A global view on water reuse and sanitation

from scarcity and waste via reuse and proper sanitation to sustainability

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Learning objective:

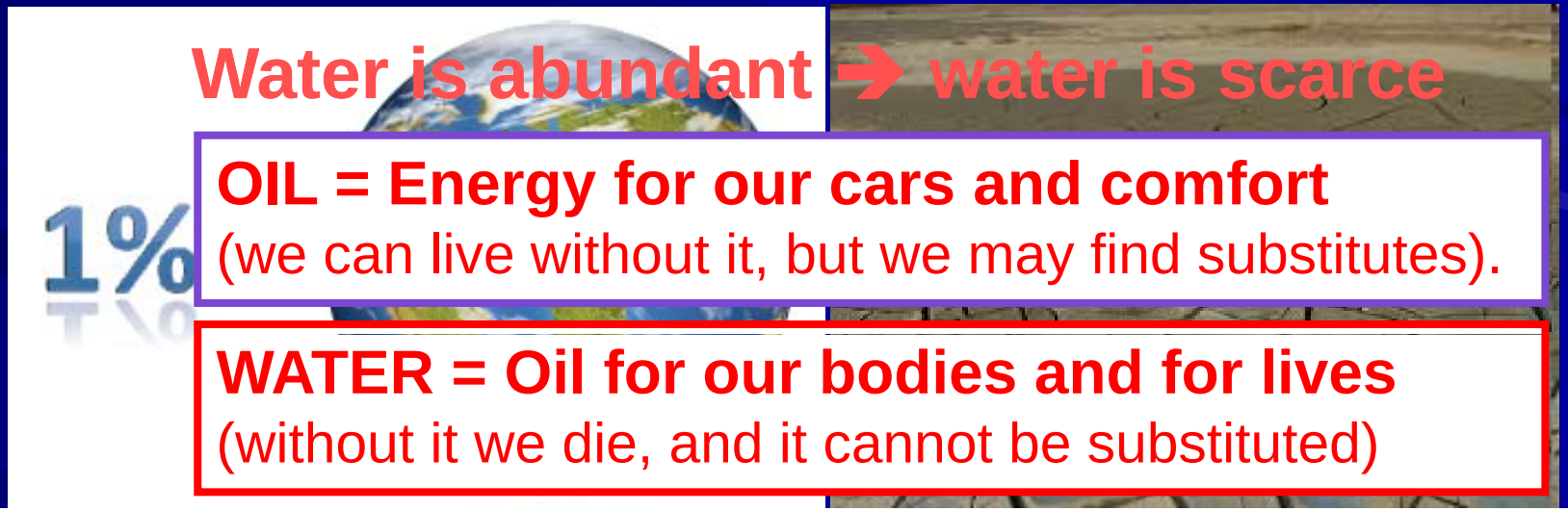
To learn about the roles of water reuse and sanitation

Contents:

- General background
- Water scarcity
- Alternatives for overcoming water scarcity
- Water sanitation and hygiene problems
- Proper sanitation

General Background:
Water – a basic human need

- Vital needs: Food, water
  - ~75% of human body
  - Water is elementary for life
- Non-vital needs:
  - Spiritual and cultural
  - Recreational
  - Transport
  - Energy



Water is abundant ➔ water is scarce

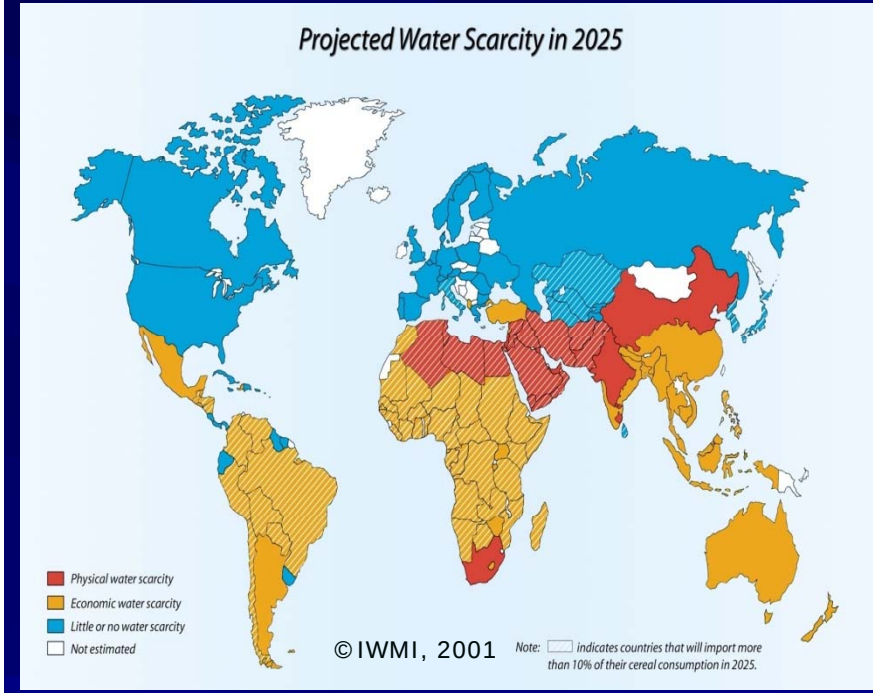
OIL = Energy for our cars and comfort
(we can live without it, but we may find substitutes).

WATER = Oil for our bodies and for lives
(without it we die, and it cannot be substituted)

Global Water Shortage: Water Scarcity

1 billion people don't have access to water

- **What is Water Scarcity?**



- **The threshold for 'water stress' is a per capita availability of 1700m^3 of water for annual consumption**
- **For 'water scarcity' the threshold per capita is 1000m^3 of water for annual consumption**

- water scarcity is either the lack of enough water (quantity) or lack of access to safe water (quality).
- economic scarcity: Water can be found...it simply requires more resources to do it.
  - *Finding a reliable source of safe water is often time consuming and expensive.*
- physical scarcity. The lack of water is a more profound problem. Not enough water is available.

The problem of water scarcity is a growing one. As more people put ever increasing demands on limited supplies, the cost and effort to build or even maintain access to water will increase. And water's importance to political and social stability will only grow with the crisis.

General Background: Local water Issues physical scarcity

- Low rainfall (100-1000mm/yr)
- Unequal rainfall distribution (space, time)
- Cyclic droughts
- Water resources: surface water, groundwater, reclaimed wastewater
- Drawdown of aquifers, sea intrusion

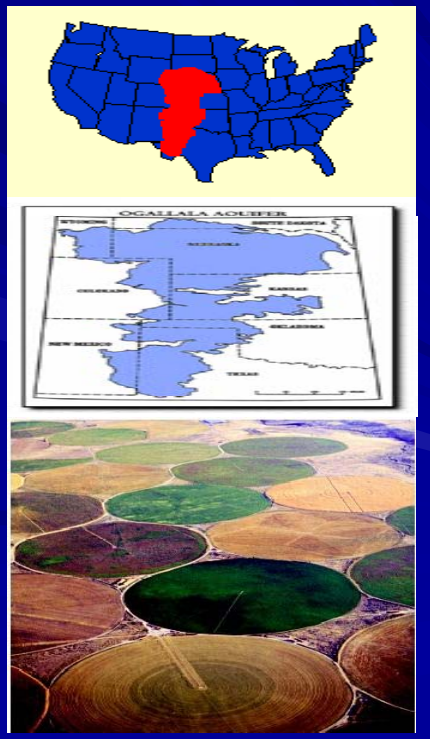
Drought = 干ばつ (Kanbatsu) aquifer = 帯水層 (taisuisoo)

Local water issues

- Taiwan:
  - Unequal distribution of rainfall (floodwaters form typhoons)
  - water pollution from industrial emissions, raw sewage; contamination of drinking water supplies
- Indonesia:
  - Management problems (Deforestation ➔ inundation)
  - Poor quality (including heavy metals)
    - > 100 M lack access to safe water
    - > 70 % reliant on water obtained from potentially contaminated sources.
  - Poor sewerage coverage: 2%
  - No access to toilets in slum areas
- Japan:
  - Quality issues: Minamata disease, Ouch-ouch (itai itai), Osaka-Kyoto water supply, Pharmaceuticals

Indicators/Examples of water scarcity worldwide

- Aral Sea (Central Asia) has almost disappeared (60% less water than in 1989)
- Water resources in Arab countries:
  - Great man-made river in Libya
  - Desalination plants (Arab Gulf) & Reuse projects (TN, Jordan)
- Facts about the Ogallala aquifer (severe drawdown)



Discussion

- Form groups of 4 to 5 students.
- 5 minutes allocated for discussion, then one volunteer from each university will present your thoughts.

- FACTORS INFLUENCING WATER SCARCITY
  - What are the causes of water scarcity?

Factors Influencing Water Scarcity

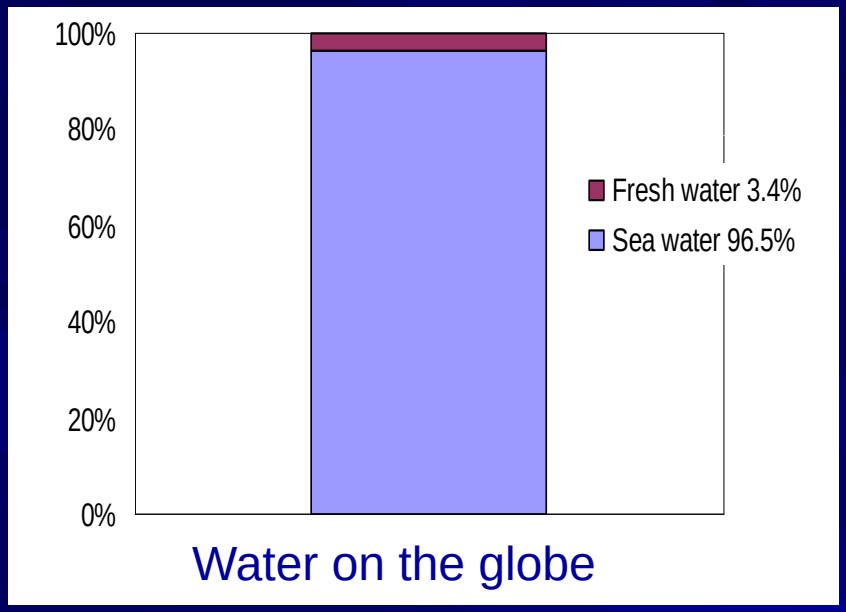
- Hydrologic Cycle (Climate Change)
  - Changes in the flux

- Population Growth and rise in living standards

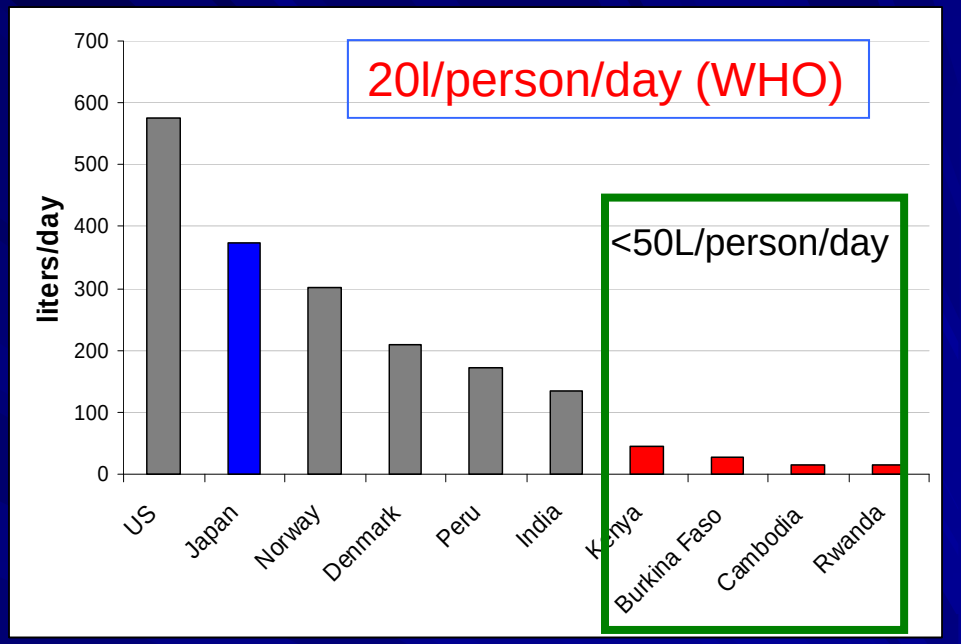
- Contamination

- Poverty

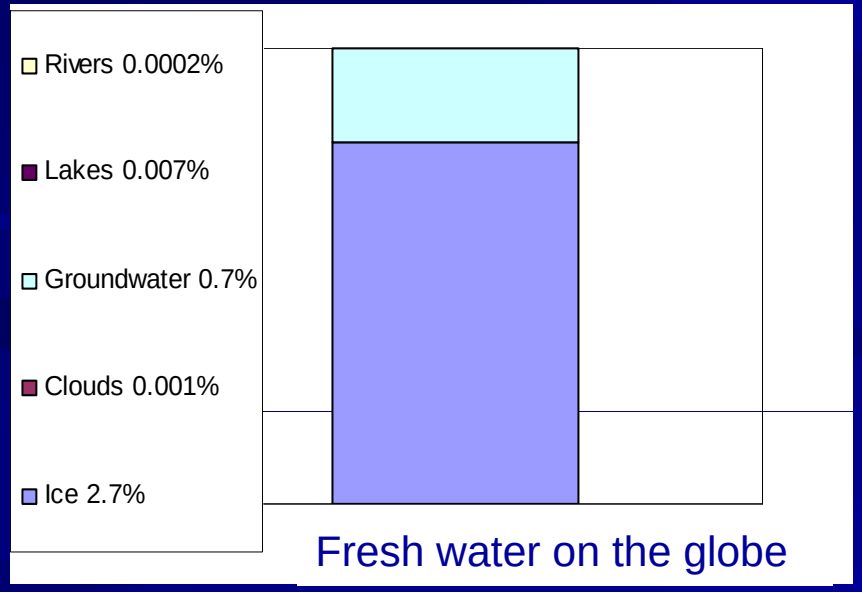
Current available freshwater and consumption



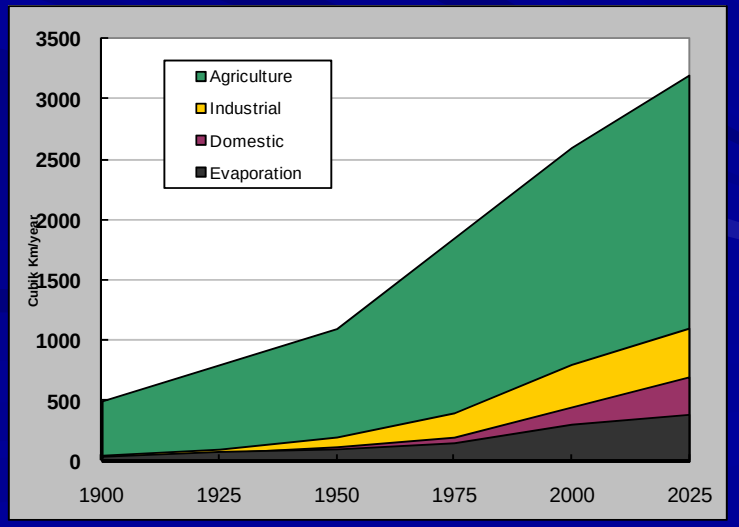
Water on the globe



Daily water consumption per capita



Fresh water on the globe



- **Will available freshwater resources be sufficient to meet the future demand if current water consumption trends remain unchanged?**

The good news:
1000 km^3 of rain falls on the earth everyday, and water is basically a renewable resource (see the water cycle)

The bad news:

- Presently, 1 Bill. of the Earths 6.5 Bill. people produce their food from non-renewable groundwater
- >1 Billion people lack safe drinking water

NOT ENOUGH

Discussion

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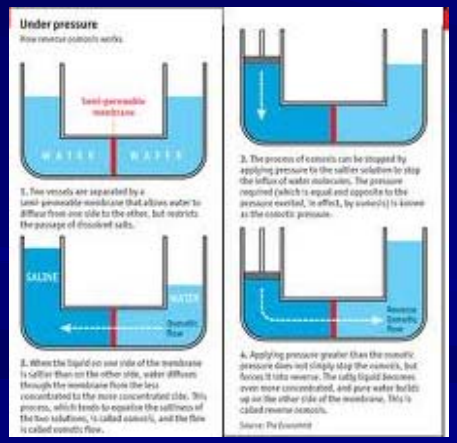
- STEPS NECESSARY TO GUARANTEE WATER SECURITY FOR ALL

Steps to guarantee water for all

- Water Transfer

- Wise use of water: Reduce use

- New water resources:



Desalination
(brackish, sea water)

Rain water harvesting

Water reuse

Why water recycling?

- To have sufficient water resources
- Desalination is still expensive
- To prevent pollution
- Stringent regulations

Conclusion:
We need new water sources
to guarantee the future for all

Artificial Water recycling

What is Water Reuse?

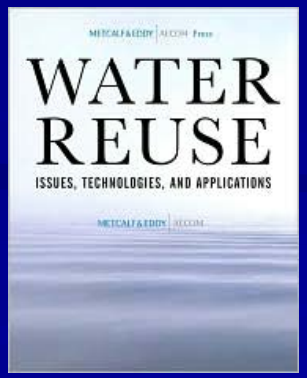
The reclamation and treatment of impaired water for the purpose of beneficial reuse.

Impaired Water

- Municipal and industrial wastewater effluent
- Brackish water
- Poor quality groundwater
- Agriculture return flows
- Storm water

Uses of Reclaimed Water

- Agricultural irrigation
- Landscape irrigation
- Non-potable* urban uses
- Industrial uses
- Environmental uses
- Groundwater recharge
- Indirect potable reuse



- Water reuse (Metcalf & Eddy)

* Potable = drinkable

Advantages of water reuse

- Augmenting water resources
- A water source that is climate independent
- A locally-controlled water resources
- Benefits to the environment
- Less dependency on conventional water resources (groundwater and surface water)
- Reduced diversion of water from sensitive ecosystems
- Reduction and prevention of pollution by reducing nutrient loads of wastewater discharges into waterways
- Replenishment of overdrawn water sources and reestablishment of those previously destroyed
- Preventing pollution & improving sanitation

Examples of reuse practices around the world

Tunisia:
Reuse in agriculture
And on golf courses

Biological treatment

Japan:
Faucets (cascade reuse)

No treatment

Australia: western corridor recycled water project (Potable reuse)

Biological treatment
Microfiltration 0.1um, 0>2 um
Reverse osmosis
Advanced oxidation UV
Chlorine disinfection

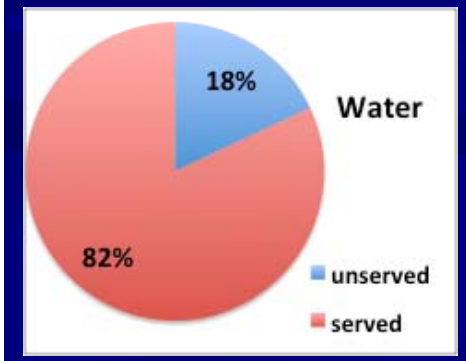
Sanitation

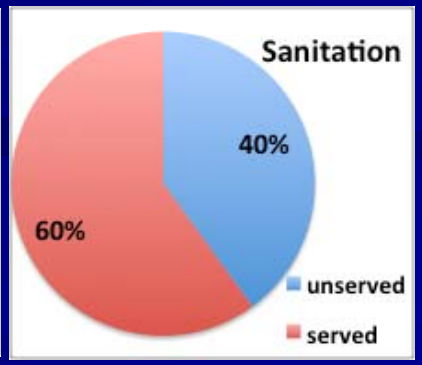
- If not disposed of properly, used water can cause major problems
- Special care must be taken when reusing reclaimed wastewater
- ~10 million people die each year from water-related diseases

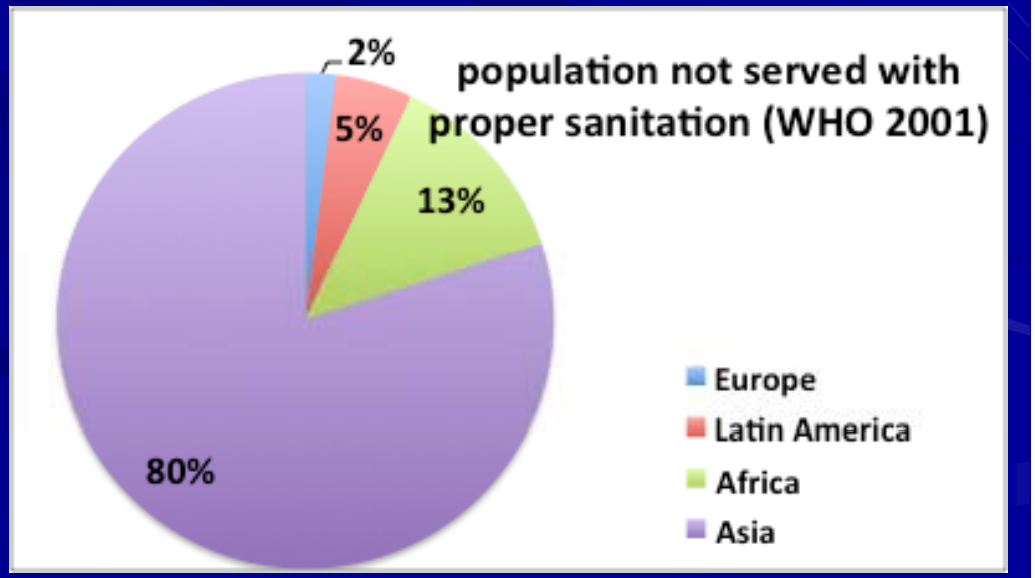
Sanitation issues and Impacts on Global Health

- Increasing scarcity and quality degradation of fresh waters
- 1,1 billion do not have access to potable water
- 2,4 billion do not have access to proper sanitary system
- Population is expected to increase about 2 billions in the coming 25 years most of them located in poor urban areas
- 90 % of the wastewater effluents are either non well treated or non treated at all.
- 80 % of diseases and 25 % of deaths in developing countries are attributed to polluted water(WHO)
- Approximately 2M tons of human waste is released annually into rivers and streams around the globe

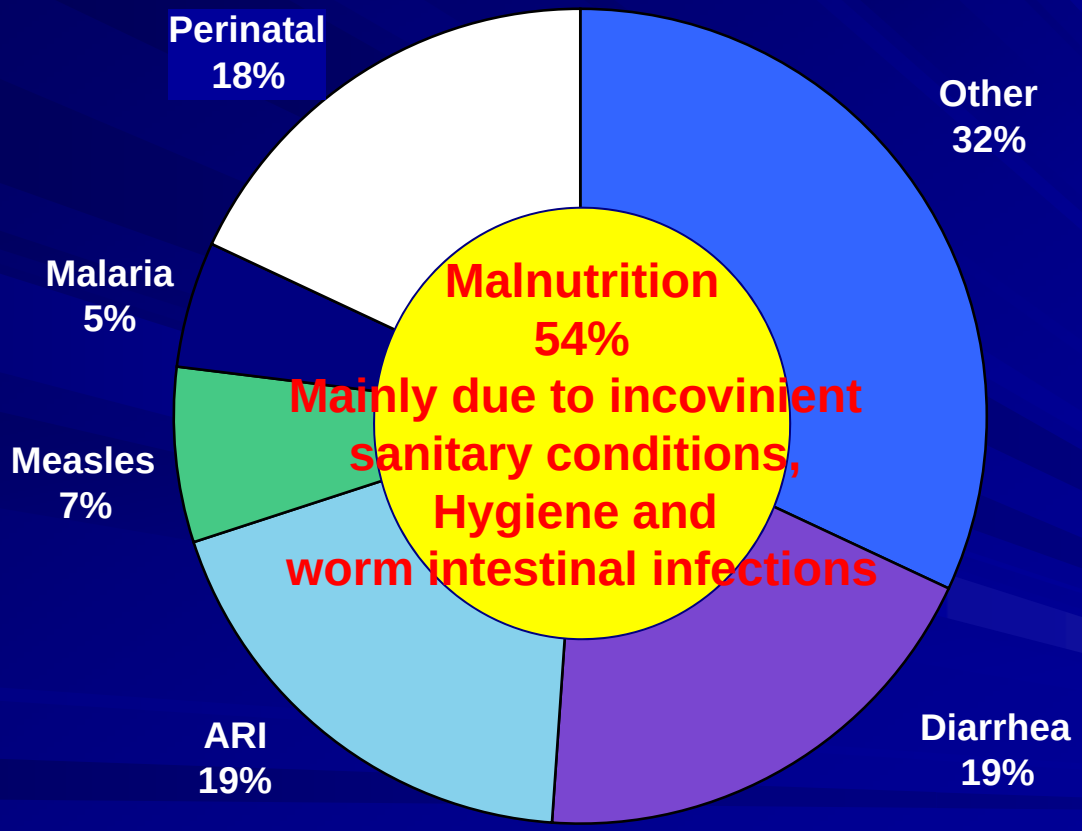
❖Sanitation coverage in developing countries (49%) is half that of the developed world (98%).





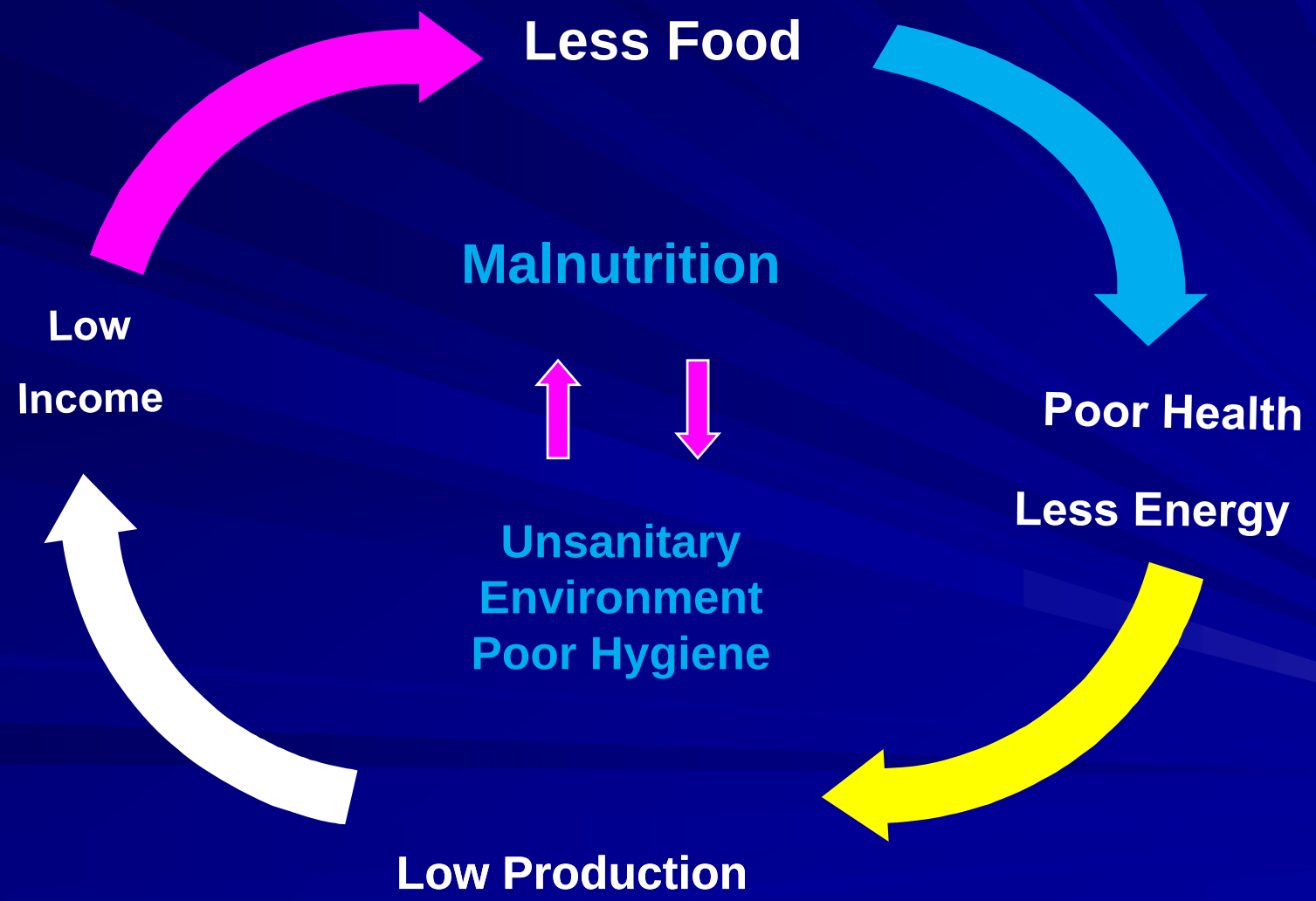


Main causes of Infants' Mortality (< 5years)



Source: WHO 1995

Poverty cycle



China

Ougadougou-Burkina Faso

Malaria causes more than 300M cases of acute illness and over 1M deaths annually

- **Lack of water induces malnourishment.**
  - Malnourished children are more vulnerable to disease
  - About 1.8M people, mostly children, die annually from diarrhea and other preventable diseases related to contaminated water.
  - Four diseases: diarrhea, pneumonia, measles and malaria, plus malnutrition, account for seven out of ten childhood deaths in developing countries. For example in Zambia, one in five children dies before their fifth birthday).

- **Lack of water induces diseases.**
  - People cannot wash often enough and suffer from diseases as a result.
  - Skin diseases like scabies and eye infections such as trachoma, the largest cause of preventable blindness in the developing world by regularly washing the face, hands, and eyes.

- Typhoid fever is contracted when people drink water or eat food contaminated by the *Salmonella typhi* bacteria found in human waste. It affects 17M people worldwide annually, with approximately 600K deaths. (it has been eliminated in developed countries).

Millenium Development Goals (MDGs)

- 7th goal: To reduce by half the proportion of people without sustainable access to safe drinking water and proper sanitation by 2015.

Under the current economic conditions it is almost impossible to achieve the goal

Up to 5.5 billions will have no access to sanitation in 2035, if we continue installing the sanitary facilities based on the current standards.

How can sanitation be improved?

- Appropriate sanitation can be provided to small communities:
  - Cheap and affordable local materials
  - Decentralized sanitary systems (No pipelines)
  - Reuse: closing the water and material cycles, by reusing solid and liquid wastes as much as possible after adequate treatment and careful control

Discussion

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- **HOW CAN WATER REUSE IMPROVE SANITATION?**

Drivers of local reuse

- Economic aspects (peter Wildere 2002)
  - Capacity of monetary insufficient to cover total expenses for centralized sanitary system
  - Rehabilitation costs of pipelines is about 100 billion euros in Germany
  - Consumers water bills can not cover these expenses
- Water management
  - Taking water from one discrete location and discharging it in a far location will negatively affect the water cycle
  - Pipeline can leak and cause unsanitary conditions
- Water resources
  - An important amount of potable water is used to transport pollutants
  - Reuse of wastewater will help to keep water near the original location

Homework

- **Identify and write a short report (less than one page) on a local, regional or national water reuse and/or sanitation issue.**
- Send it to: guizani-m@census.hokudai.ac.jp
- Subject: undergraduate-report