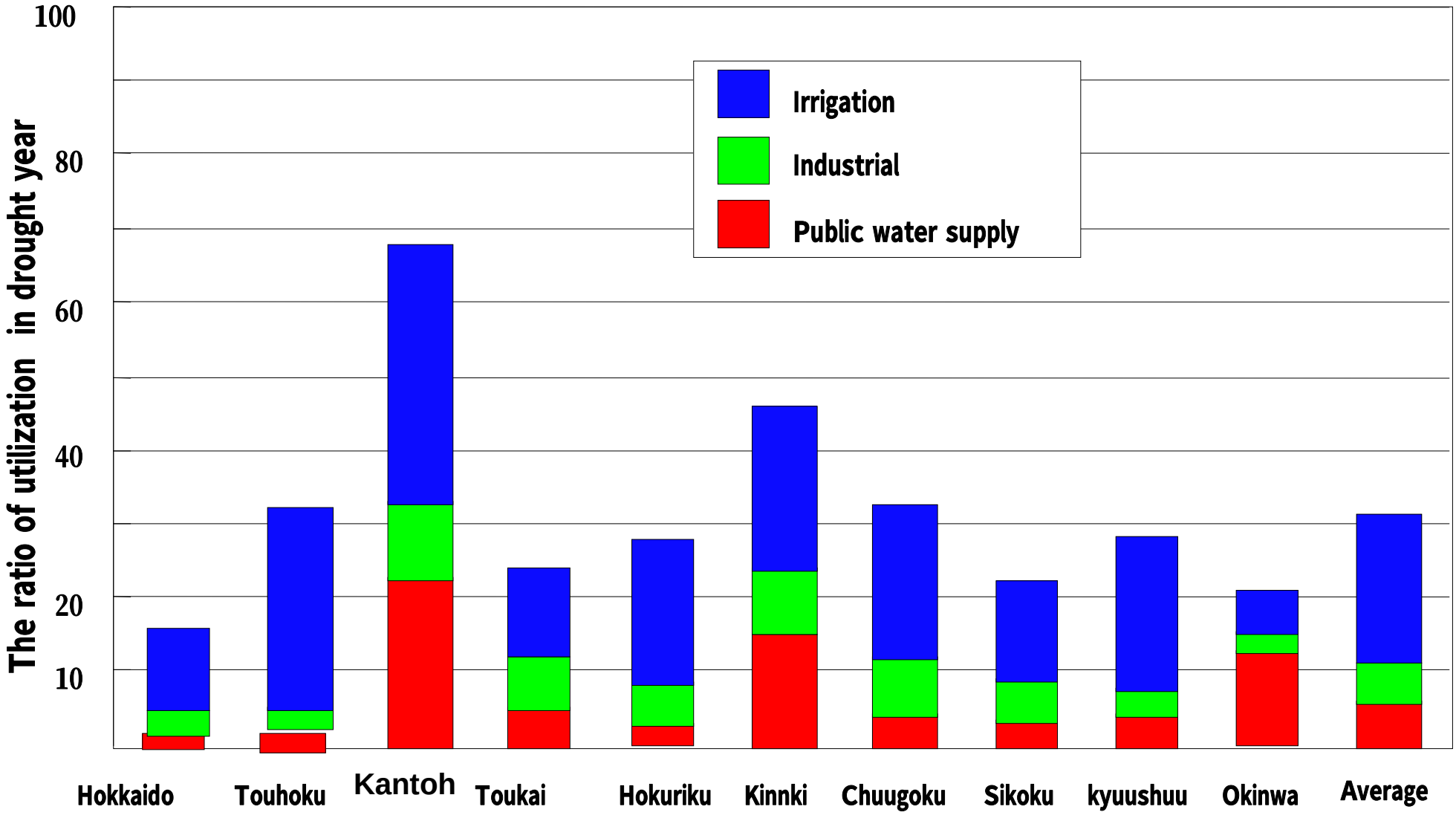


How much water resource ?

- Average consumption of water per person per day is 250 liters,
- Total consumption are about 90m3/year
- The used water becomes the treated water of BOD 20 mg L^{-1} when it is treated by biological wastewater treatment process.
- In order to reduce the BOD to about 4 mg L^{-1} for the maintenance of biological ecosystem in the aquatic environment, there must be about four times more water for dilution.
- In other words, in order to dilute the treated waste water it needs about four times the area required for daily water consumption, which is 360m^3

- Total demand 450m^3 cpy

Areal Distribution of water resource utilization



Water resource in China (m^3/CpY)

Region	Beijing	Tianjin	Hebri	Henan	Shandong	Shanxi
Water	329	153	363	441	381	456

Water resource of Japan is about1500 m^3/CpY

China is going to

- Allocate water resource at 2015
  - Agricultural 52%
  - Industrials 18%
  - Domestic 15%
  - Ecological 15%

- Development of water and waste-water facilities are national project
- But the level of performance should superior than global standard of conventional treatment facilities

Traditional Water Supply System in Large Cities

Population of Edo (Tokyo) : 1.3 million

Tamagawa water Supply System in Tokyo: 6m³/sec.

Transmission line (Open channels): 43Km

Gravity transmission and distribution system: 3700

Distribution wells in town

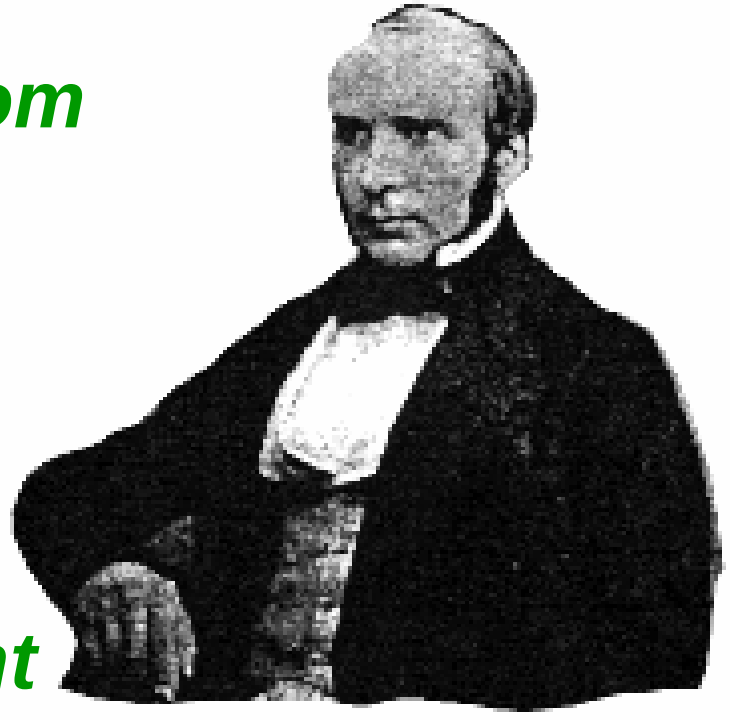
Never invaded of Cholera and Typhoid fever

Massive outbreak of Cholera in Japan:1860,

41000 deaths in Edo

John Snow

- *Epidemiology & Environmental engineering*
- *Cholera was transmitted from Asia with trading actvities*

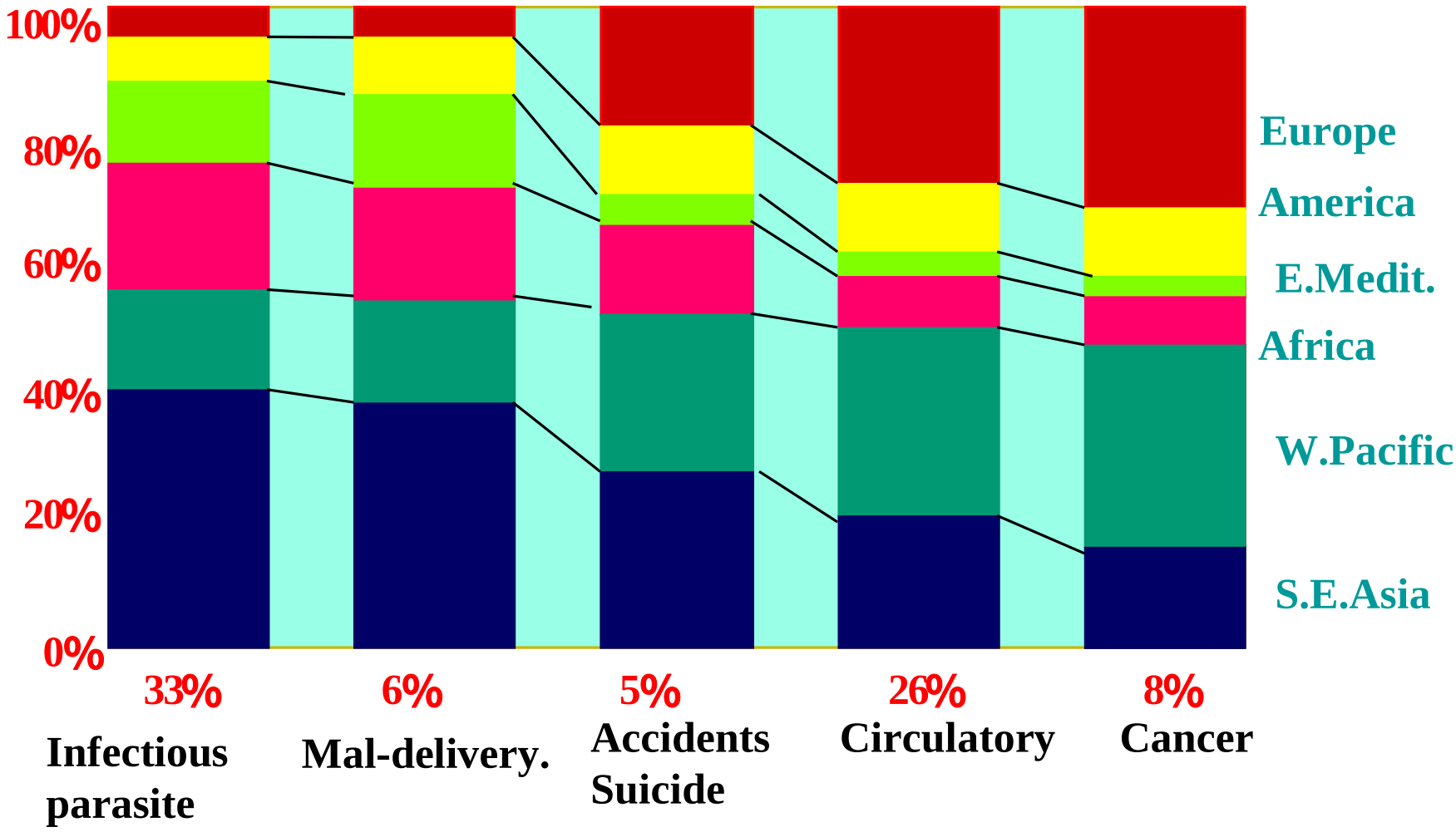


1855

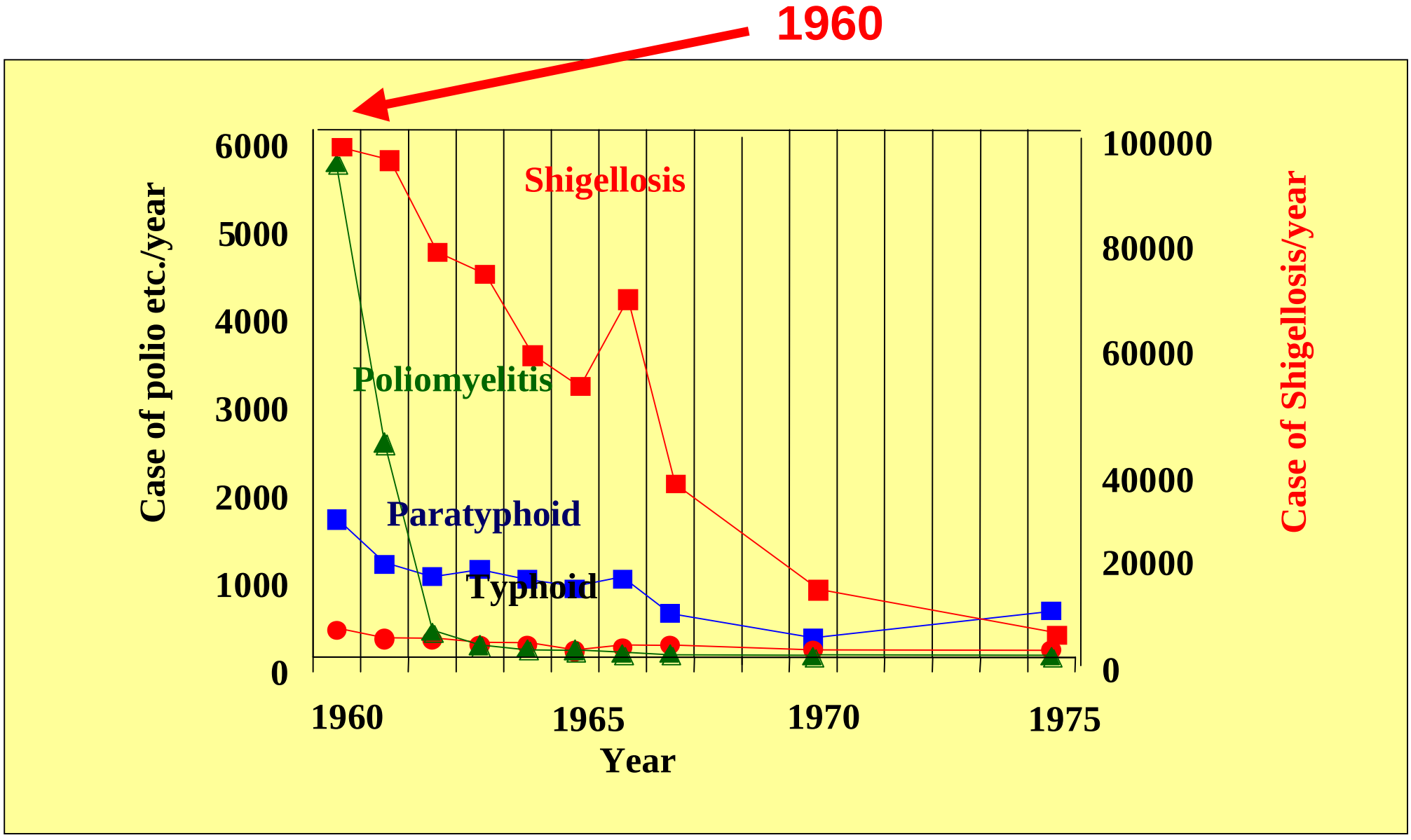
Statistical verification

- *Cholera and water treatment*

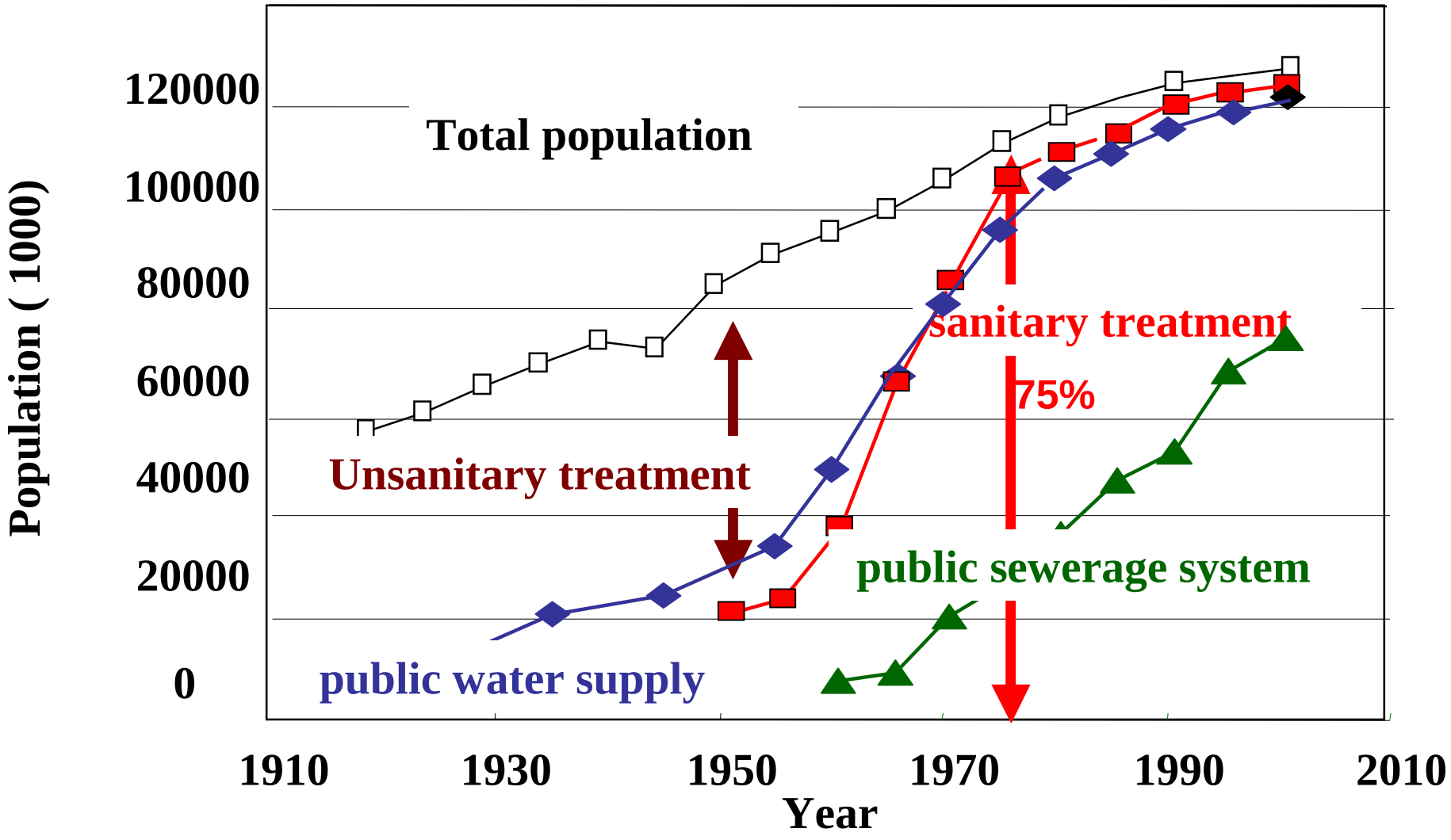
Regional differences of death of cause



Feces - oral route infectious disease in 1960-1975

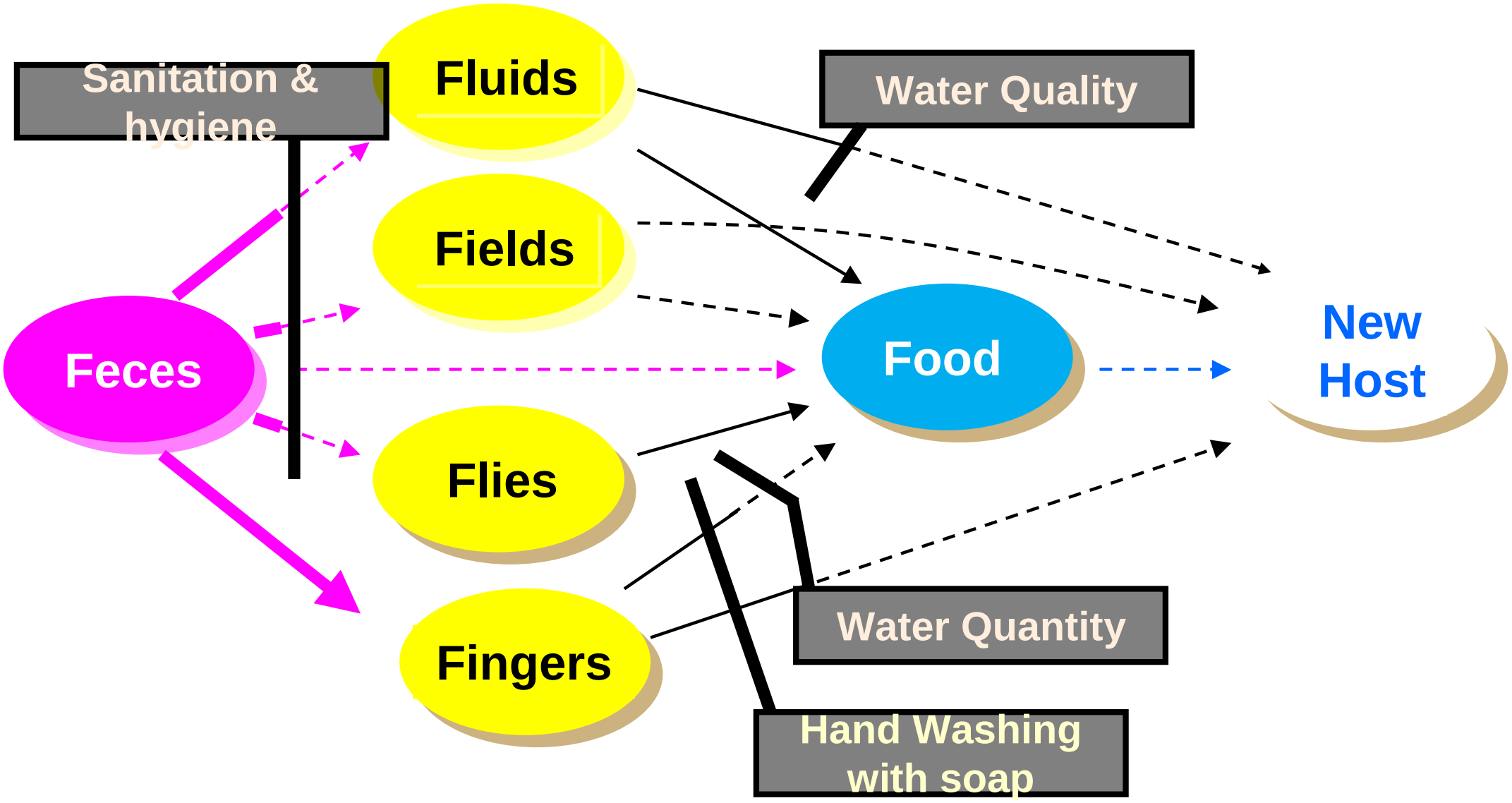


Development of water supply and sanitation



Reducing Exposure

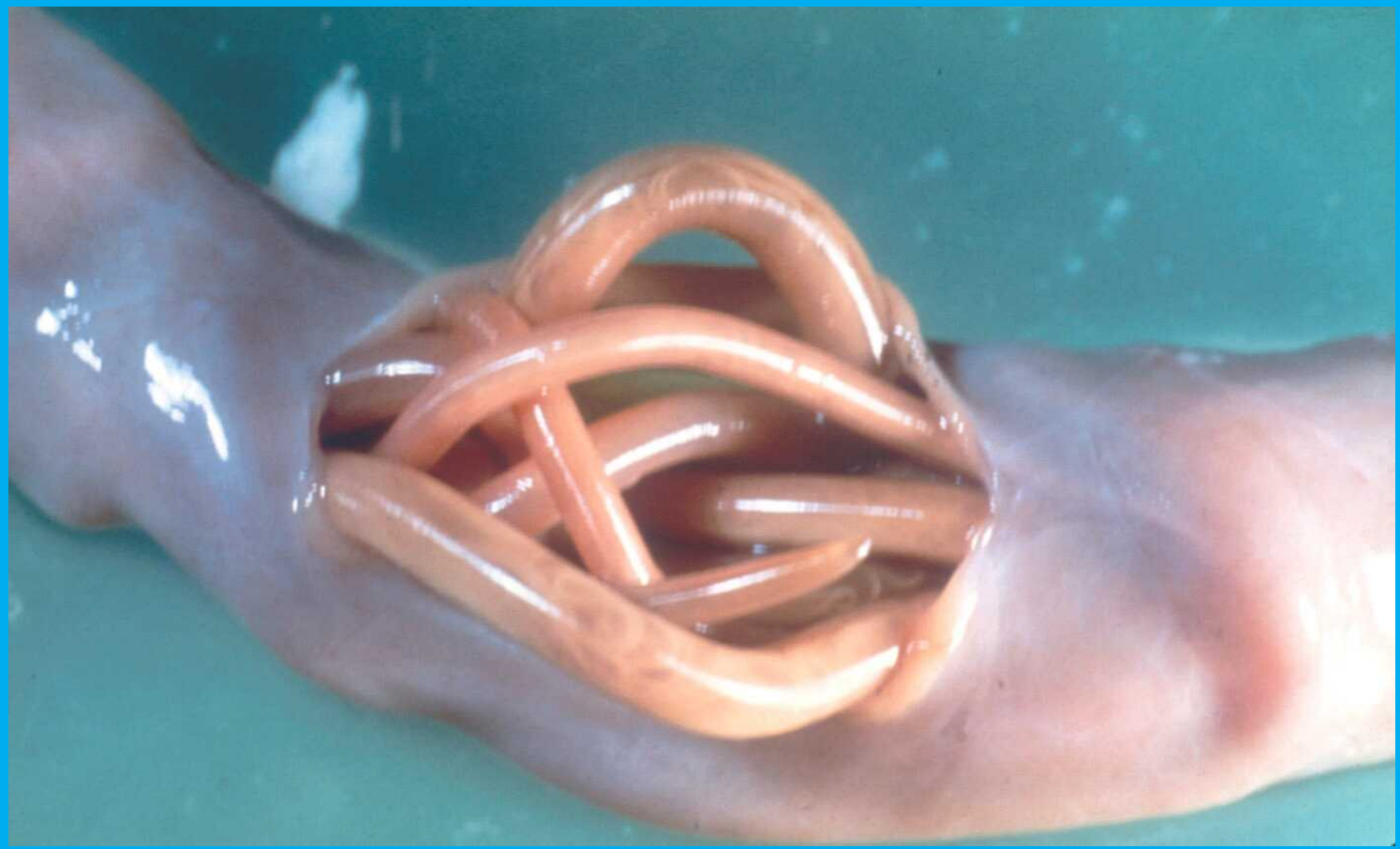
The F-Diagram



Sanitation

- Toilet should be facilitated to prevent the entry of hygienic insects and animals that carry the pathogens in the excreta, and it act as a barrier to release of parasitic worms or their eggs in the excreta into the surrounding environment. However, the role of toilets is lost unless the excreta are eventually removed from the pits or feces tanks.

Intestinal worms



Malnutrition & stunting

Lower IQ

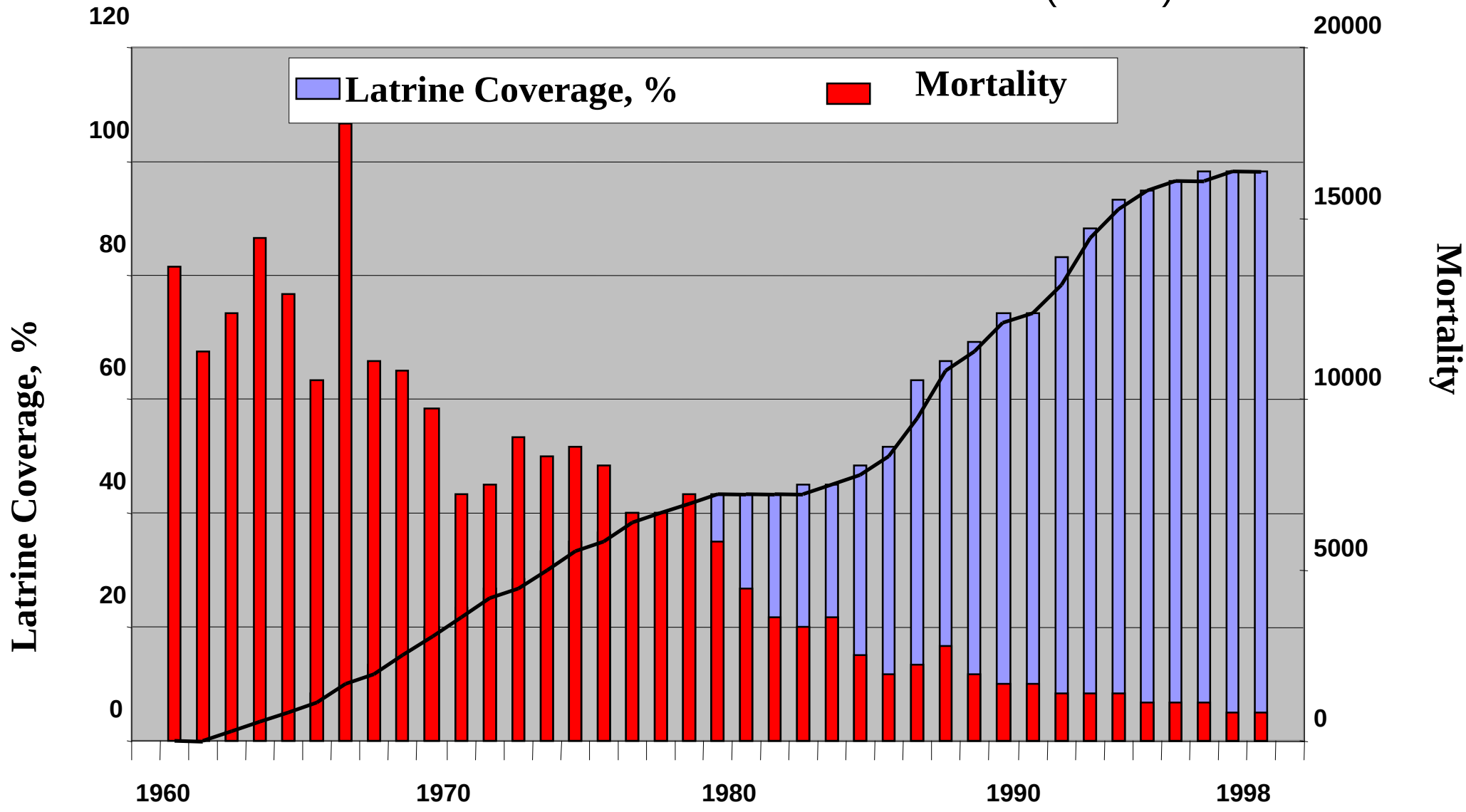
Shorter body height

Anemia - contributing to maternal mortality

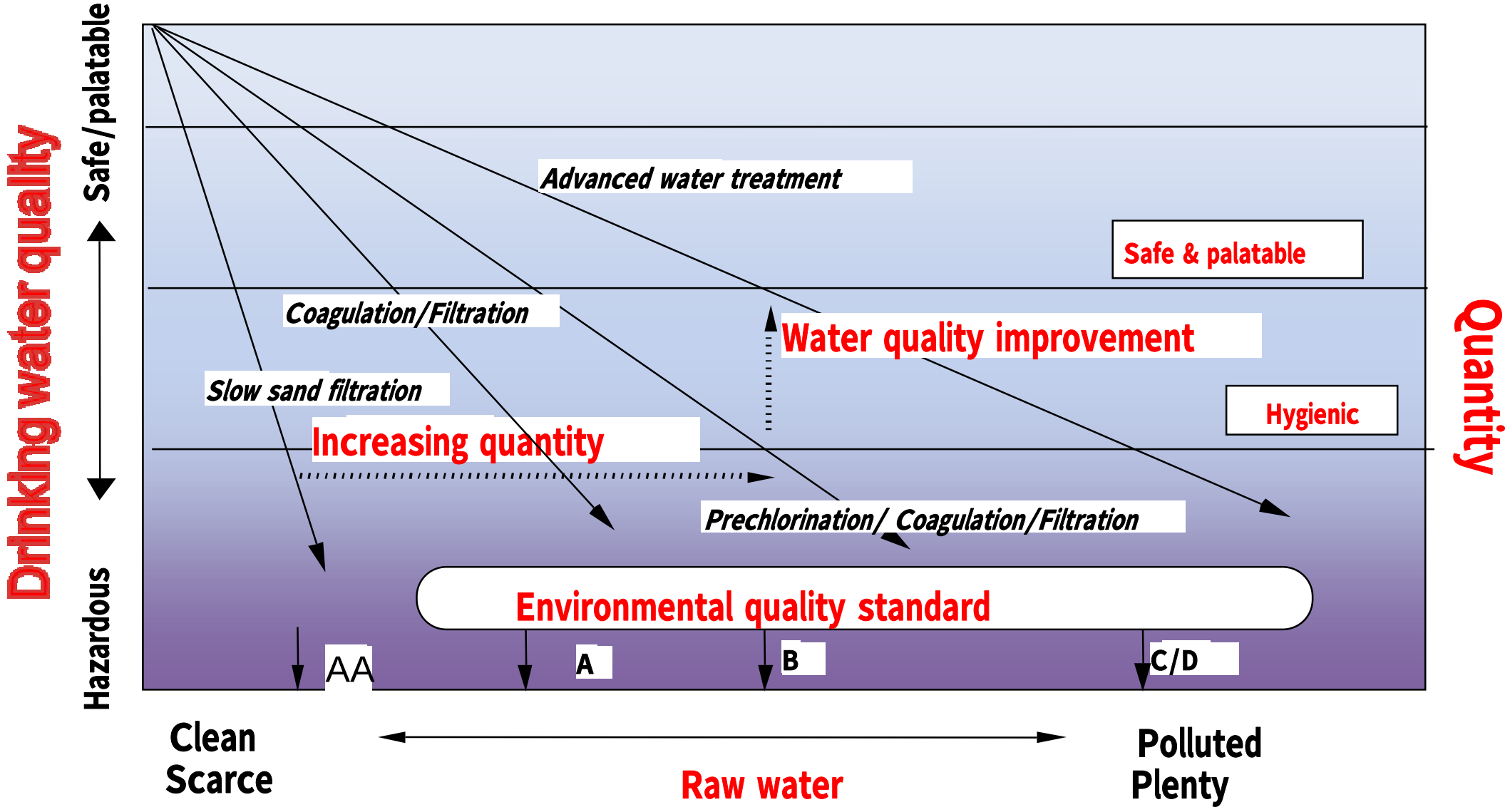
unicef

Universal Sanitation - Thailand

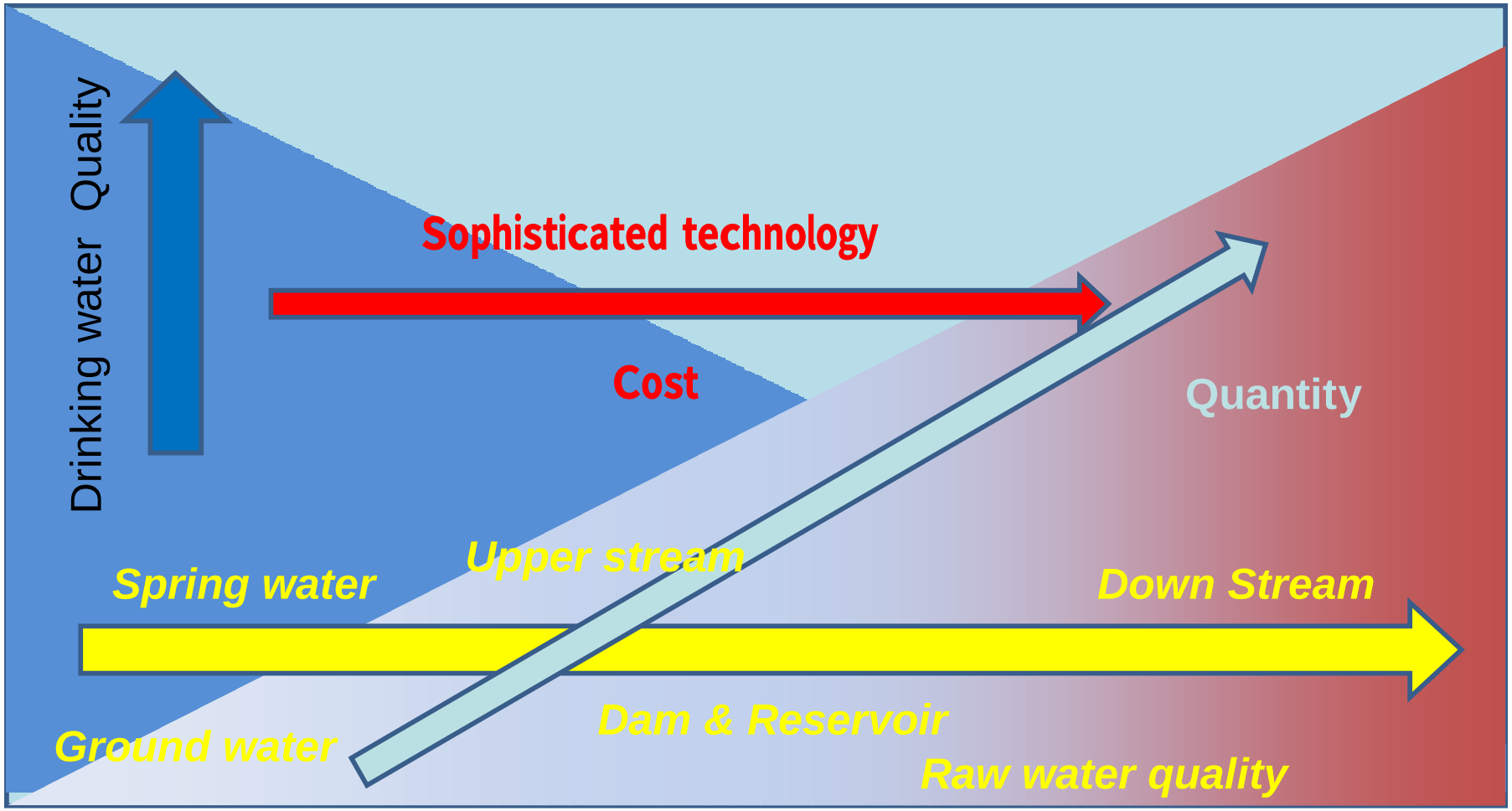
(Unicef)



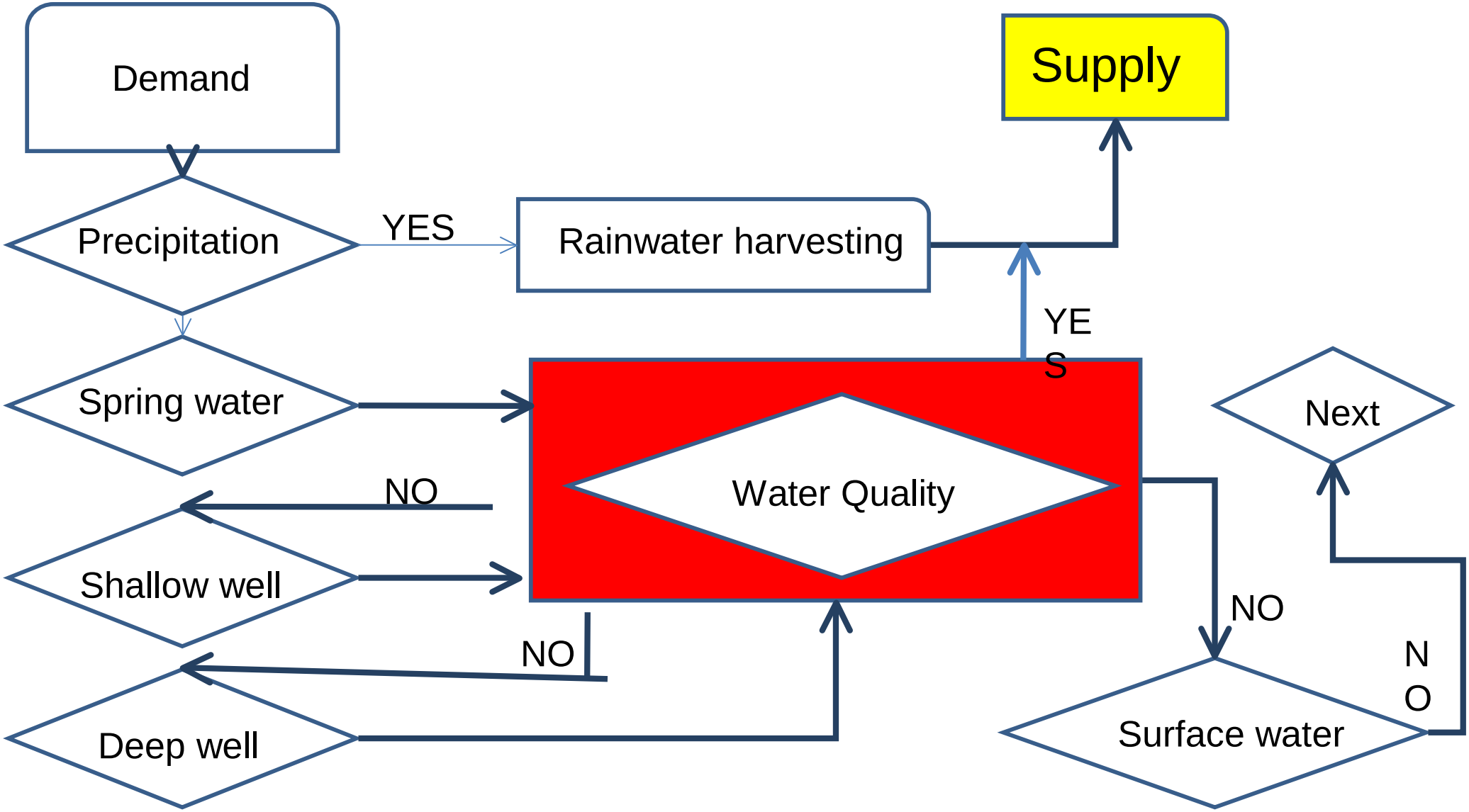
Water treatment system and water quality



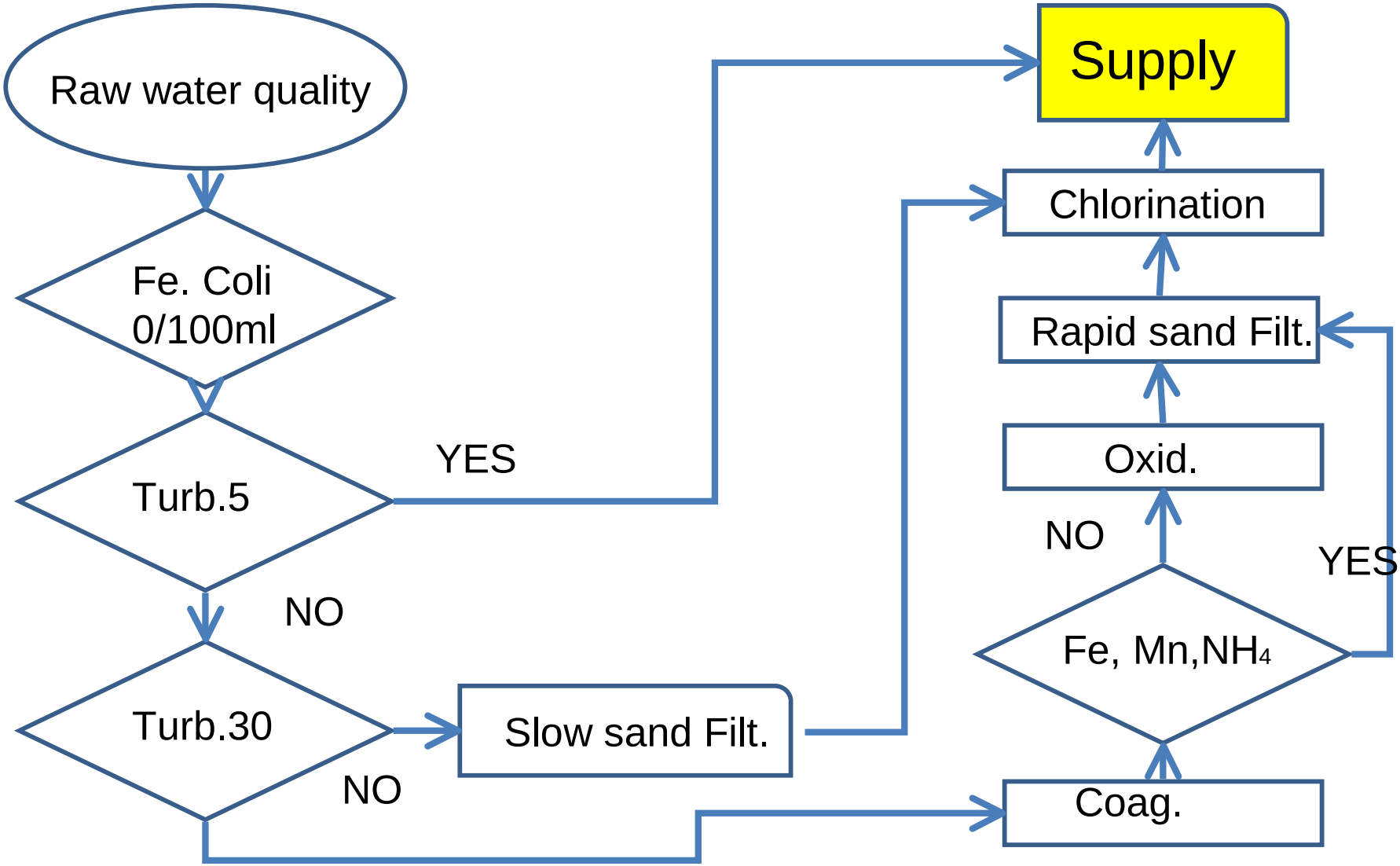
Selection of water purification technology



Cascadian Selection of water system



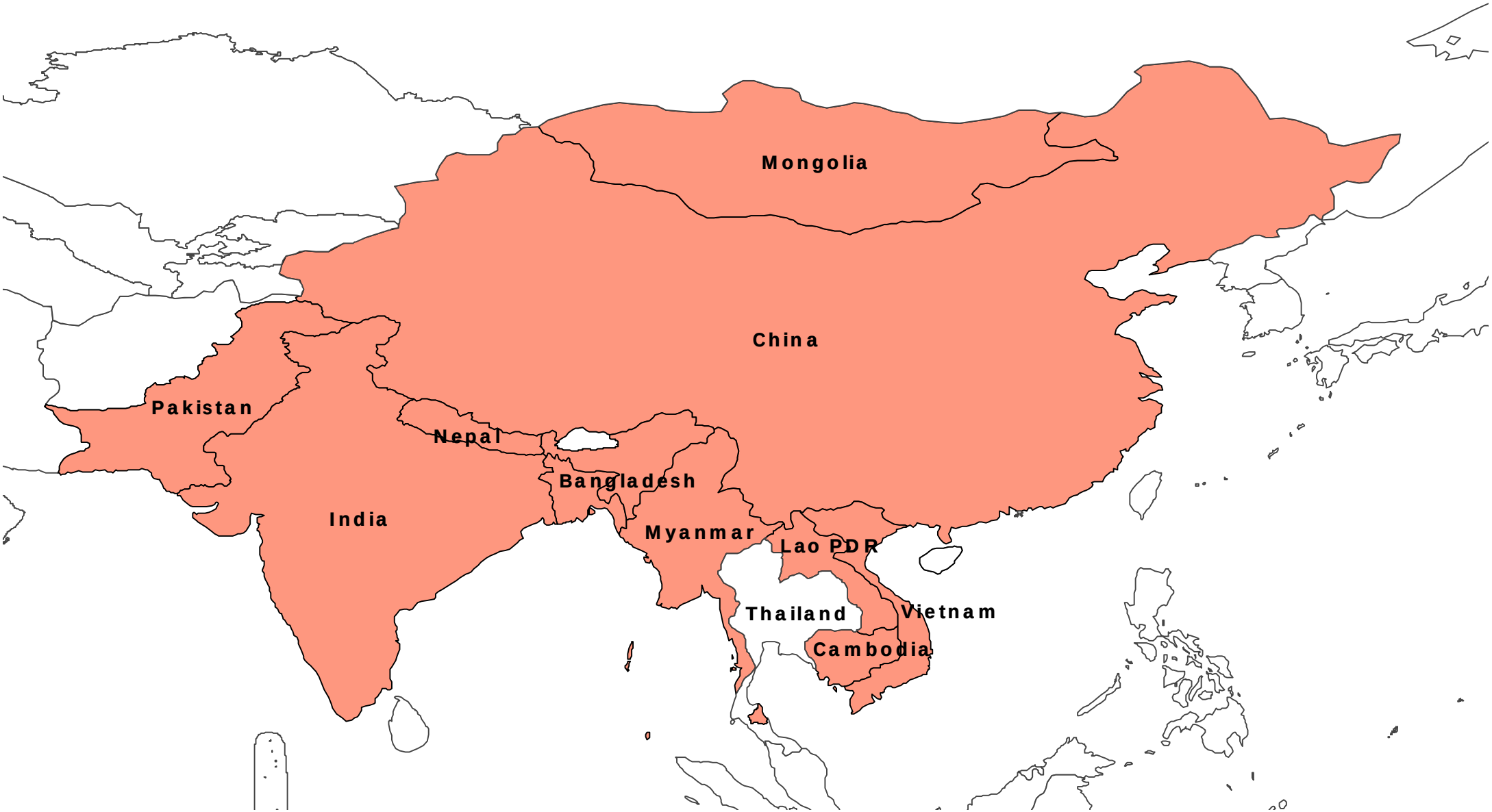
Selection of system for surface water

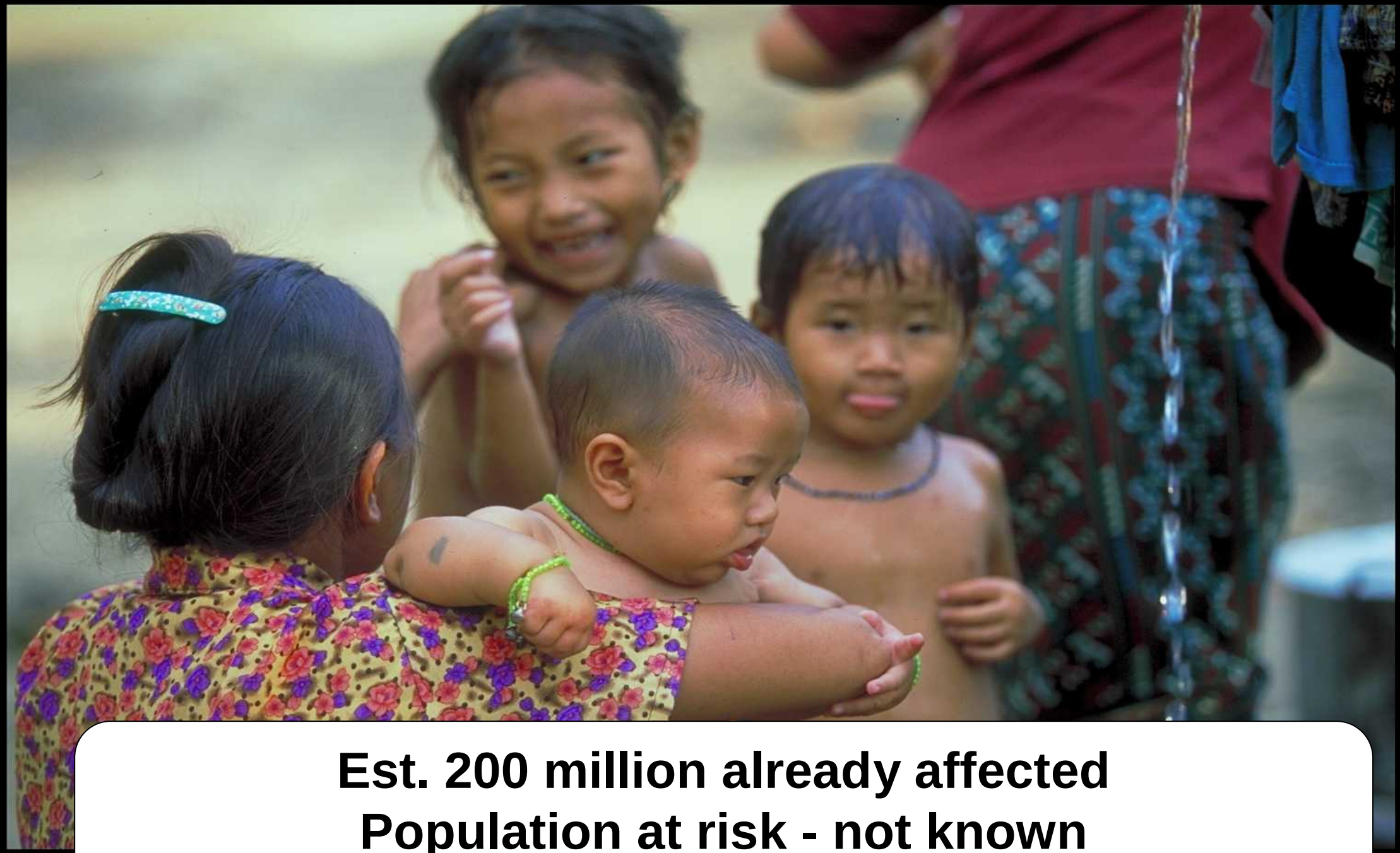


Direct drinkable water service

- Decentralized water service system
- Membrane (RO,NF.UF,MF) filtration unit produce 20% drinkable water from distributed piped water
- Separate supply system for drinkable water and miscellaneous purpose water

Arsenic affected countries in Asia





Est. 200 million already affected
Population at risk - not known
Damage to health - irreversible and untreatable

- **Arsenic contamination -**
- ***"An emerging public health problem"***

unicef

Arsenic

- Toxic and carcinogenic
- Known poison for >4000 years
- Acute poisoning symptoms occur within 30 min. of ingesting lethal dose
- Arsenic toxicity in drinking water & Environment
  - Chronic in nature
  - Takes 5-20 years to develop symptoms
  - Symptoms found in infants in China, India & Thailand (possible transfer from mother to child?)

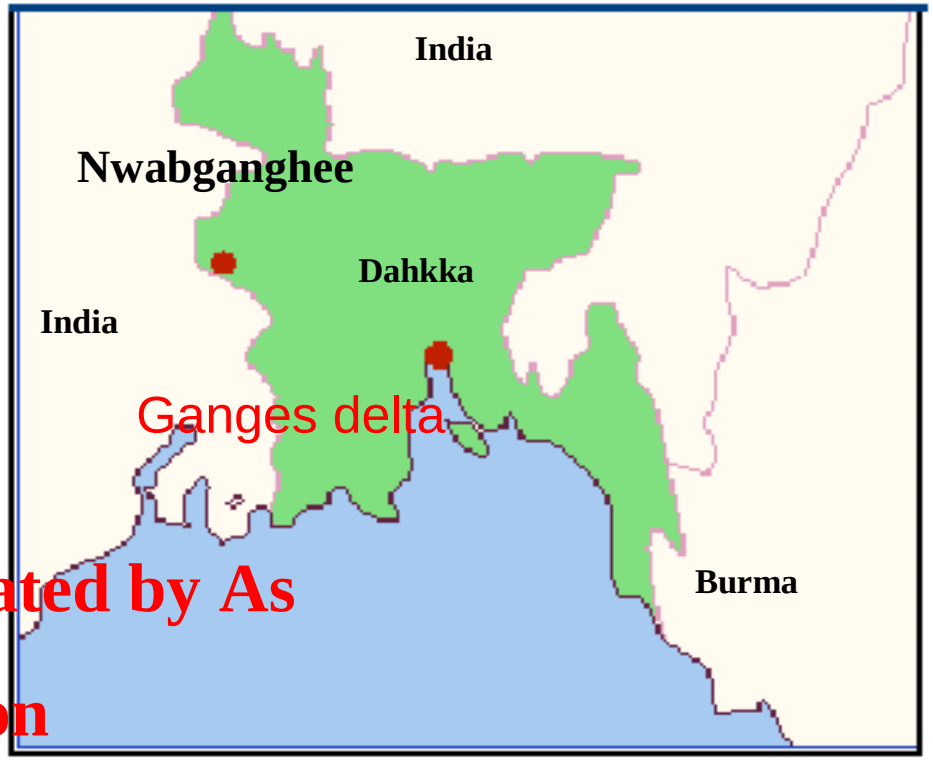
Bangladesh

- **~ 1970 water source was surface water & Shallow dug well**

High mortality rate especially in infants and children by water related infectious diseases

Many tube well have developed

Decreasing infant & child mortality

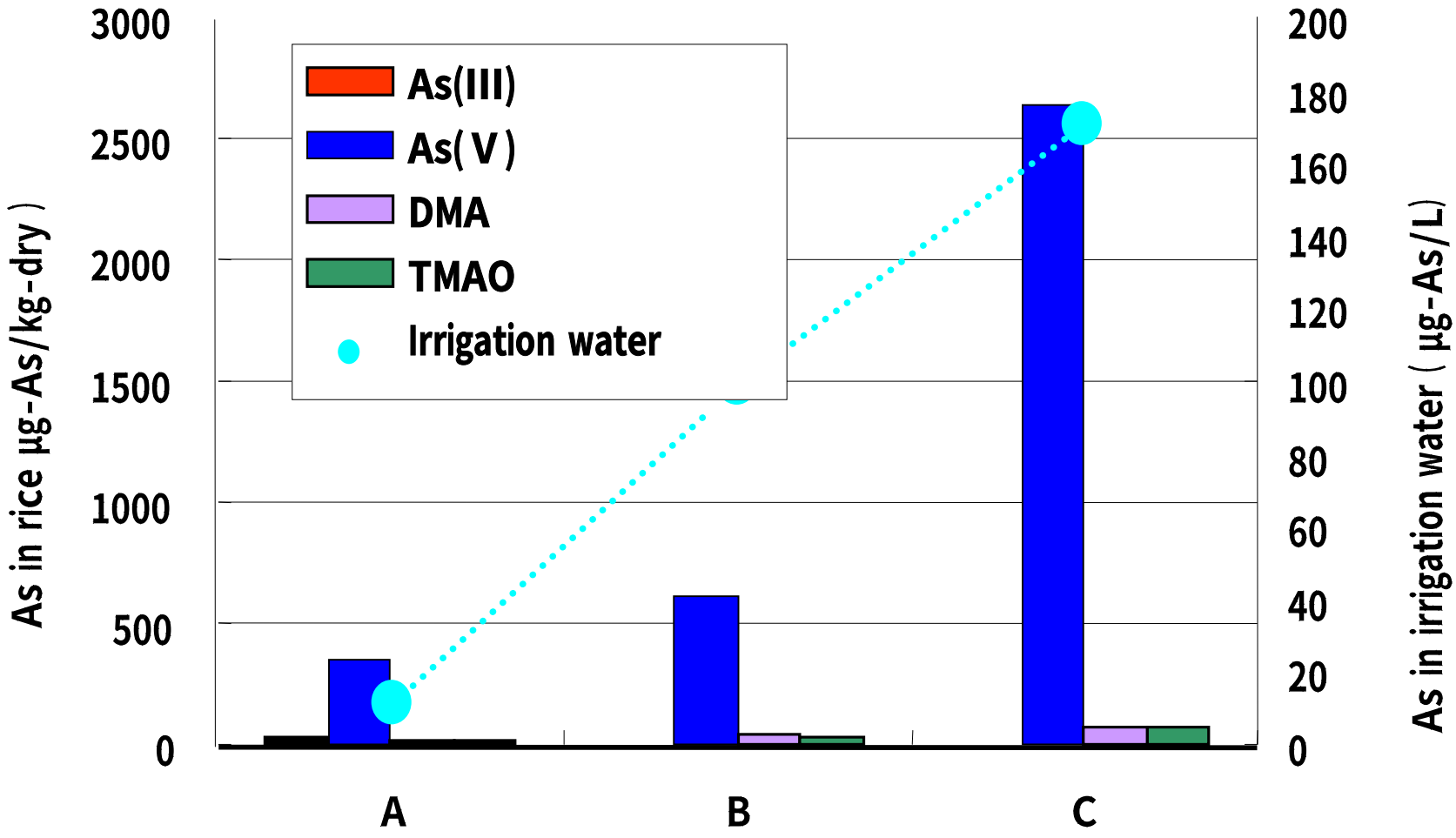


- **In 1990 Ground water were contaminated by As**

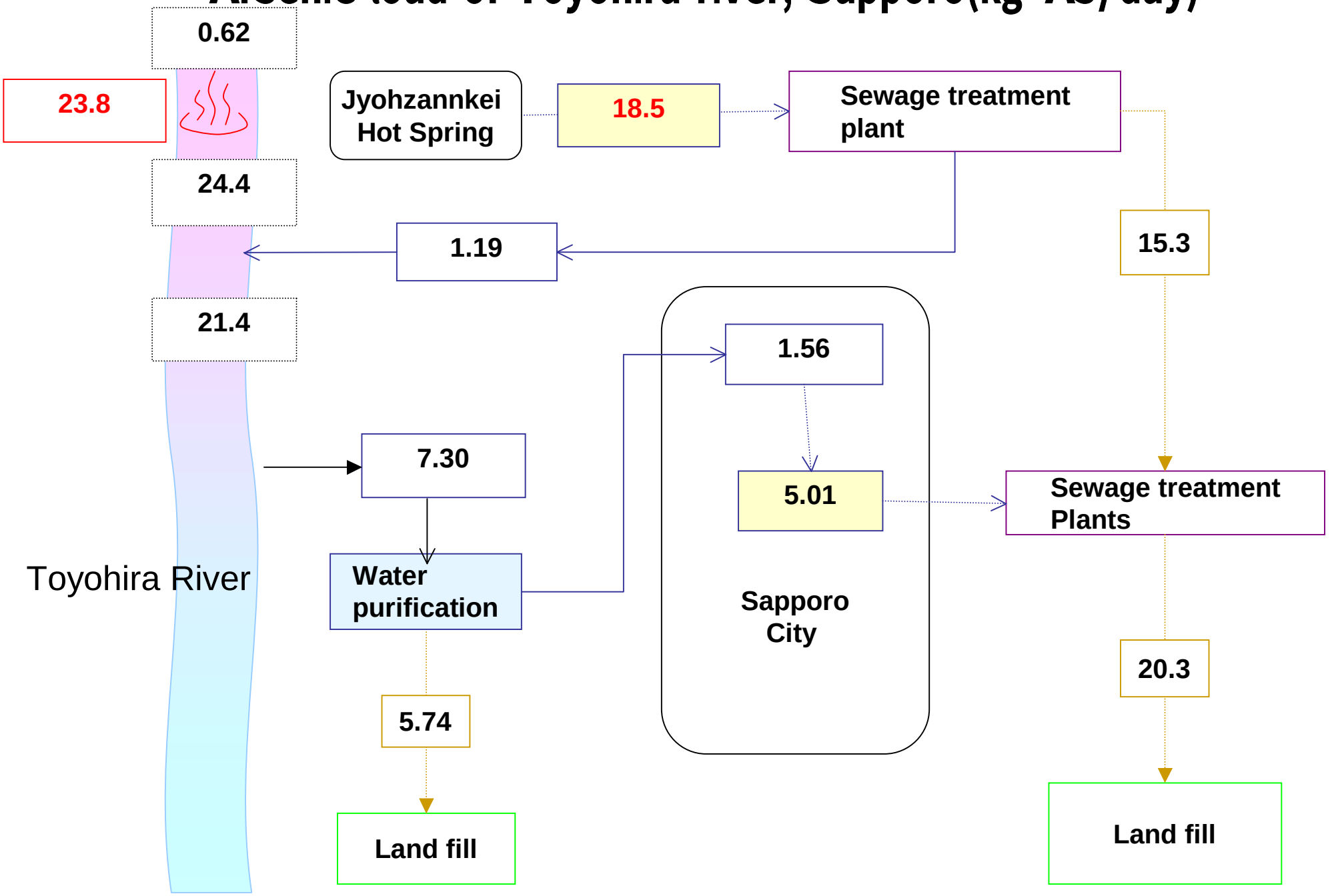
Excessive use of ground water irrigattion

Tubewell & Dugwell

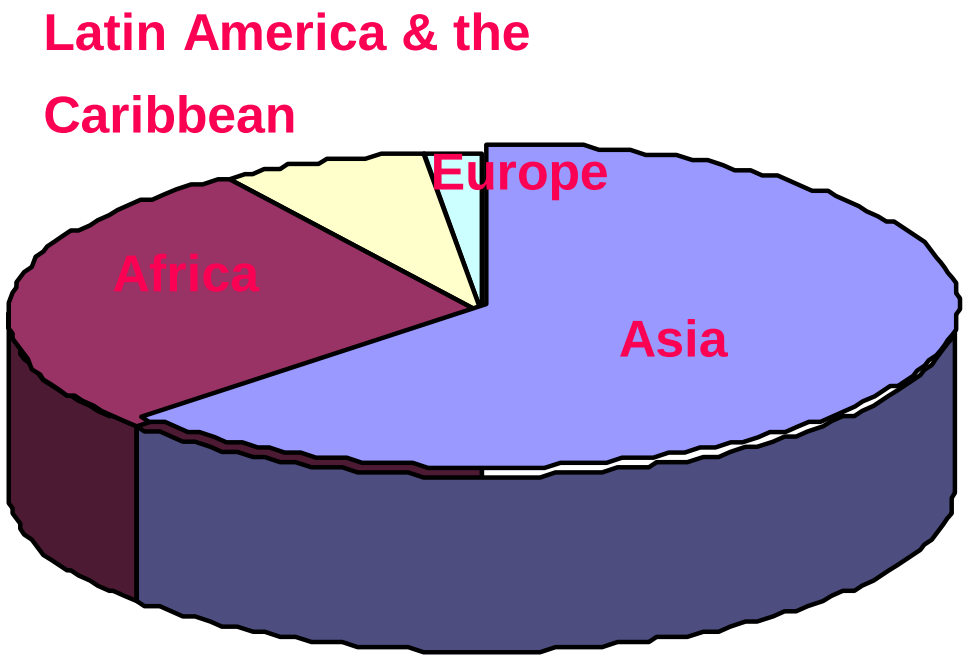
As concentration and rice

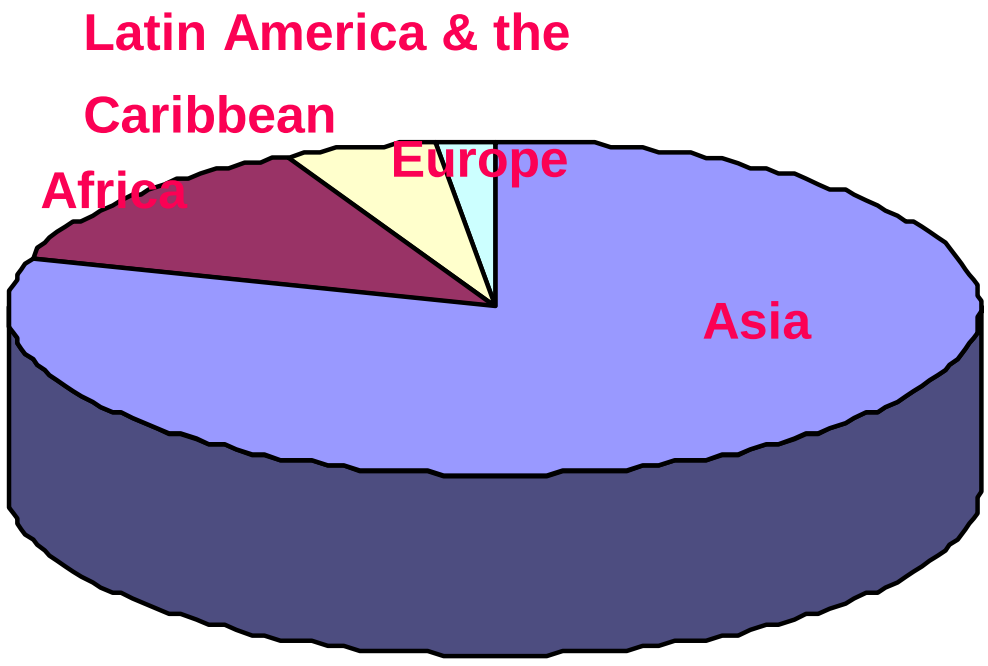


Arsenic load of Toyohira river, Sapporo(kg-As/day)



What are the constrains for safety water and Sanitation

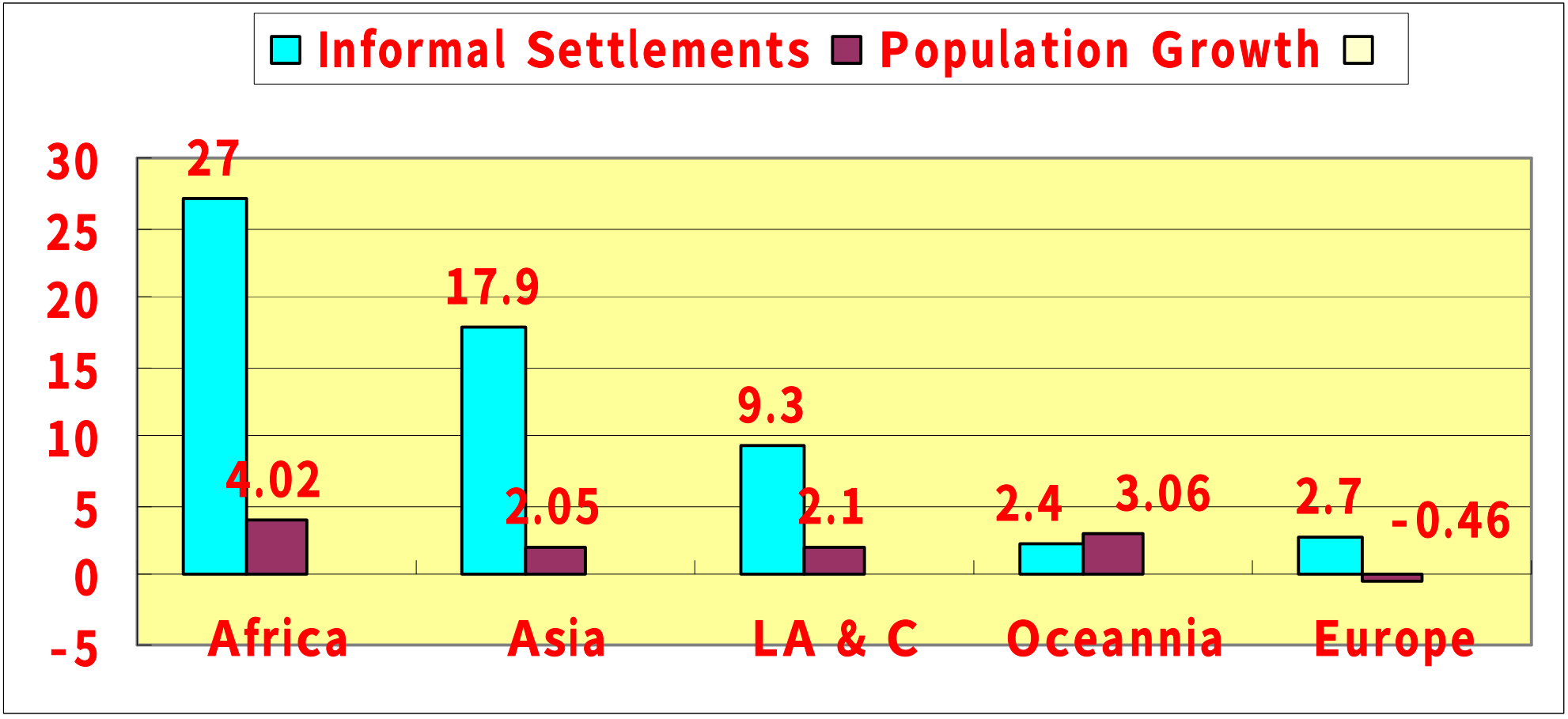




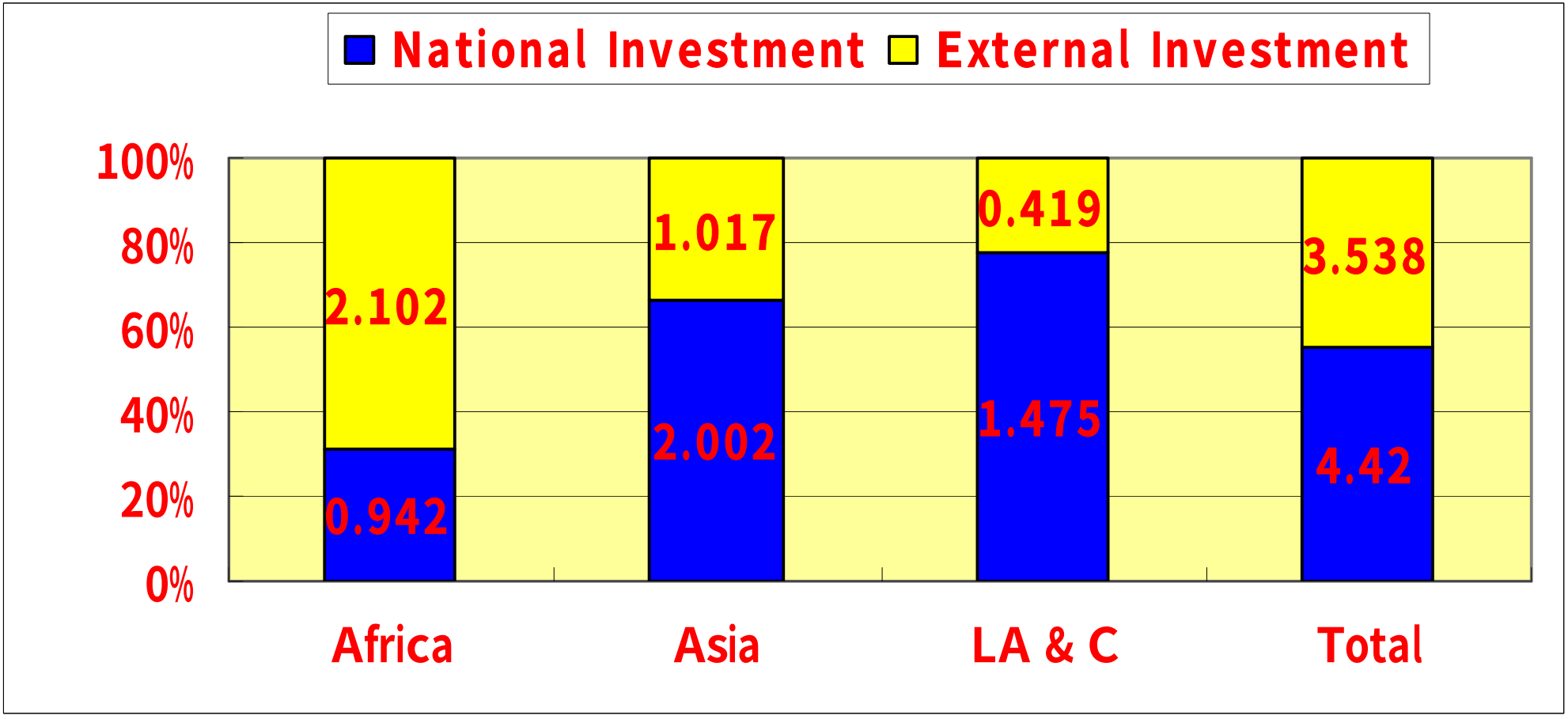
Water Supply
1.1 billion

Sanitation
2.4 billion

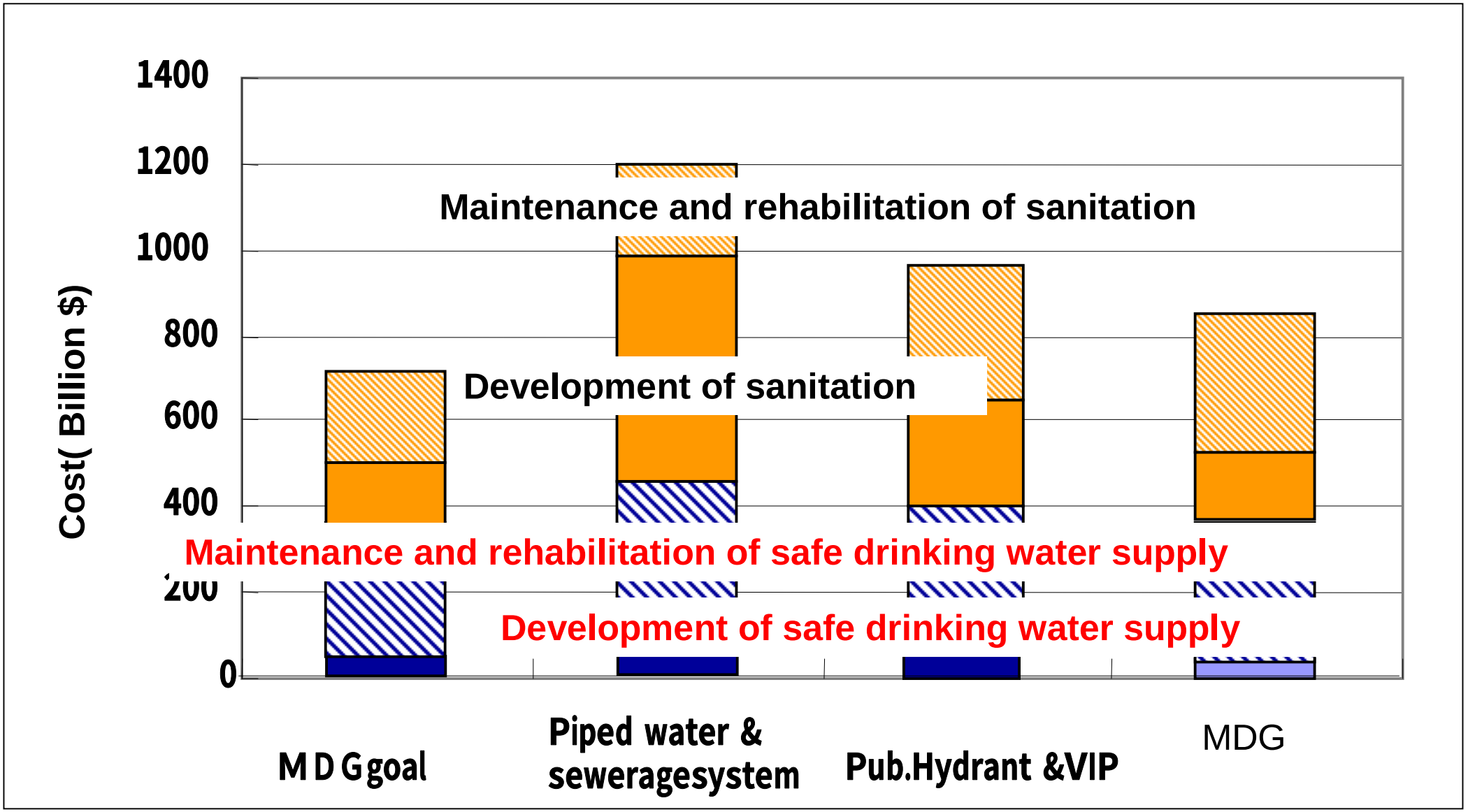
Population growth rates and proportion on informal settlements in urban area



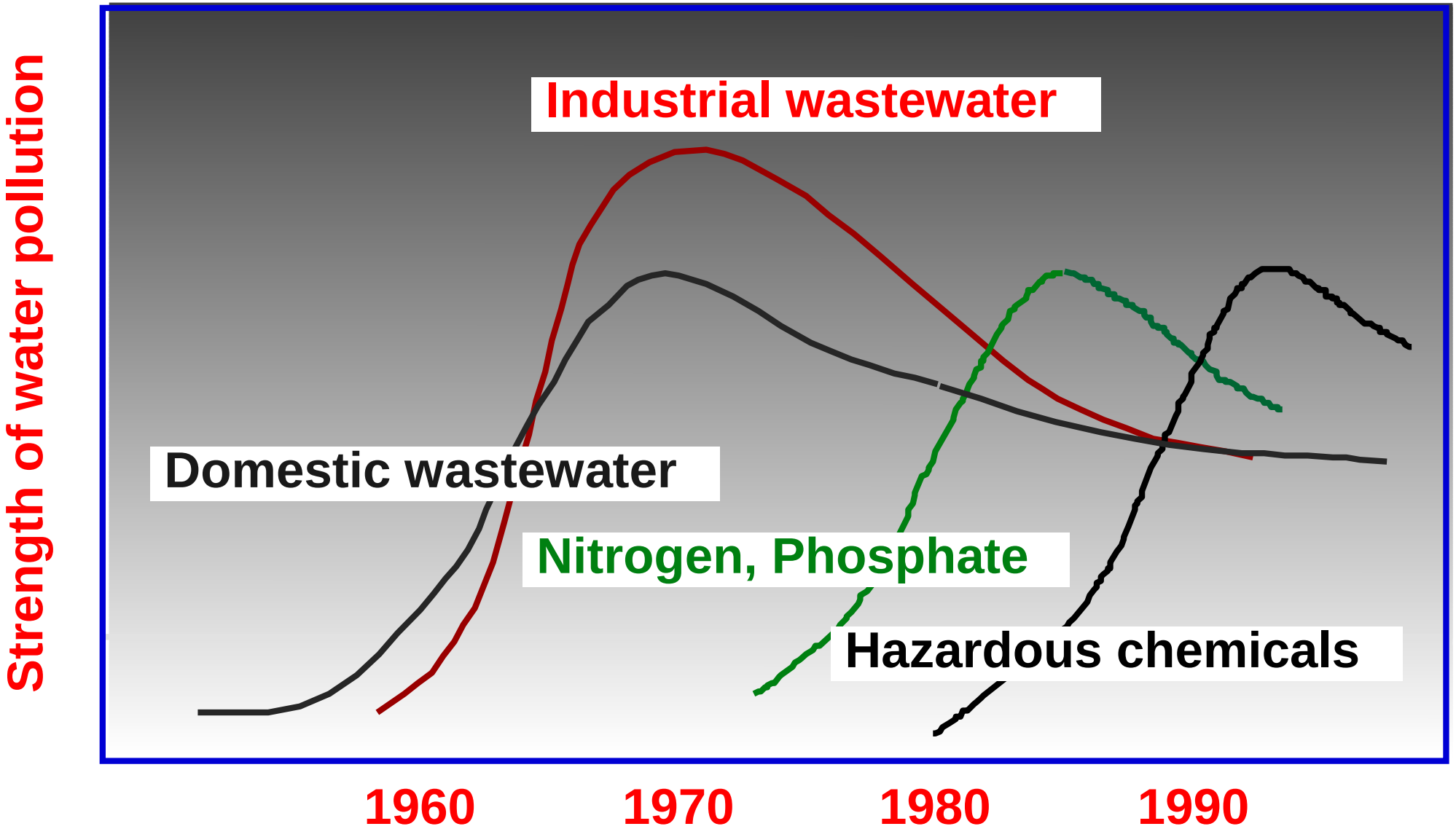
Annual investment in urban water supply



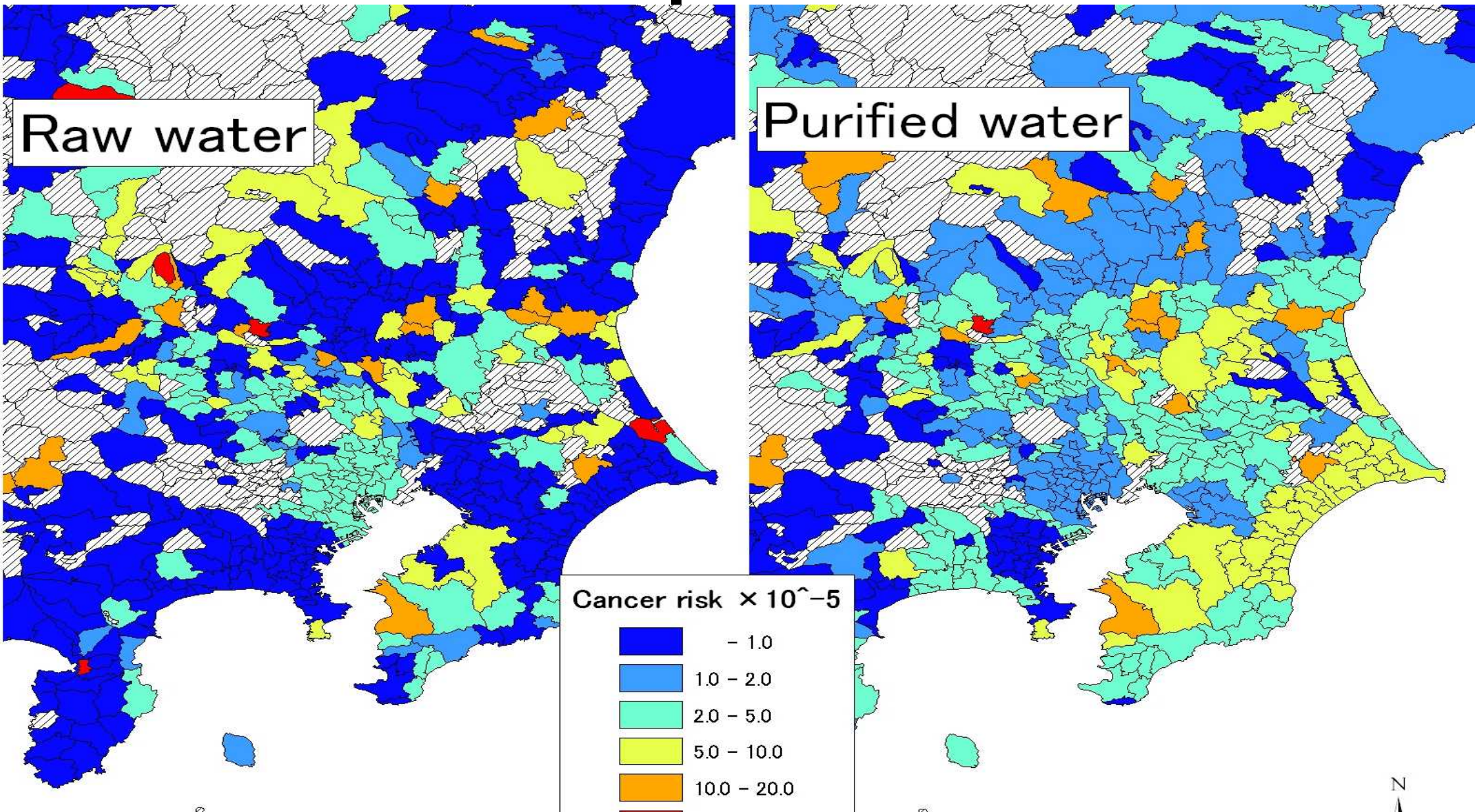
Cost for safe drinking water supply and sanitation (2005-2015): WHO



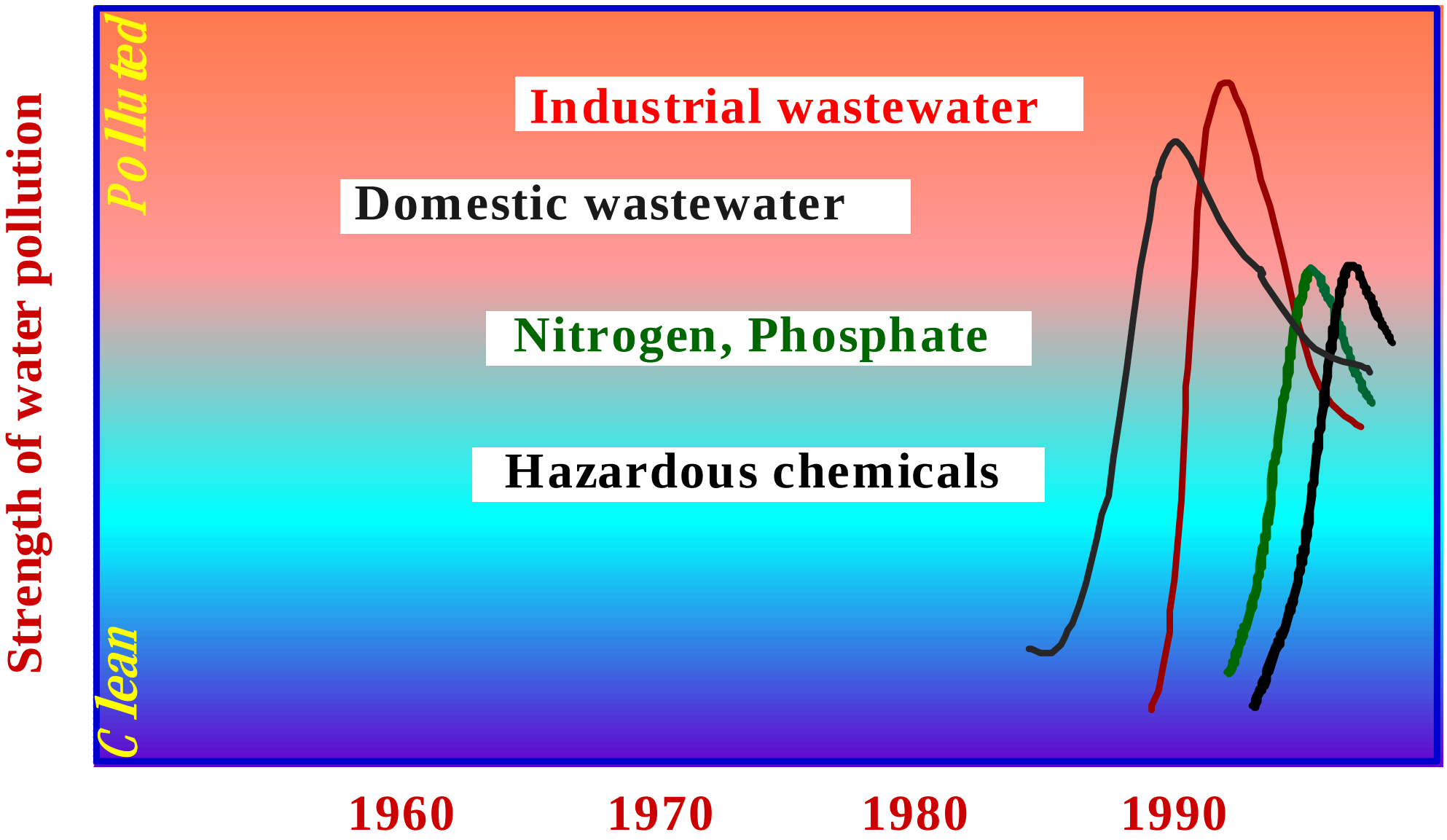
Water pollution aspects of industrialized countries



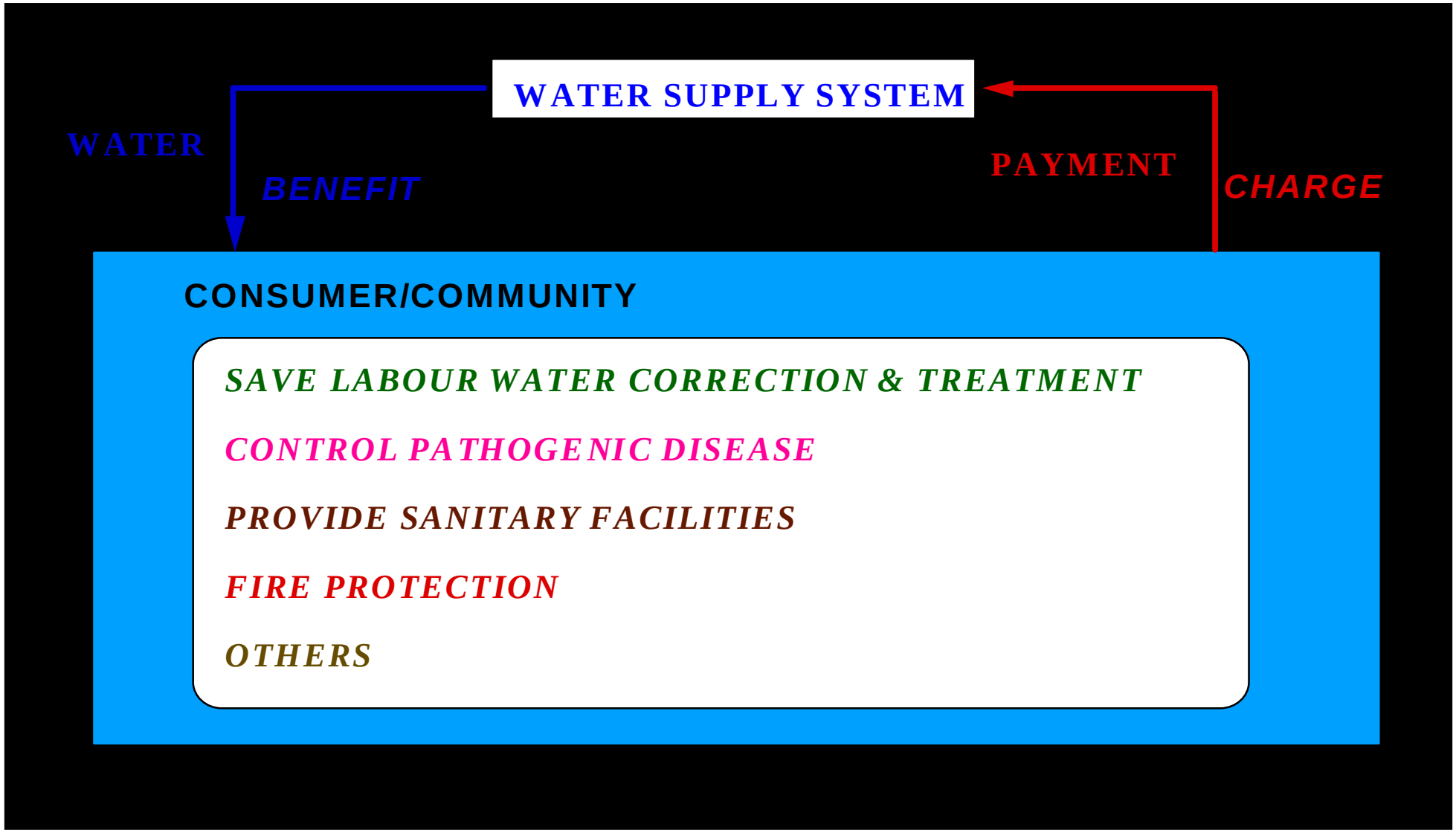
Distribution of Cancer Risk of Tap Water in Metropolitan Area



Current situation in developing countries



Sustainable Development of Water Supply Services



How much can we pay ?

- 0.8% of disposal income for water tariff
- The disposal income of the residents of large cities such as the capital is greatly higher than for the residents of rural areas.
- The dispensable limit varies even within one country must be recognized.
- The problem depends on the system that is feasible to facilitate and maintenance/control for the sustainable services of water and sanitation

Conclusions

- **Full cost pricing**
- **Monopoly system**
- **Water is essential not only in healthy daily life but also economical/social activities**
- **Sustainability**
- **Customers satisfaction**
  - **Governance/Transparency of business**
  - **Financial soundness**
  - **Human resource**