



Title	Wise use of Water
Author(s)	Magara, Yasumoto
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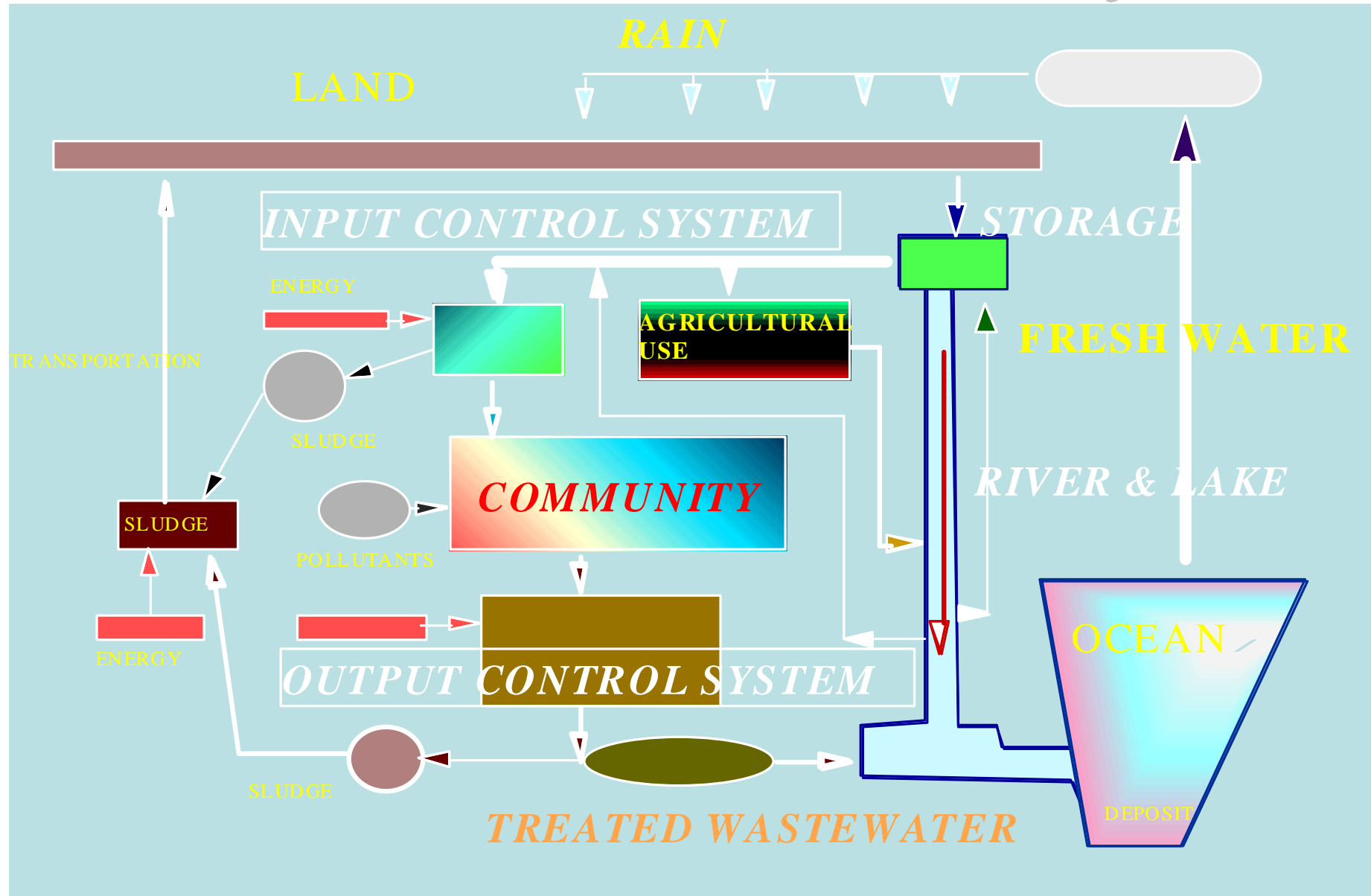
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# Wise use of Water

**Magara, Yasumoto**

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Environmental Bio & Nano Engineering Research Center  
Hokkaido University**

# *Natural & manmade water cycle*

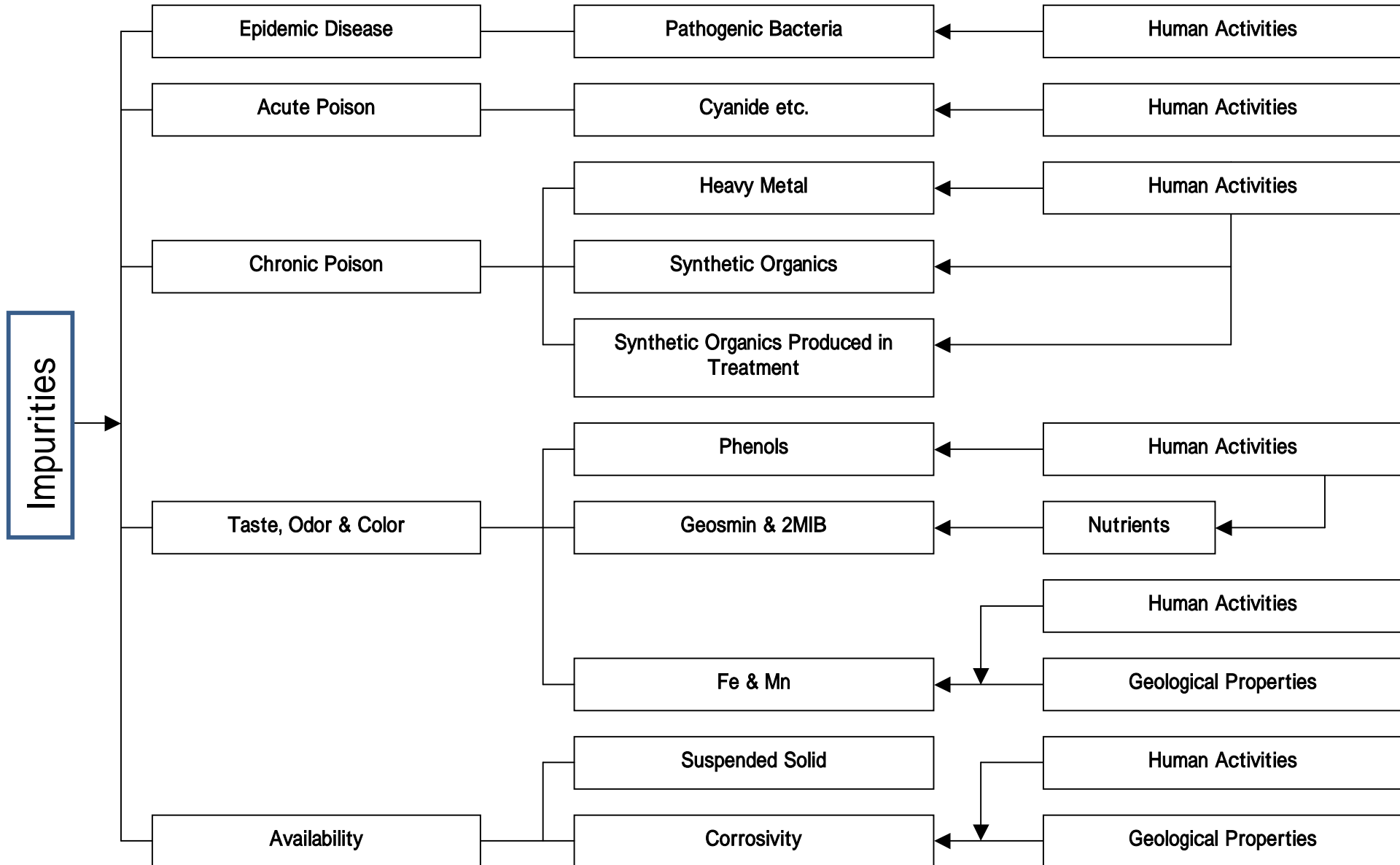


**150 X10<sup>12</sup>m<sup>3</sup> of fresh water resource/ a week**

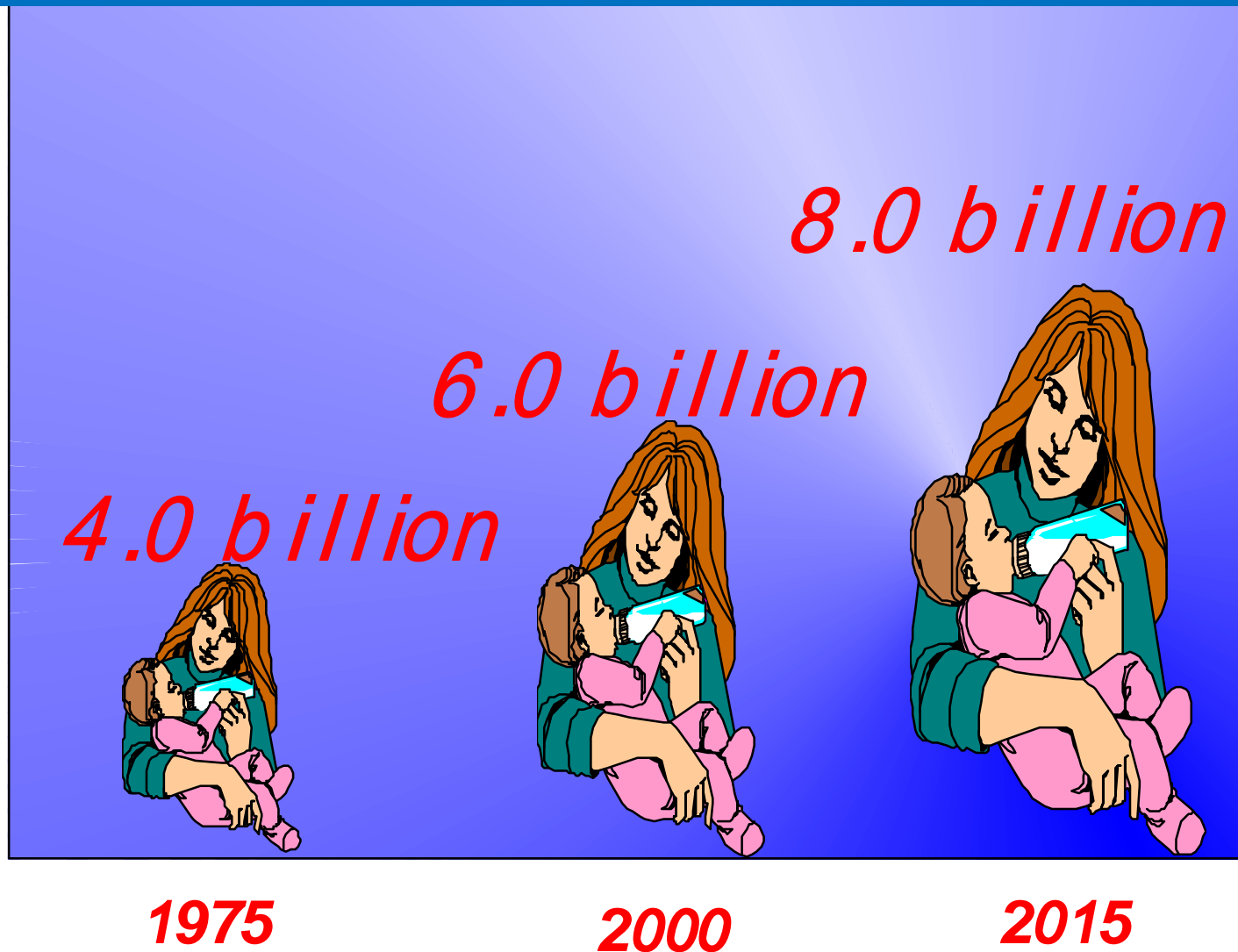
# Surface fresh water is safe or not ?

- 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

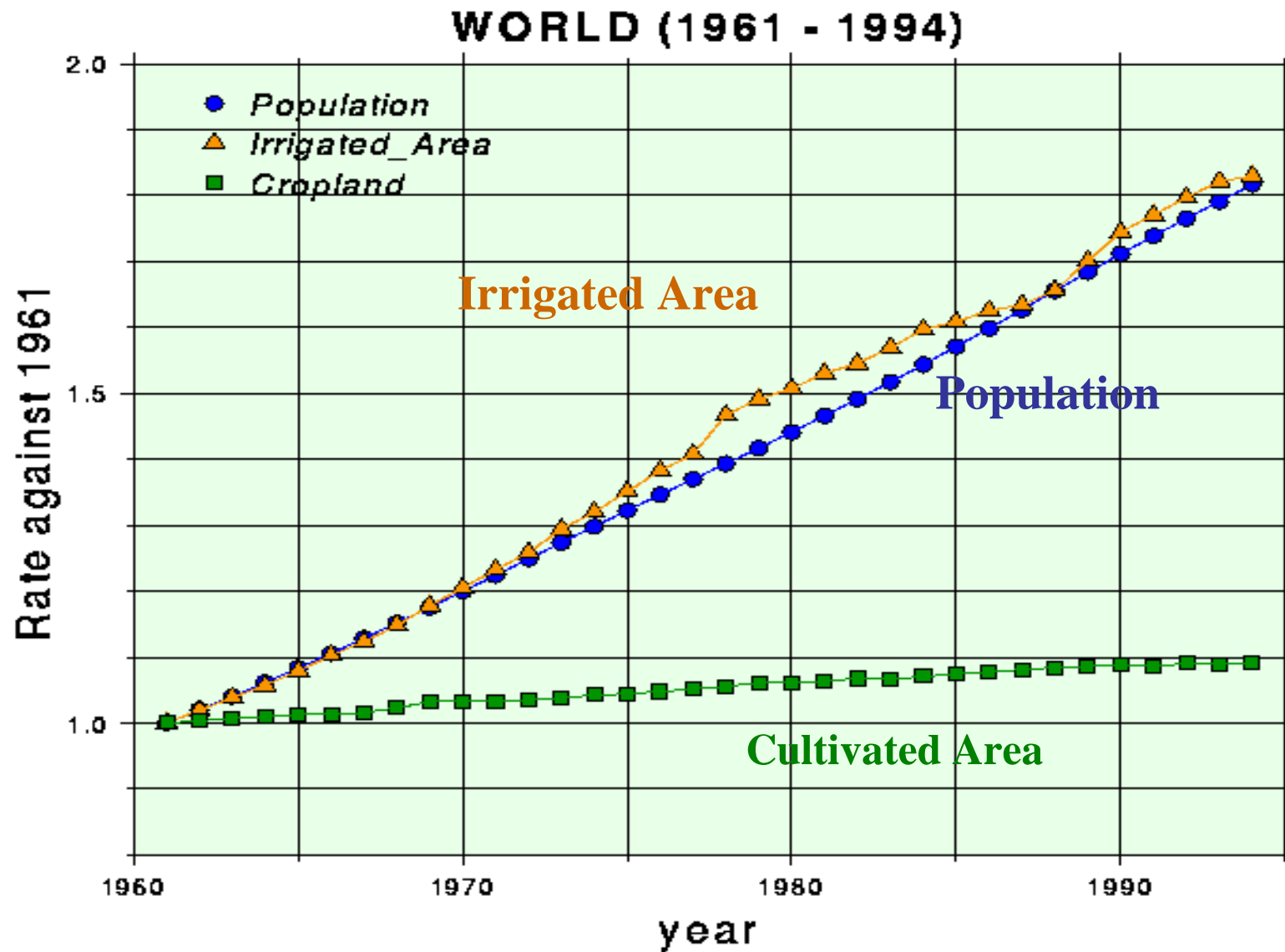


# WORLD POPULATION



**We must share  $150 \times 10^{12} \text{m}^3$  of fresh water resource/ a week**

# Demand of irrigation water

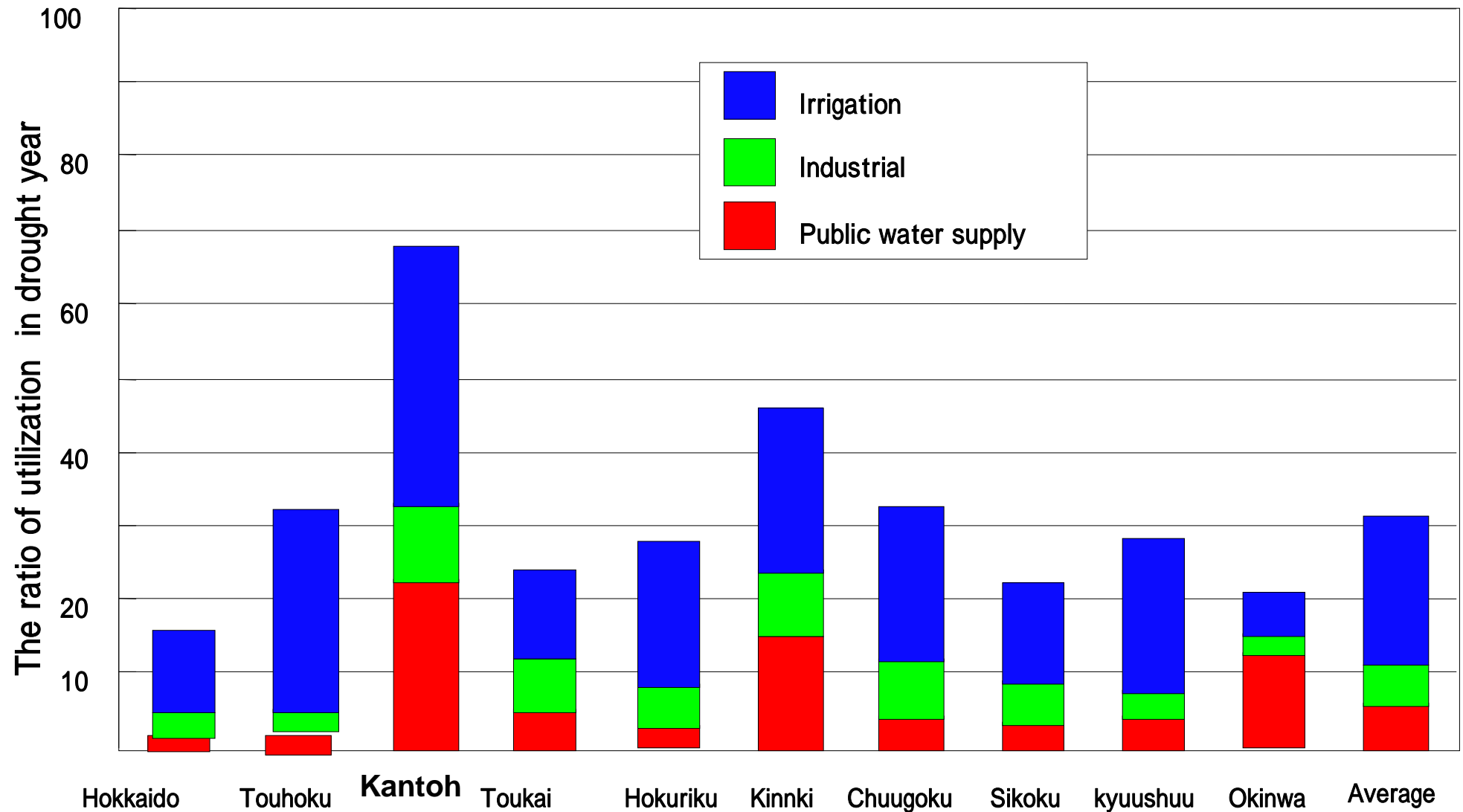


# How much water resource ?

- Average consumption of water per person per day is 250 liters,
- Total consumption are about 90m<sup>3</sup>/year
- The used water becomes the treated water of BOD 20 mg L<sup>-1</sup> when it is treated by biological wastewater treatment process.
- In order to reduce the BOD to about 4 mg L<sup>-1</sup> 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<sup>3</sup>
- Total demand 450m<sup>3</sup> cpy



# Areal Distribution of water resource utilization



# Water resource in China (m<sup>3</sup>/CpY)

Region	Beijing	Tianjin	Hebri	Henan	Shandong	Shanxi
Water	3 2 9	1 5 3	3 6 3	4 4 1	3 8 1	4 5 6

**Water resource of Japan is about 1 5 0 0 m<sup>3</sup>/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:  $6\text{m}^3/\text{sec}$ .

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

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# *John Snow*

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

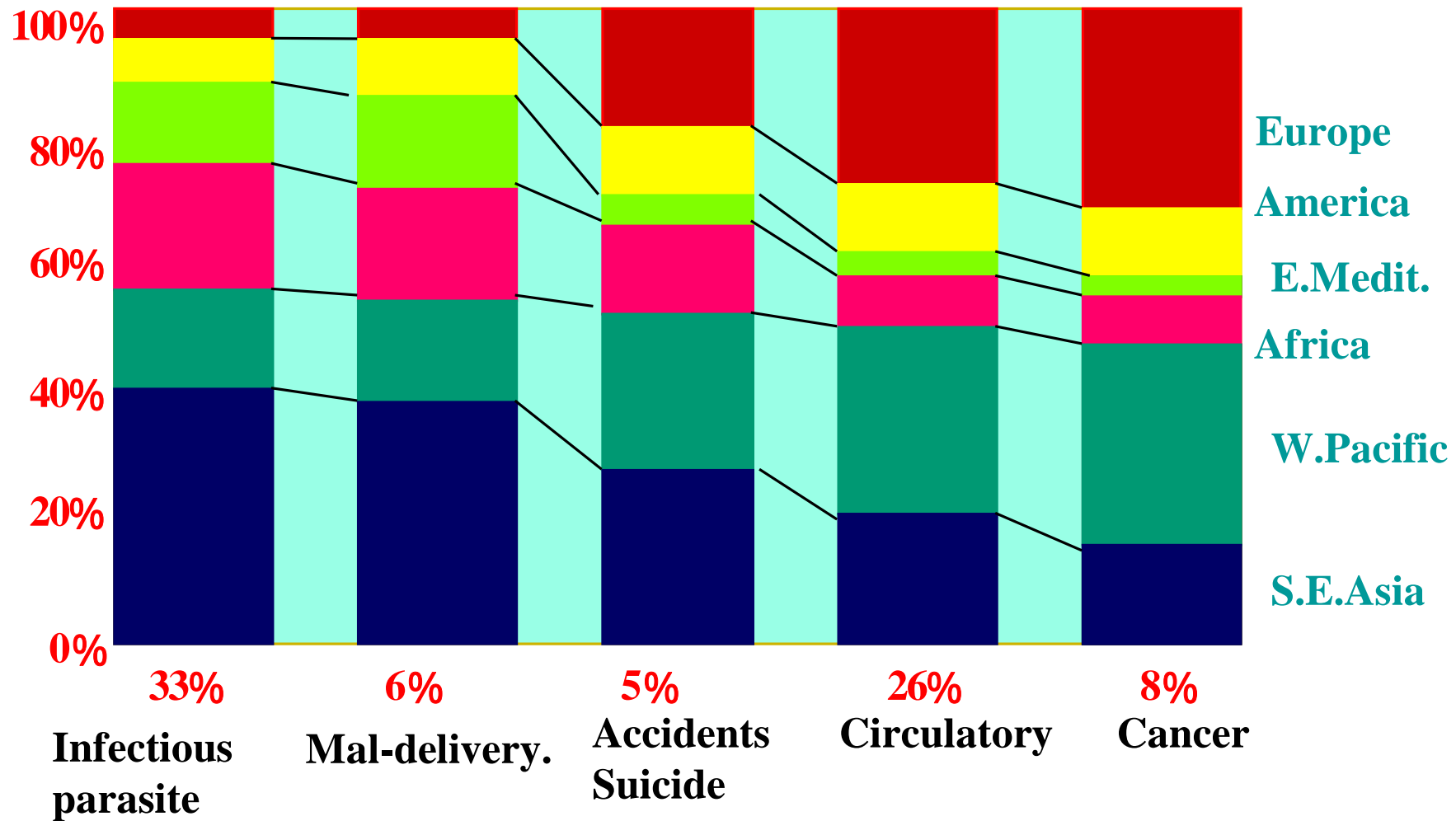
**1855**

**Statistical verification**

- *Cholera and water treatment*

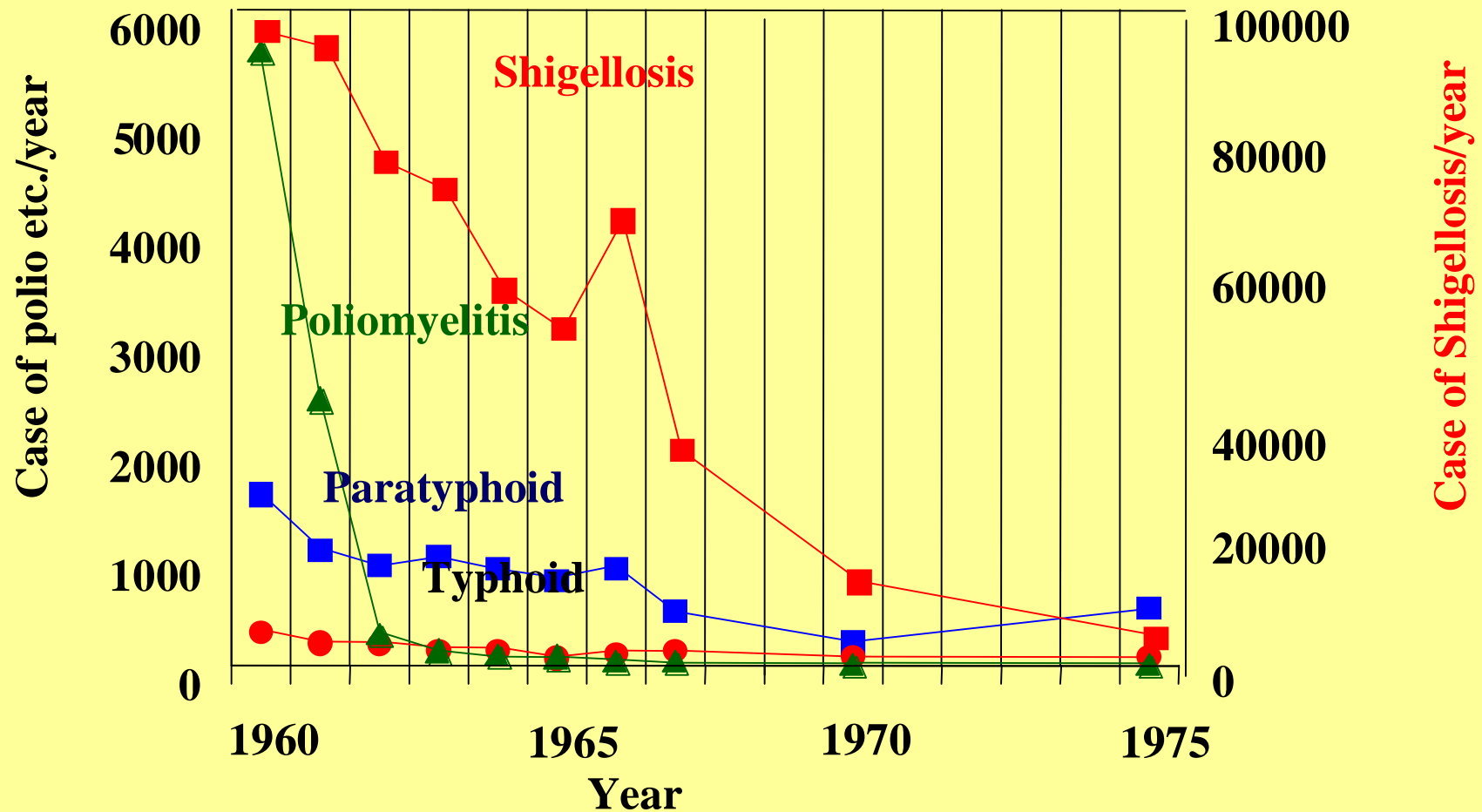


# Regional differences of death of cause

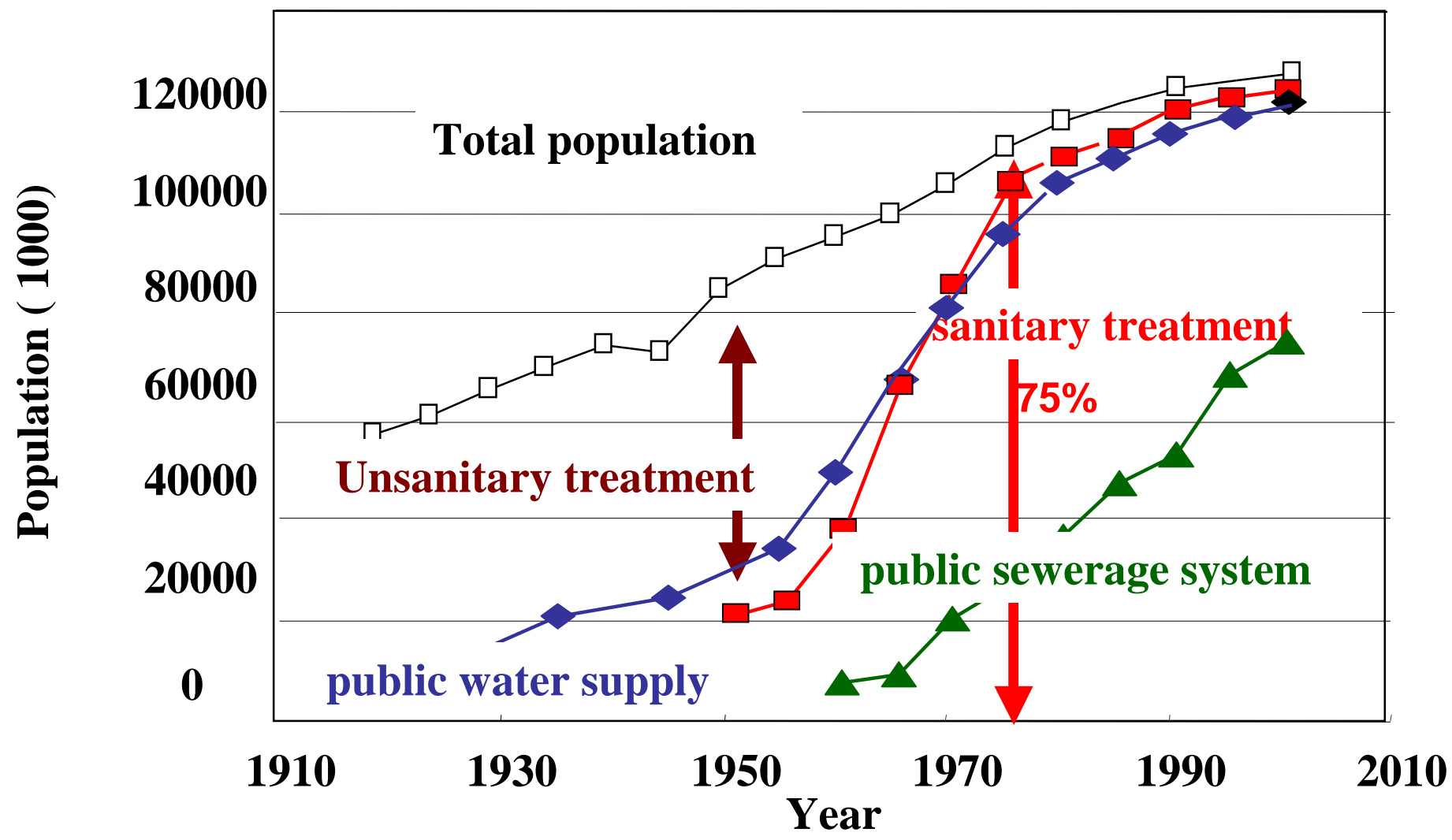


# Feces - oral route infectious disease in 1960-1975

1960



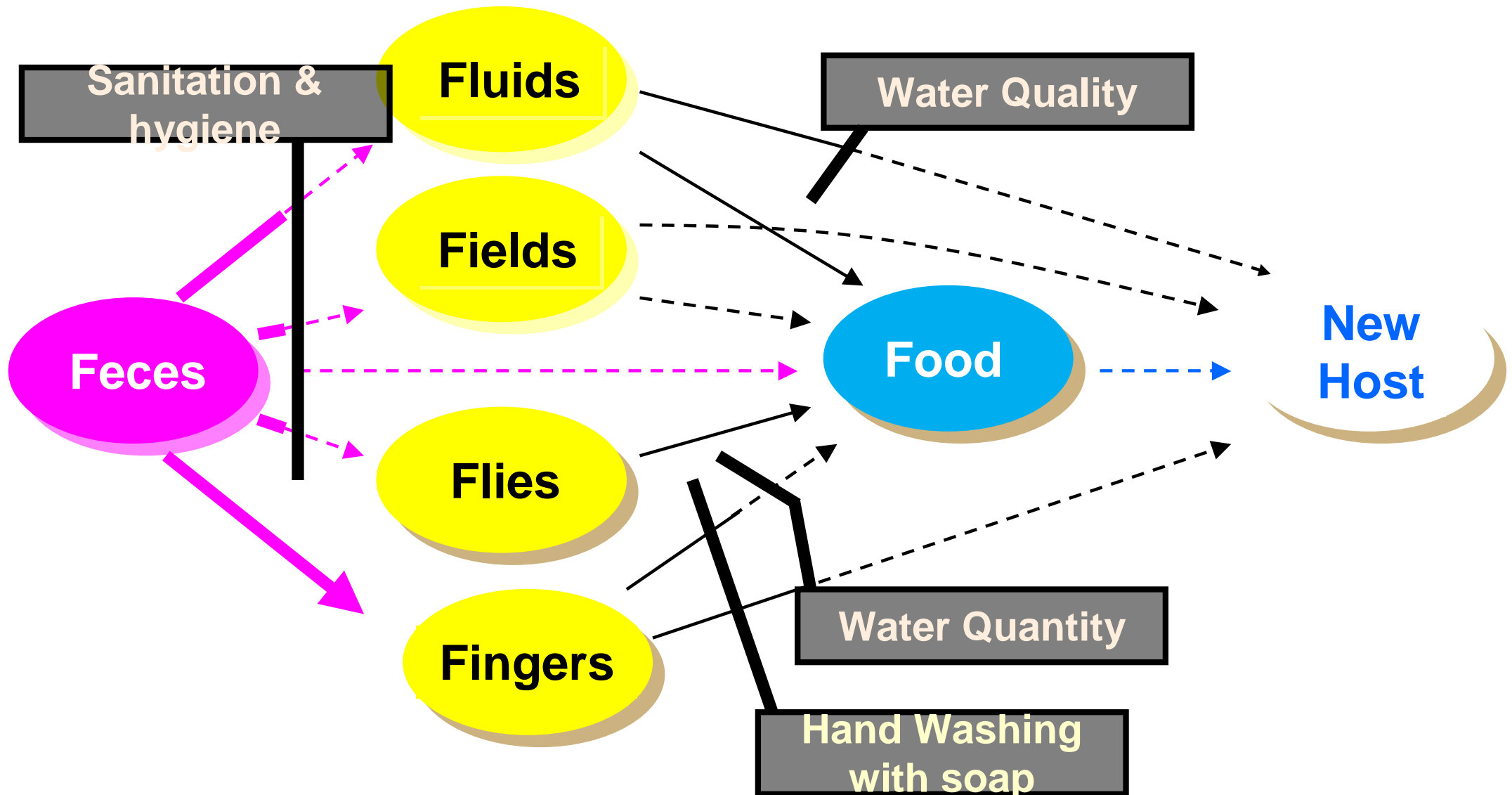
# Development of water supply and sanitation





# 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





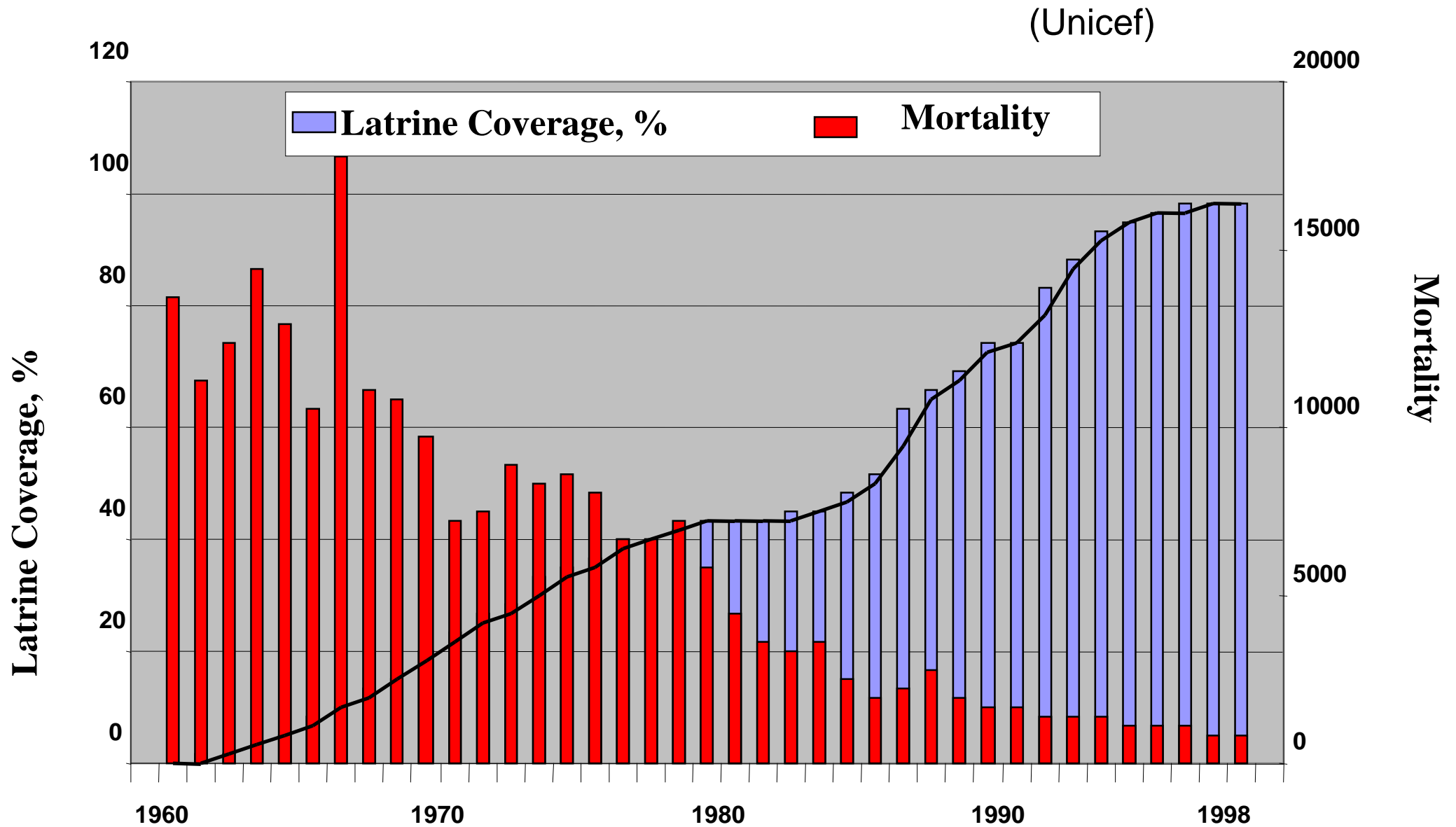
**Malnutrition &  
stunting**

**Lower IQ**

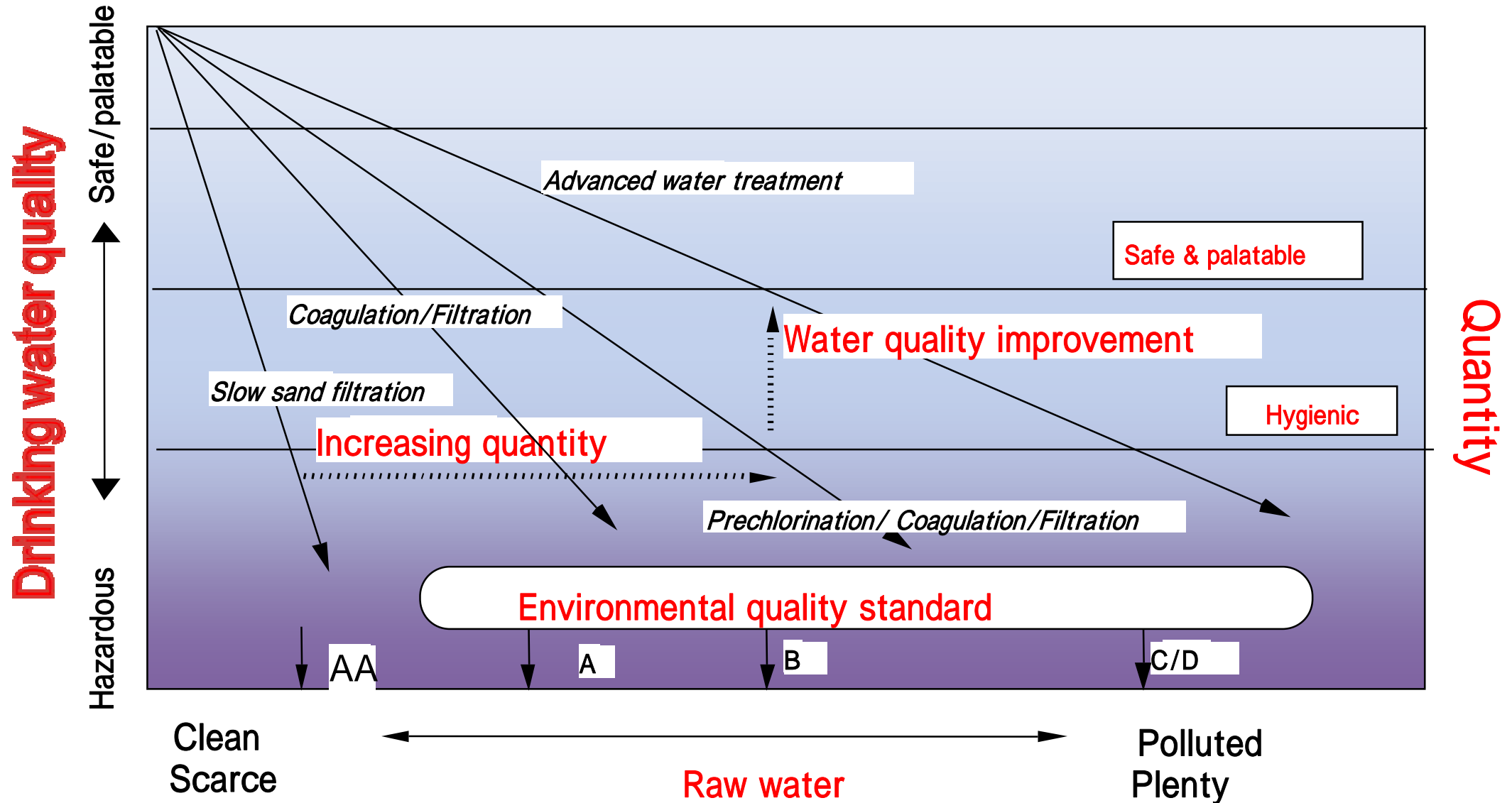
**Shorter body  
height**

**Anemia -  
contributing to  
maternal  
mortality**

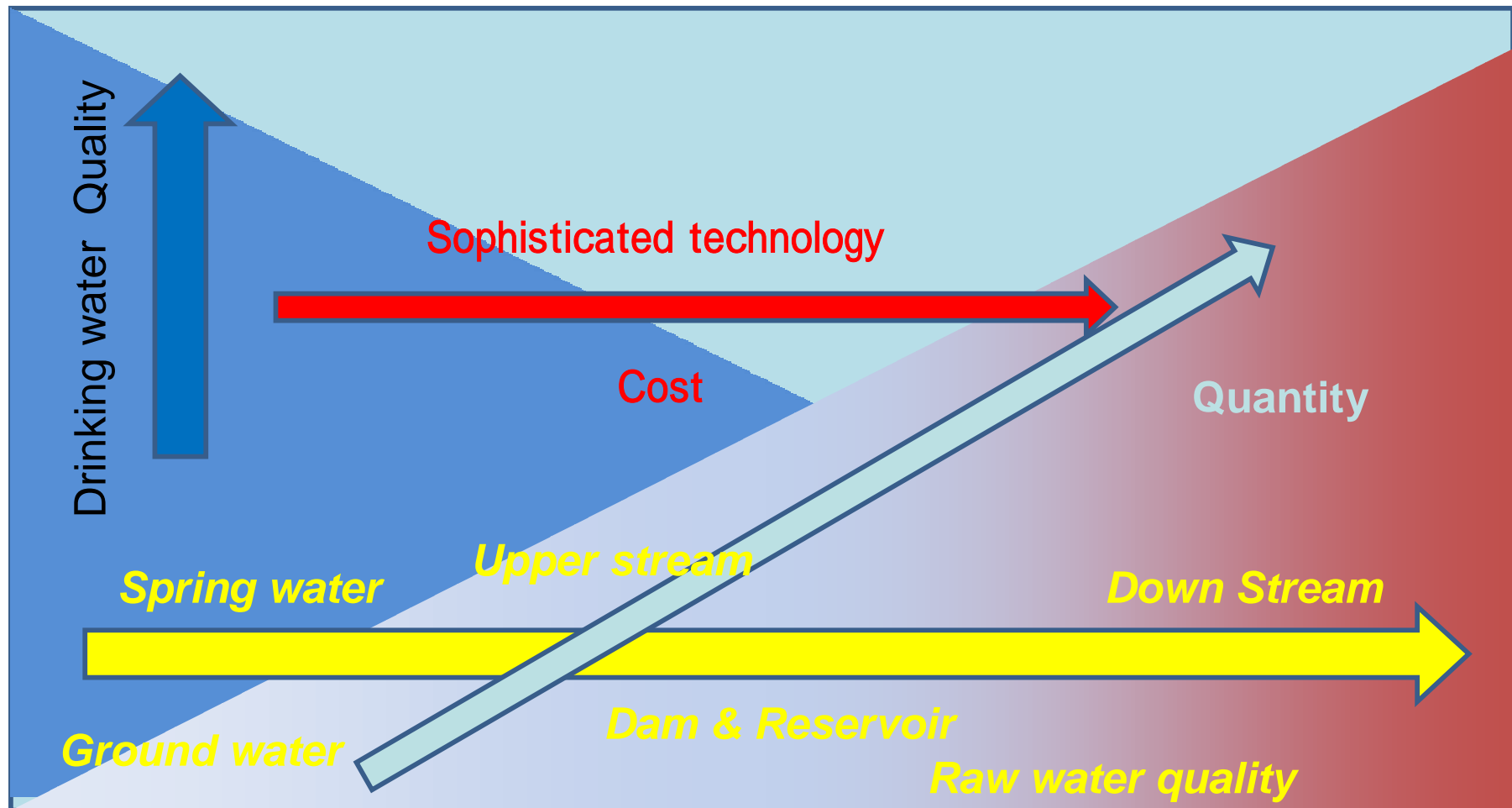
# Universal Sanitation - Thailand



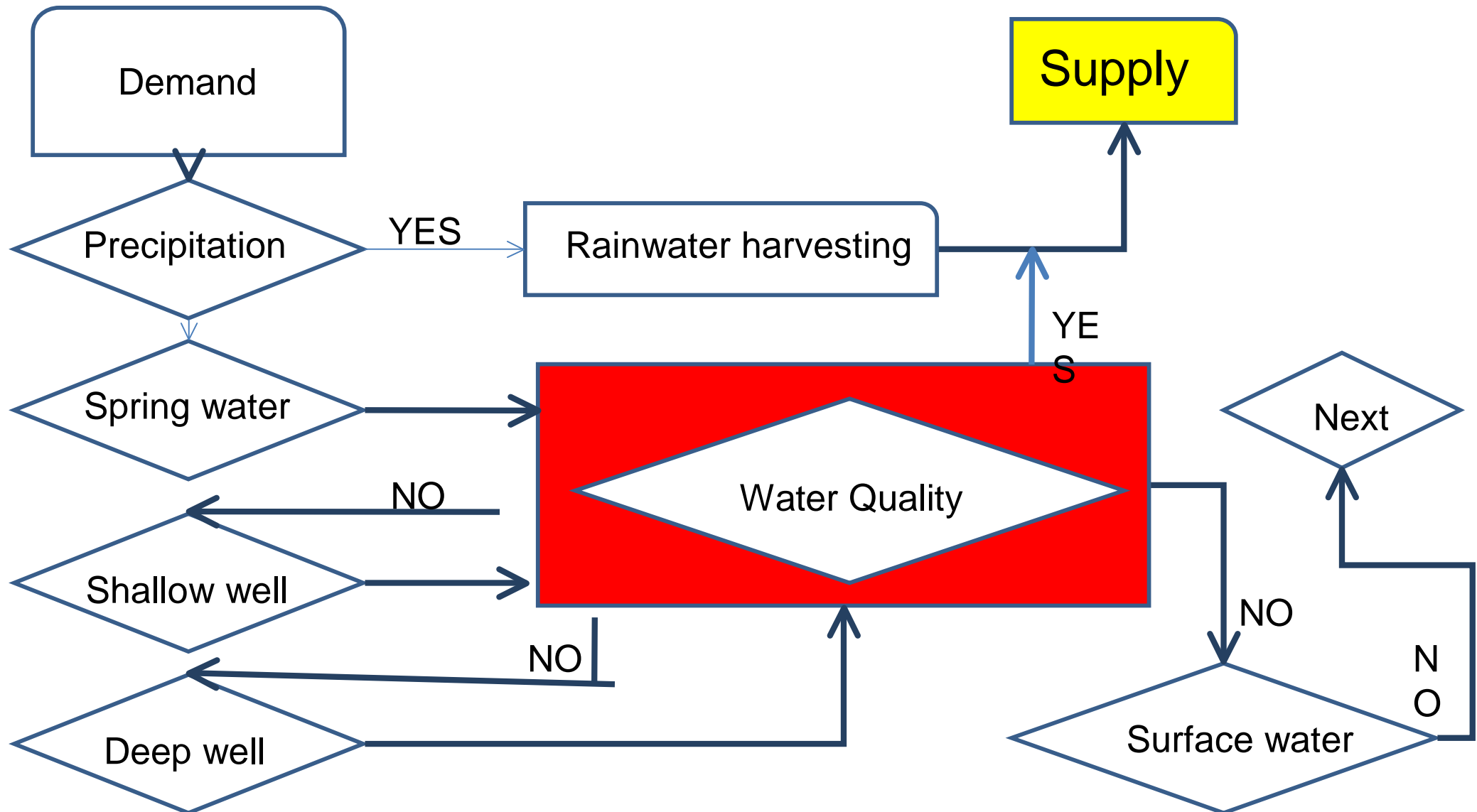
# Water treatment system and water quality



# Selection of water purification technology

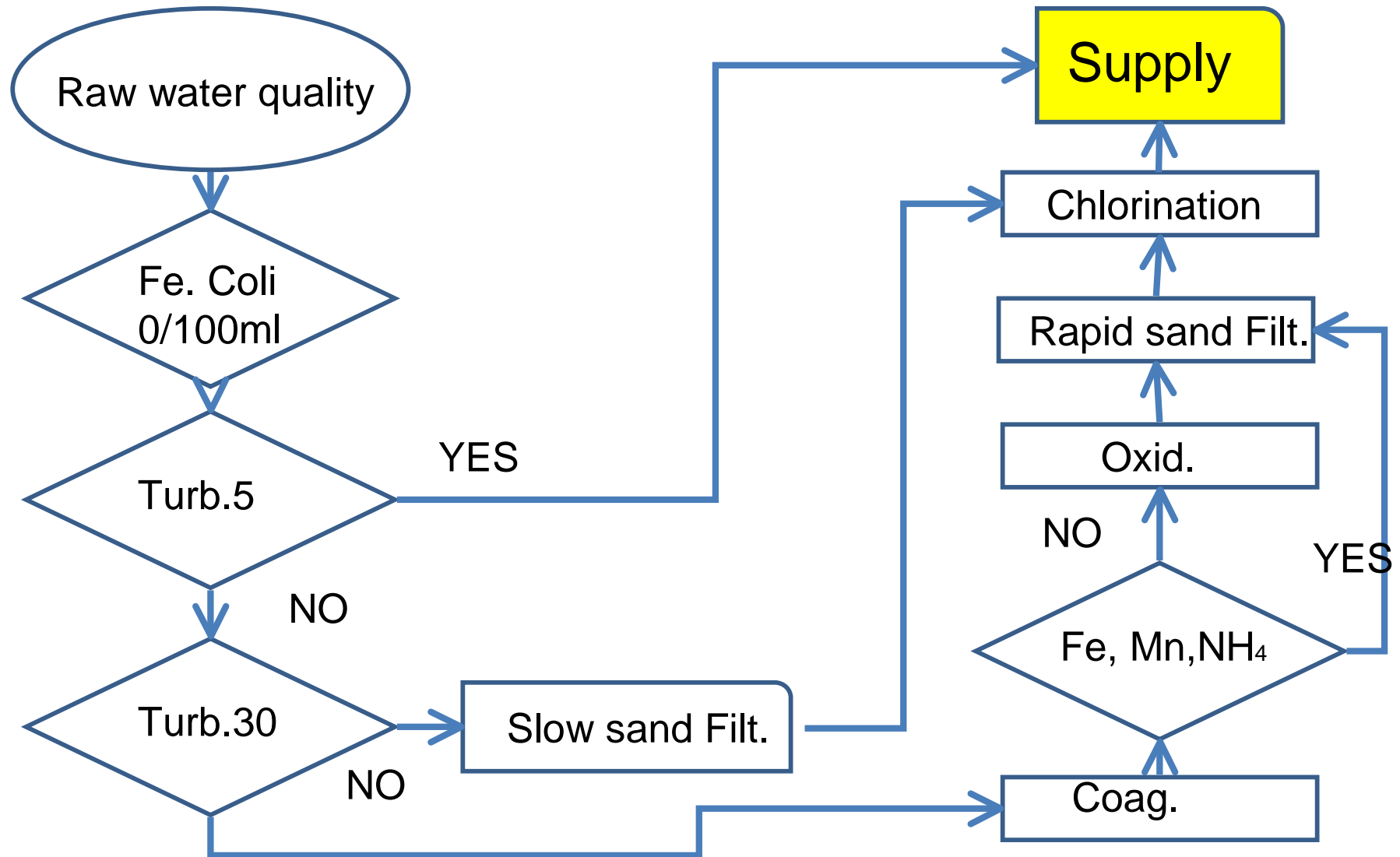


# Cascadian Selection of water system





# Selection of system for surface water





## 管道直饮水部分业绩

1	烟台莱山区	莱山区	住宅	4000户
2	莱山区	莱山区	住宅	4000户
3	烟台莱山区	莱山区	住宅	4000户
4	广州华林广场	华林广场	住宅	4000户
5	深圳南山区	南山区	住宅	4000户
6	深圳南山区	南山区	住宅	4000户
7	烟台莱山区	莱山区	住宅	4000户
8	烟台莱山区	莱山区	住宅	4000户
9	烟台莱山区	莱山区	住宅	4000户
10	烟台莱山区	莱山区	住宅	4000户
11	烟台莱山区	莱山区	住宅	4000户
12	烟台莱山区	莱山区	住宅	4000户
13	烟台莱山区	莱山区	住宅	4000户
14	烟台莱山区	莱山区	住宅	4000户
15	烟台莱山区	莱山区	住宅	4000户
16	烟台莱山区	莱山区	住宅	4000户
17	烟台莱山区	莱山区	住宅	4000户
18	烟台莱山区	莱山区	住宅	4000户
19	烟台莱山区	莱山区	住宅	4000户
20	烟台莱山区	莱山区	住宅	4000户
21	烟台莱山区	莱山区	住宅	4000户
22	烟台莱山区	莱山区	住宅	4000户

· 管道直饮水  
· 中水·生活污水·医院污水  
· 工业废水·超纯水  
· 变频加压节能技术

## 生活污水及医院污水部分业绩

[illegible]

進口款水櫃



节时取水



管道直饮水典型工艺



深圳市18M公司生活  
污水处理工程

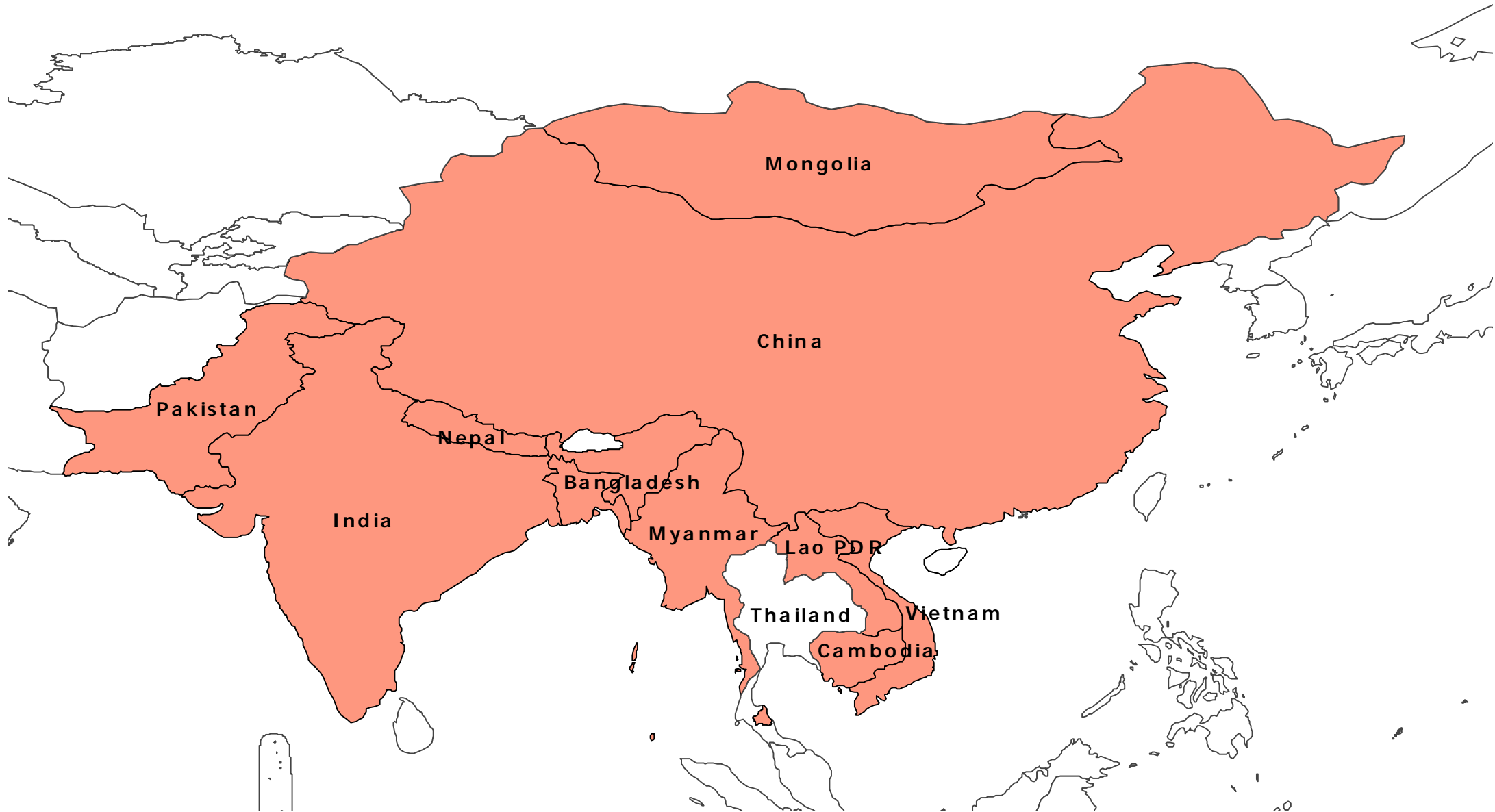


深圳金隆漂染公司废水  
处理工程图

WWW.SZHENY.COM

公司地址：深圳市南山区麒麟路水务集团南山大楼9F 电话：（0755）2651 0999 26510966 传真：（0755）26510822

# 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”*





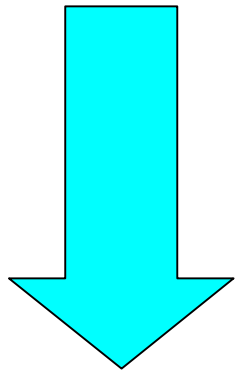
# Arsenic

- 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**

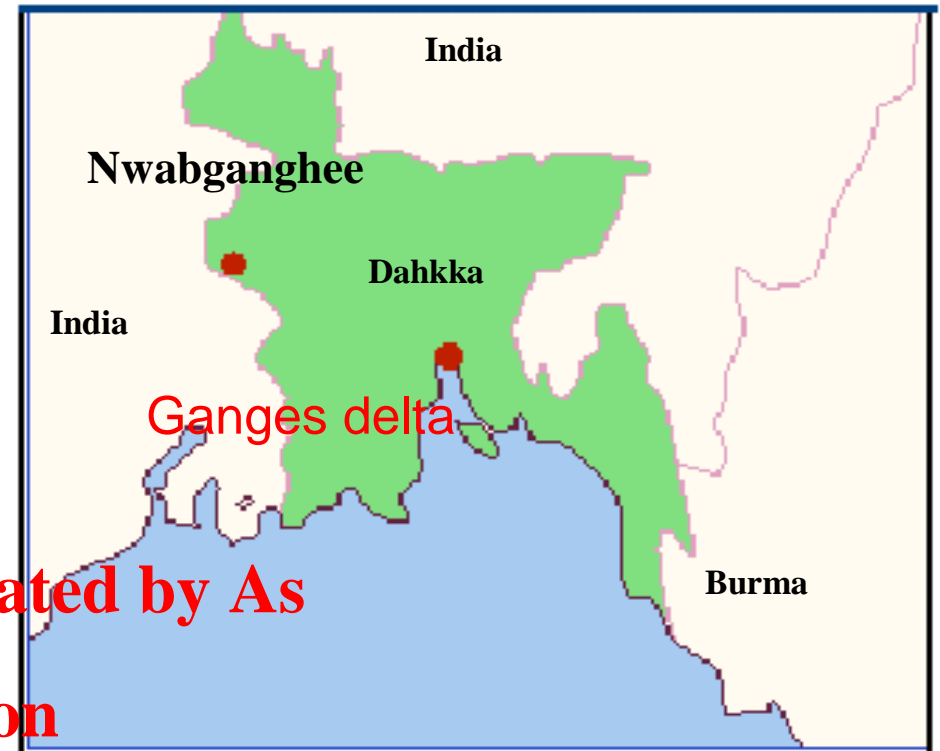


**Many tube well have developed**

**Decreasing infant & child mortality**

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

**Excessive use of ground water irrigation**

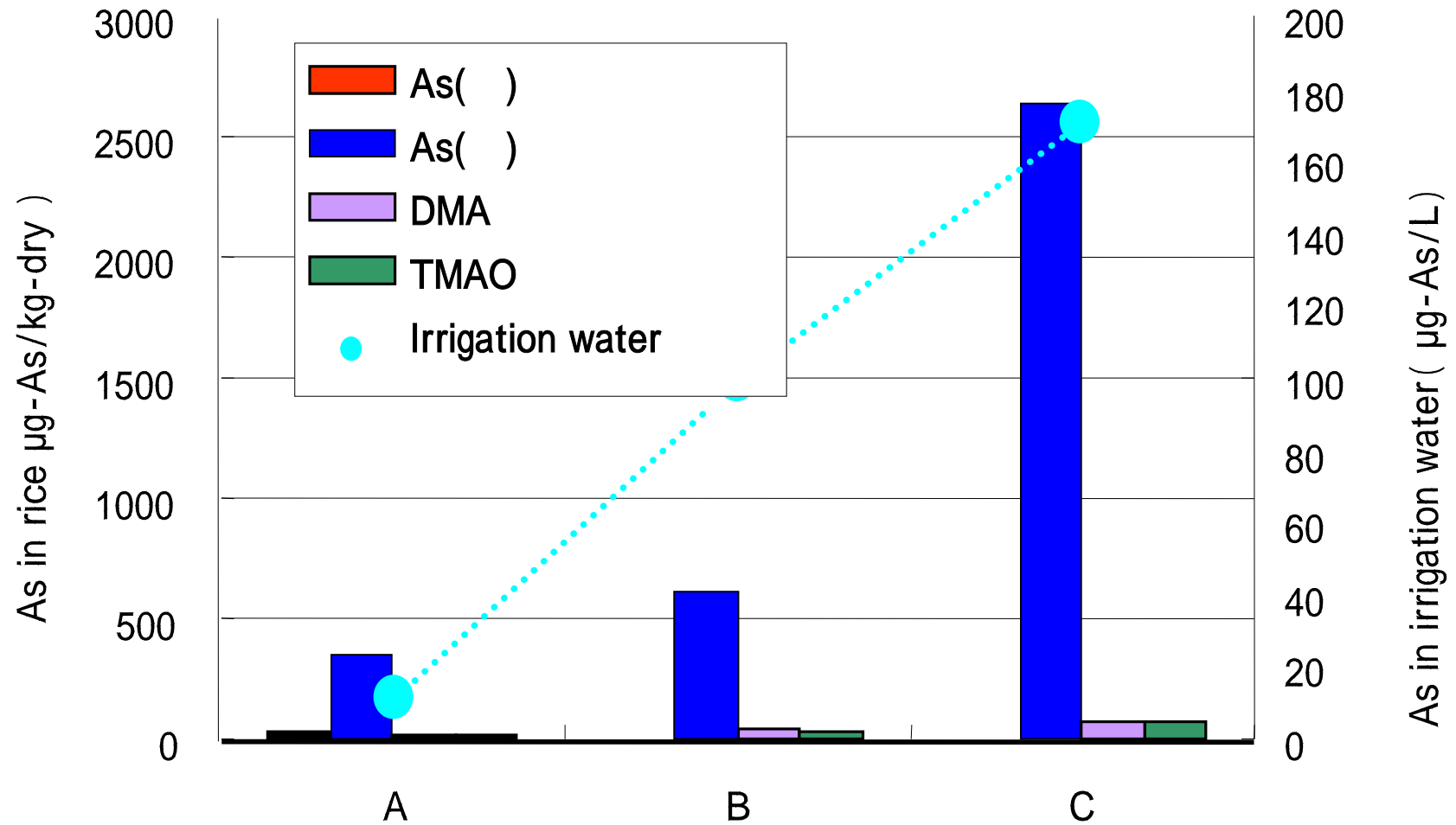


# Tubewell & Dugwell

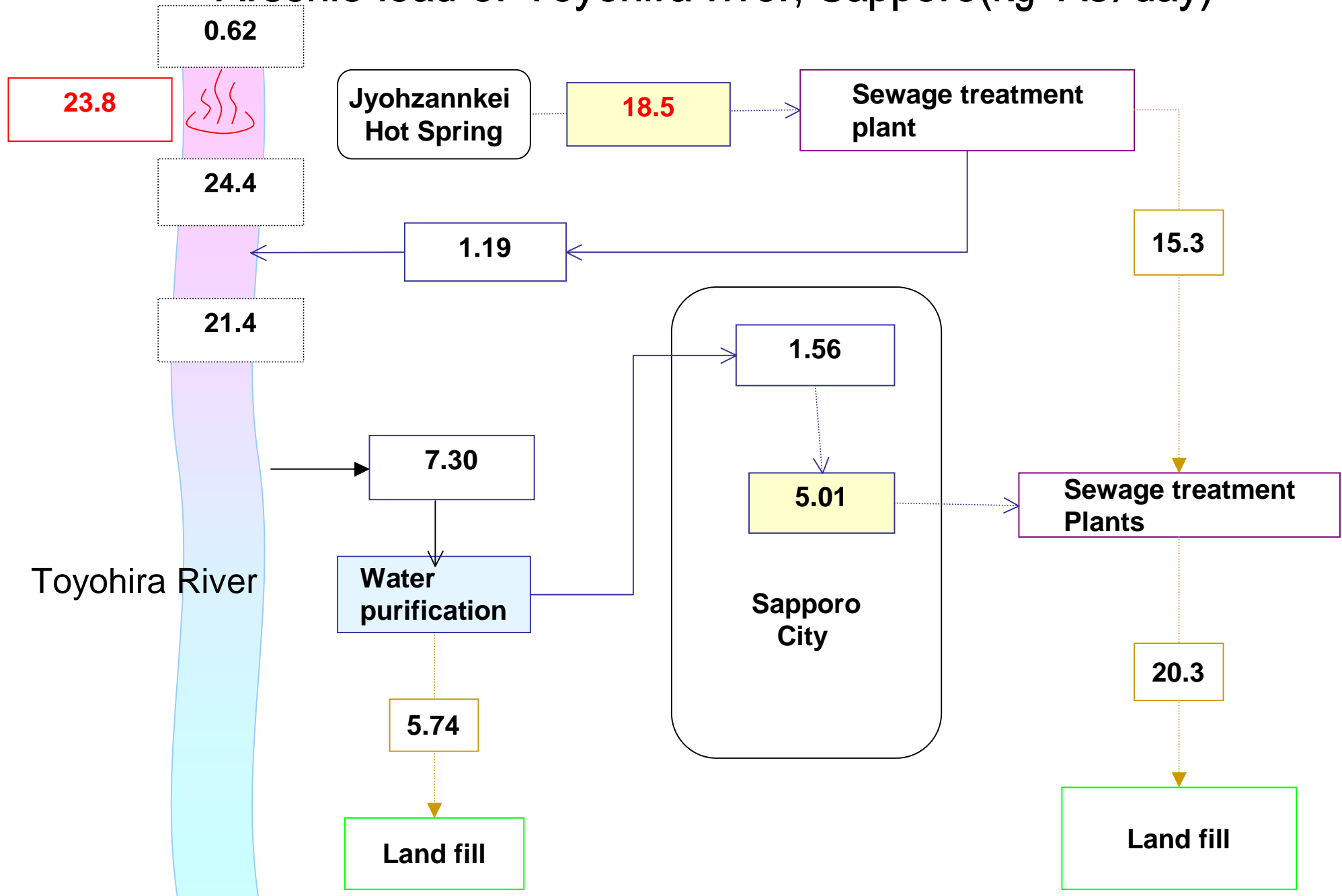




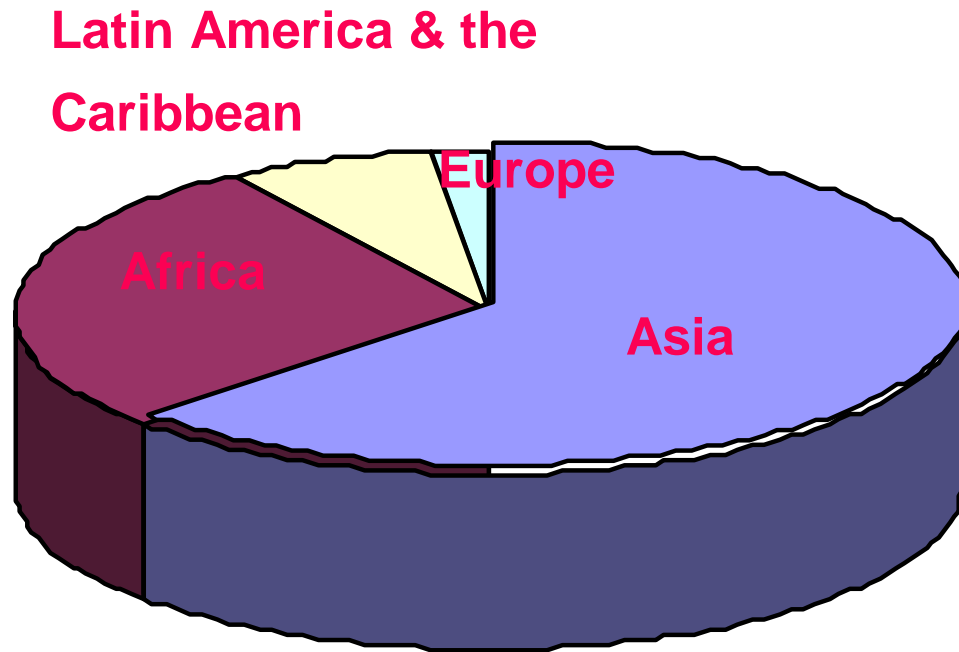
# As concentration and rice



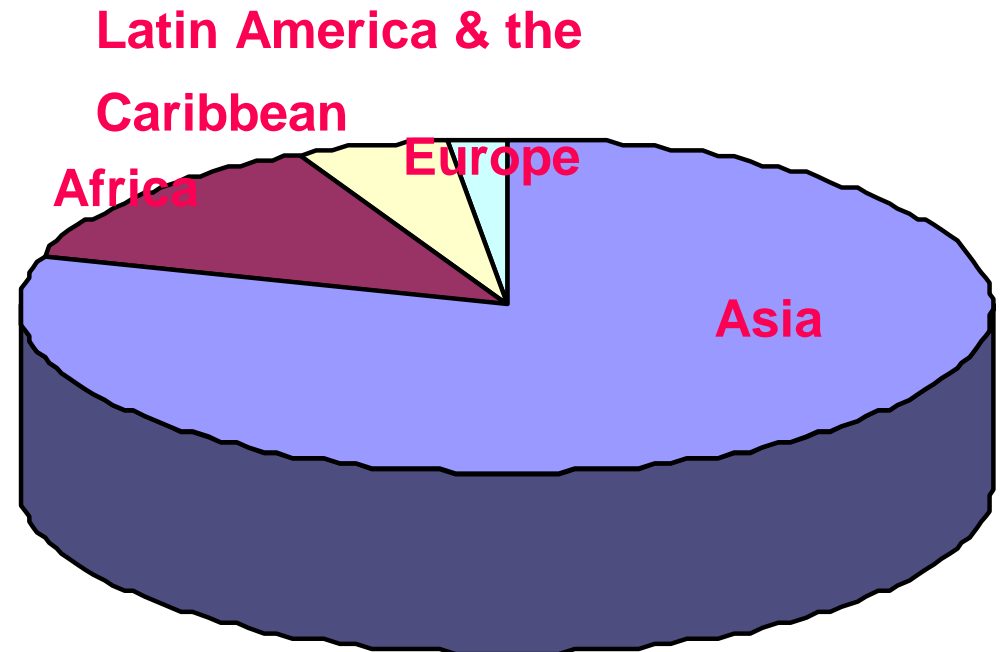
# Arsenic load of Toyohira river, Sapporo(kg-As/day)



# What are the constraints for safety water and Sanitation

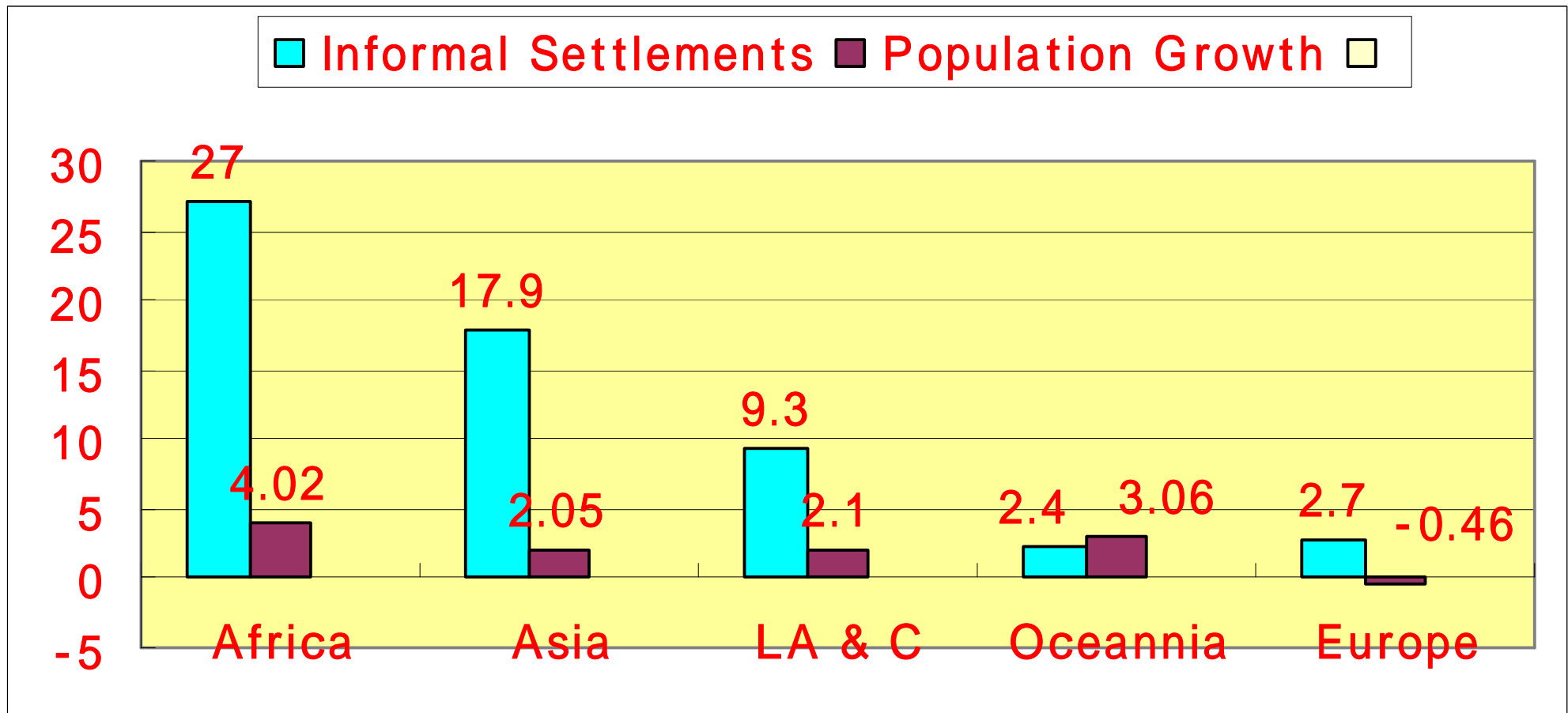


**Water Supply**  
**1.1 billion**

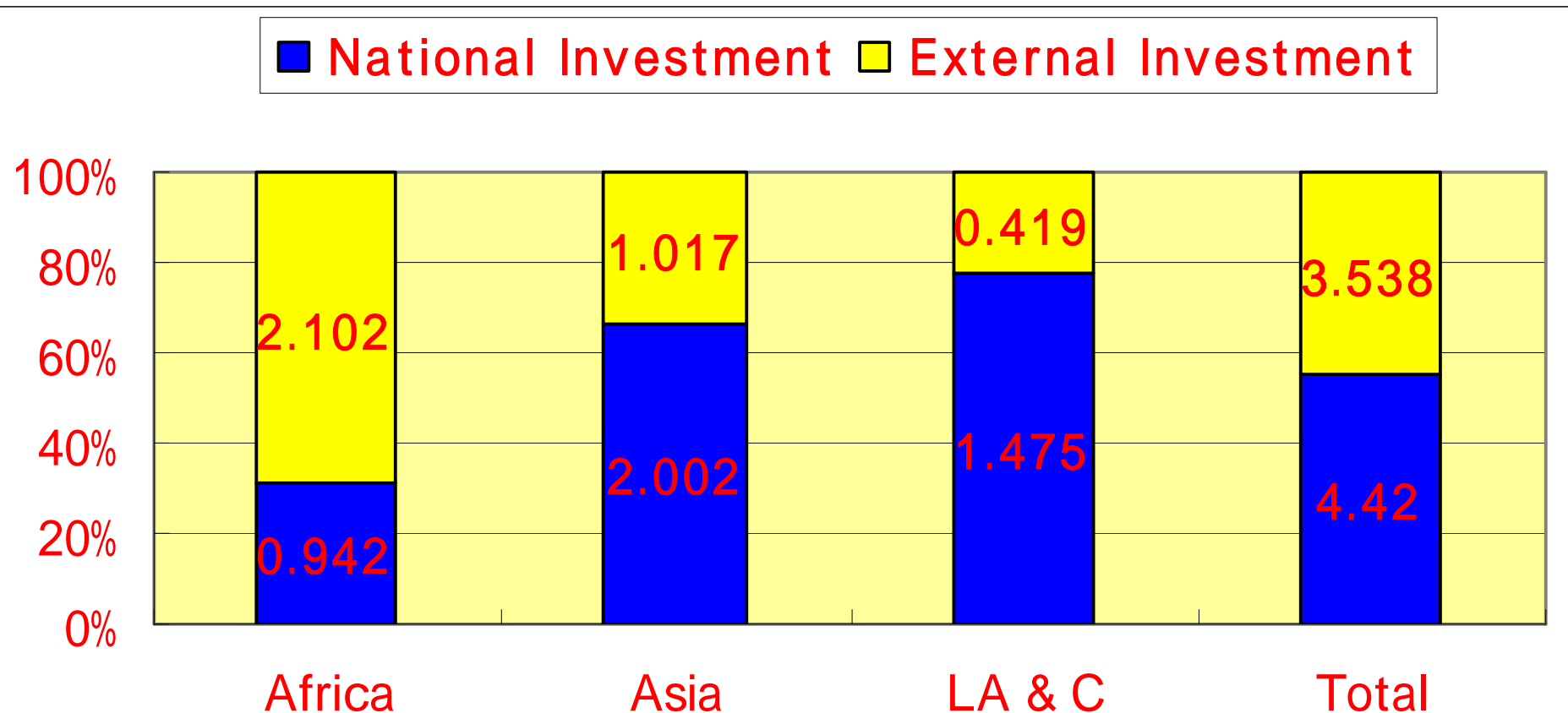


**Sanitation**  
**2.4 billion**

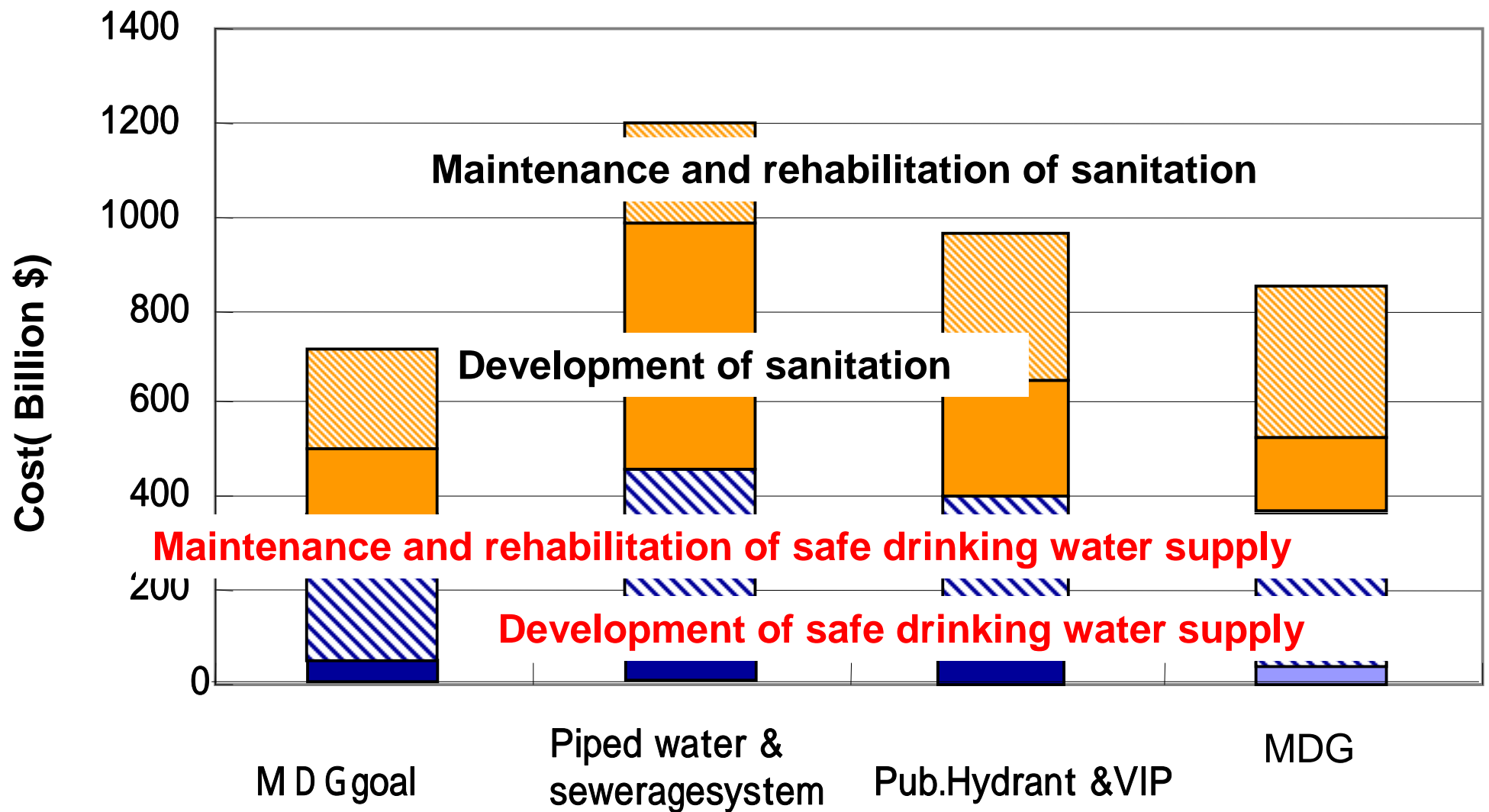
# *Population growth rates and proportion on informal settlements in urban area*



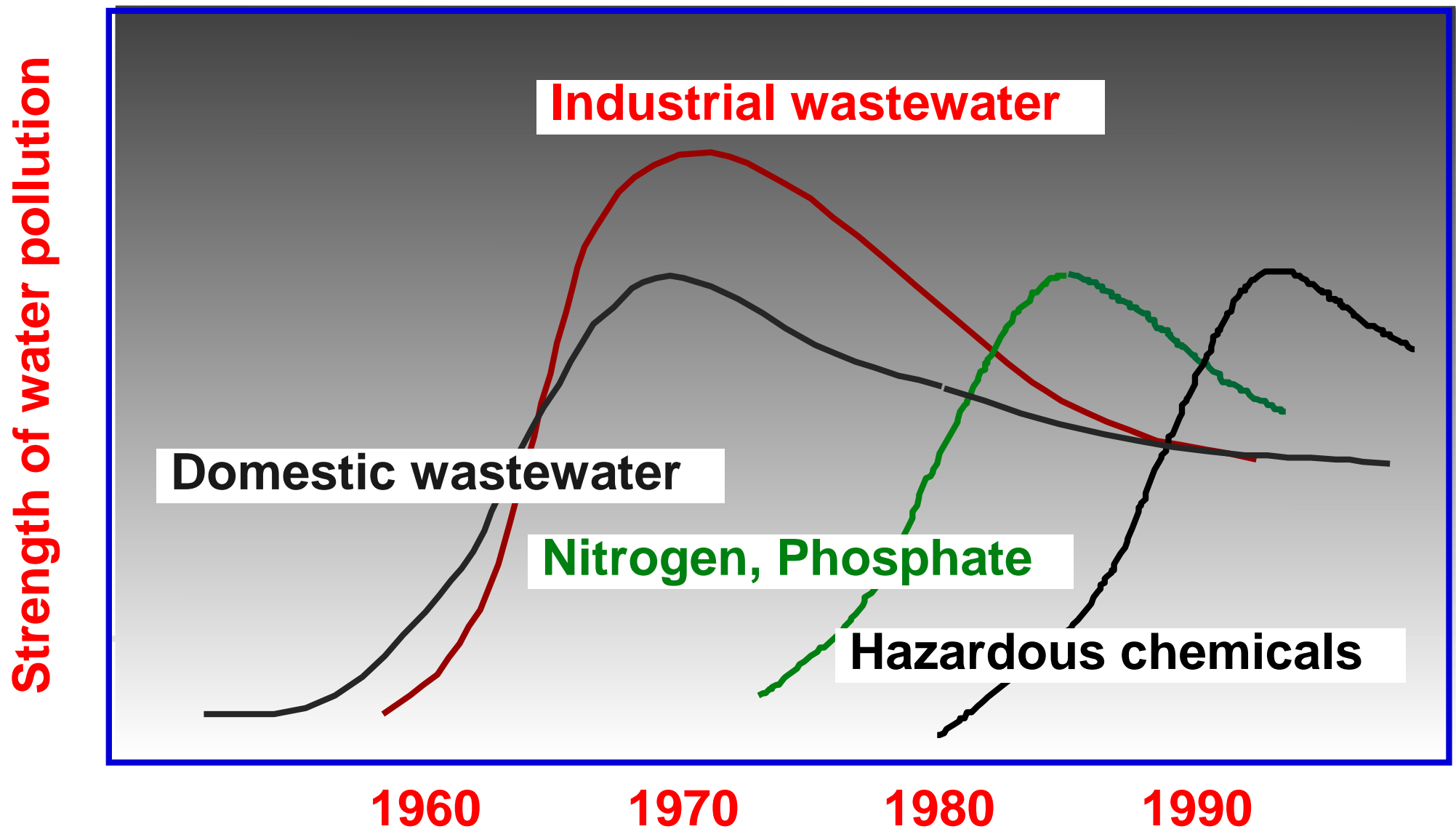
# Annual investment in urban water supply



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

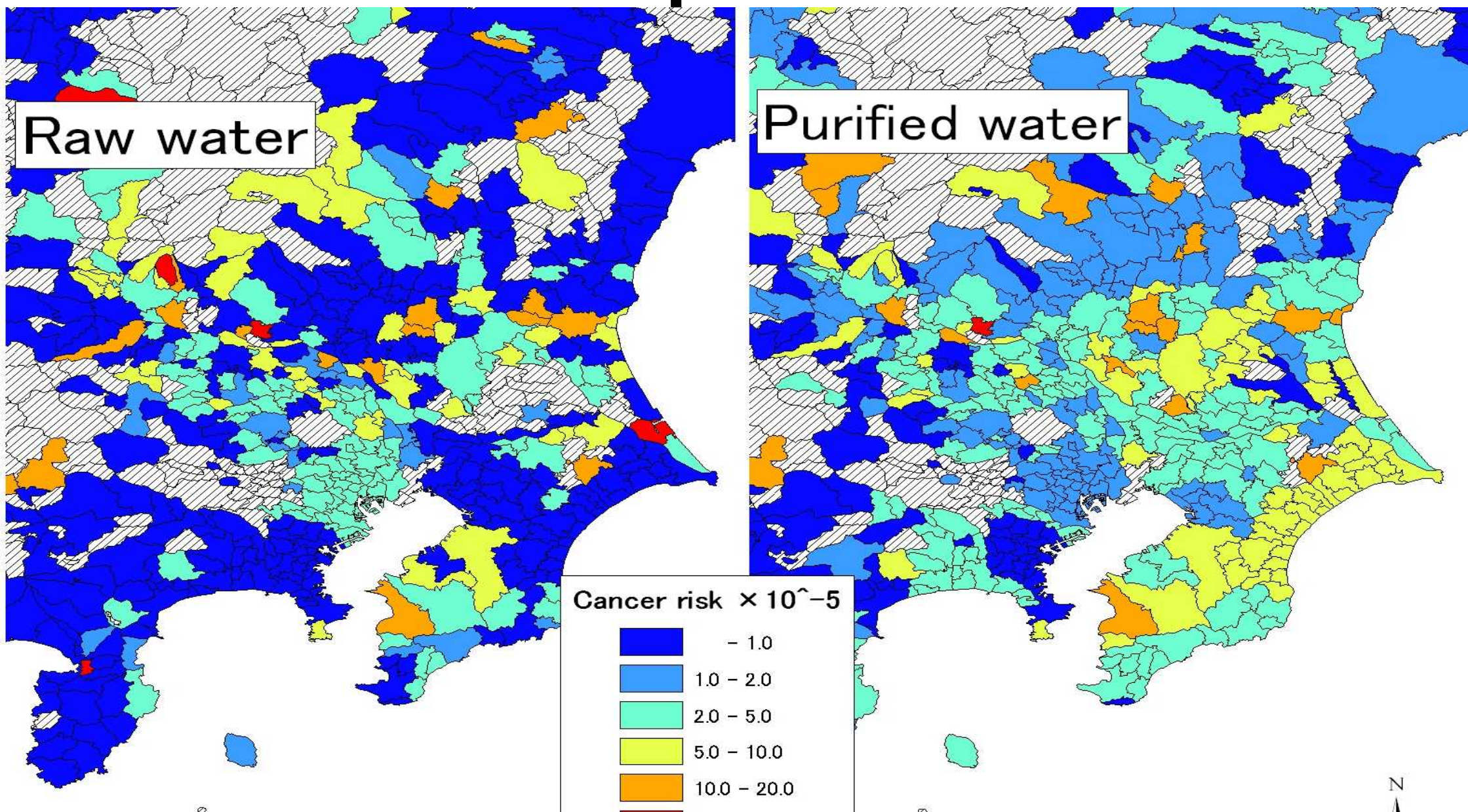


# Water pollution aspects of industrialized countries



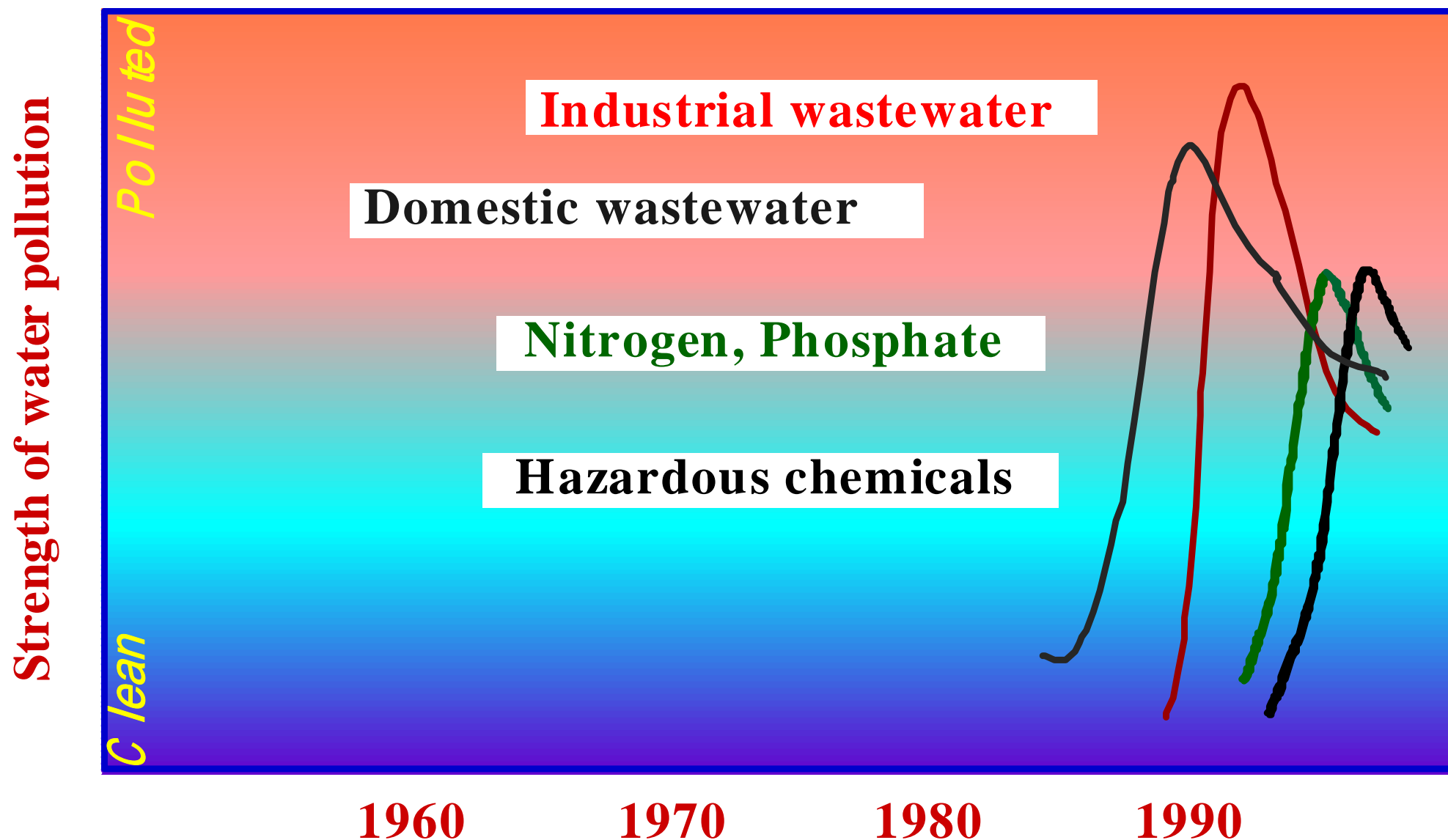


# Distribution of Cancer Risk of Tap Water in Metropolitan Area

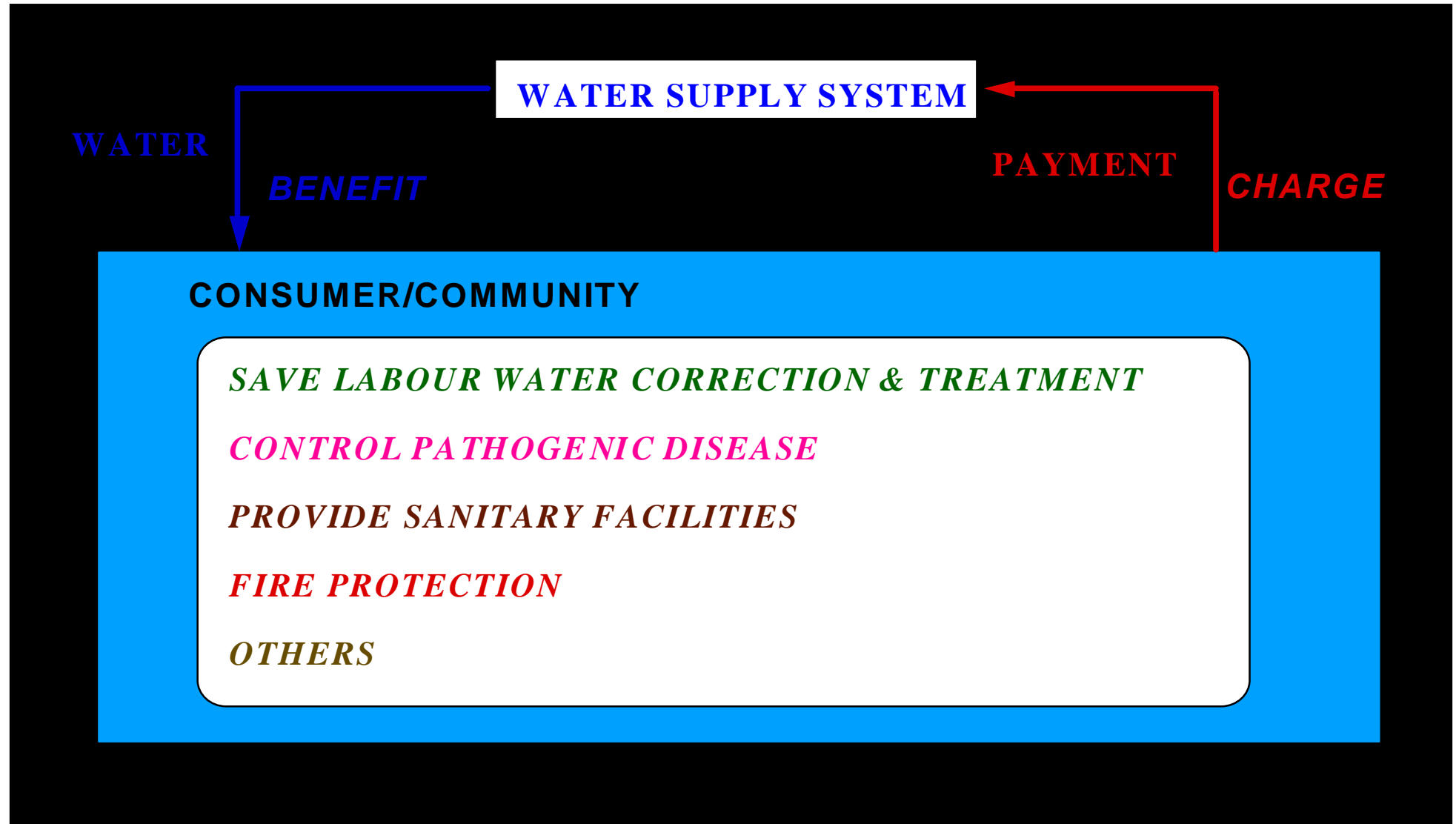




# Current situation in developing countries



# 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**