

Guidance

Drinking water quality risk management

Water & Waste Engineering 01
2024/4/19



名古屋大学減災連携研究センター
Disaster Mitigation Research Center, NAGOYA UNIVERSITY

1

Water & Waste Engineering

Keywords: water system, waste treatment system, water supply engineering, wastewater engineering, waste management engineering

Outline: We will give lectures on the water and wastewater system, waste management system, the management system and cutting-edge technologies for water, waste, and human health and the environment. In addition, we consider the water and waste system from the viewpoint of natural disaster, climate change, and depopulation society. And, we will discuss the emergency environmental management.

Objectives:

- To management system and technology for water and waste management system
- To discuss and explain on water, wastewater and waste management.
- To discuss the future water and waste system with the influence on natural disaster, climate change, and depopulation society.
- To understand emergency environmental management.

2

2024 Water & Waste Engineering Contents

4/19 Introduction & Drinking water quality risk management
4/26 Water supply system in Japan
5/10 Water safety plan
5/17 Water quality risk management in emergency
5/31 Recovery of clean water
6/05 Wastewater treatment system in Japan
6/14 Watershed water quality management
6/21 Waste management system in Japan
6/28 Solid waste management technology
7/05 Disaster debris management system
7/06 Disaster resilience and water system (Online)
7/12 Student Presentation 1
7/19 Student Presentation 2
7/26 Report (No class)

3

Water & Waste Engineering

Credits: 2

Grading criteria:

Participation 45%
Presentation 25%
Report 30%

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4

Self Introduction 1min per person

5

What is 'RISK'?

6

risk

- > a situation involving exposure to danger:
- > the possibility that something unpleasant or unwelcome will happen:
- > a person or thing regarded as likely to turn out well or badly, as specified, in a particular context or respect:
- > a person or thing regarded as a threat or likely source of danger:
- > a possibility of harm or damage against which something is insured.
- > the possibility of financial loss:

©New Oxford American Dictionary, 2013

7

risk management

- > Risk management — Vocabulary, ISO Guide 73:2009
 - coordinated activities to direct and control an organization with regard to risk
- > Risk management framework
 - set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization

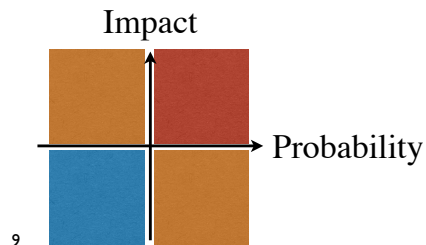
©ISO/Guide 73:2009 Risk management — Vocabulary

8

risk management

> Risk = Impact × Probability

- prioritization process
- balancing resources



risk management: method

- > Method consist of the following elements, performed, more or less, in the following order.
 1. identify, characterize threats
 2. assess the vulnerability of critical assets to specific threats
 3. determine the risk
 4. identify ways to reduce those risks
 5. prioritize risk reduction measures based on a strategy

©ISO/Guide 73:2009 Risk management — Vocabulary
10

risk management strategy

- > Make a plan
 - a list of individual risks
 - a rating of each risk based on likelihood and impact
 - an assessment of current controls
 - a plan of action
- > Consider the effectiveness of those actions
 - very inadequate, or non-existent, inadequate, satisfactory, strong, very strong
- > Decide how to handle each risk
 - avoid, reduce, transfer, accept

11

risk management strategy

- > A risk management strategy provides a structured and coherent approach to identifying, assessing and managing risk.
- > Risk management framework
 - set of components that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organization.

©ISO/Guide 73:2009 Risk management — Vocabulary
12

Environmental Management System

- > ISO14000;
 - **a family of standards** related to environmental management that exists to help organizations
 - **minimize** how these operations negatively affect the environment
 - **comply with applicable laws, regulations**, and other environmentally oriented requirements
 - **continually improve**
- > The current version of ISO14000 is ISO 14001:2015 which was published in Sept. 2015.

13

ISO 14001; Basic principles and methodology

- > the well-known Plan-Do-Check-Act cycle.
- > Do-CAP
- > **Plan:**
 - establish objectives and processes required
- > **Do:**
 - implement the processes
- > **Check:**
 - measure and monitor the processes and report results
- > **Act:**
 - take action to improve performance of EMS based on results

14

Environmental risk

- > **Environmental risk = Toxicity × Exposure**
 - Risk = Impact × Probability

15

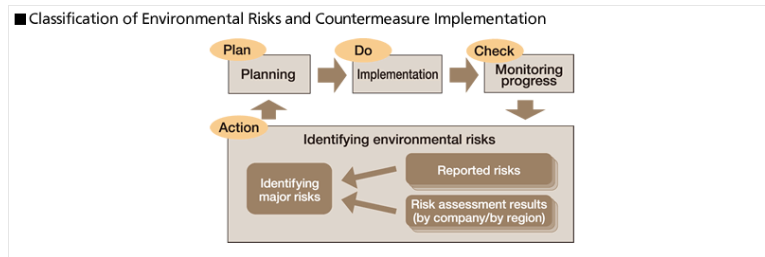
a case study; Environmental Risk Management in Panasonic

- > **To identify** environmental risks and implement the management system, environmental risks are identified for each Company and for each region in the world each year.
- > From these risks, environmental risks on a group-wide level are **selected**.
- > The risks that show a high level of frequency or seriously impact business management are designated as major risks and **prioritized in** planning and executing **risk-reducing measures**.
- > These measures are implemented for each major risk, and progress is **monitored** and **followed up** on a quarterly basis in **the PDCA cycle**.

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a case study; Environmental Risk Management in Panasonic



17

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➤ Environmental Compliance Management at Factories

- Panasonic manages its environmental systems in full compliance with laws and regulations. We regularly measure emissions of gas, wastewater, noise, odor, etc., and introduce preventative measures for cases that may lead to serious violations.
- Environmental pollution; air, water quality, noise, odor, waste

18

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➤ Measures Against Soil and Groundwater Contamination

- In the latter half of the 1980s, soil and groundwater contamination due to chlorinated organic solvents was detected at some Panasonic sites.
- Specifically in 1991 we created the Manual for Preventing Contamination of Soil and Groundwater and began conducting necessary surveys and measures.
- In 1995, we discontinued the use of chlorinated organic solvents, and in 1999 created Guidelines on the Prevention of Environmental Pollution to ensure there would be no recurrence of similar problems at our sites.

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19

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➤ Measures Against Soil and Groundwater Contamination

- In fiscal 2003 we began enhancing our surveys and measures to comply with relevant laws and regulations, including the Soil Contamination Countermeasures Act, which was enforced in Japan in 2003, and in fiscal 2004 started implementing measures to place all our bases across the globe under management supervision with regard to soil and groundwater.
- Specifically, we conduct onsite inspections and interviews at the bases, in addition to surveying their use of VOCs and heavy metals.

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20

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> Soil and Groundwater Risk Management Policy; Pollution dispersion prevention beyond Panasonic premises

1. Conduct historical surveys
2. Determine and install monitoring wells at the premises' borders
3. Analyze groundwater at the borders
4. Check possibility of pollution from external sources
5. Report to management department
6. Determine the external pollution dispersion prevention methods
7. Install the external pollution dispersion prevention methods
8. Install assessment wells
9. Begin assessments (monitoring)

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21

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> Soil and Groundwater Risk Management Policy; Thorough pollution source elimination

1. Conduct brief status check
2. Horizontal direction detailed analysis
3. Vertical direction detailed analysis
4. Determine the magnitude of pollution
5. Discuss the areas and methods of purification
6. Conduct purification and install pollution dispersion prevention measures
7. Monitor pollution source (groundwater) after purification
8. Report purification completion to management department

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> Initiatives for PCB Pollution

- Panasonic discontinued the production of equipment containing polychlorinated biphenyls (PCBs) in Japan in 1972 and has since been strictly managing its PCB waste.
- With the enforcement of the Law concerning Special Measures for Promotion of Proper Treatment of PCB Waste in July 2001, optimized storage, decontamination, and notifications are being practiced in compliance with the law.

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23

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> Initiatives for PCB Pollution in 2016

- 124 of 2,281 units, including transformers and capacitors using PCBs submitted under the early registration scheme were treated, by Japan Environmental Storage & Safety Corporation (JESCO) as our subcontracted PCB waste disposal operator.
- Approx. 38 tons of stabilizers and other waste with a high PCB concentration were consigned for treatment to JESCO, and approx.
- 126 tons of low-concentration PCB waste was contracted to a private incineration facilities certified by the Japanese Ministry of the Environment.
- We will continue to treat PCB waste towards March 31, 2027, which is the legally designated deadline by which decontamination is to be completed.

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24

Risk analysis

> A preliminary example

- A player in a casino with an initial capital of V_0
- After the game the capital is V_1
- We denote the profit by a random variable $X = V_1 - V_0$
- $X = \begin{cases} 0.6 & \text{with probability } p, \\ -0.4 & \text{with probability } 1 - p. \end{cases}$

25

Dealing with risk

> Risk analysis is;

- the systematic study of uncertainties and risks we encounter in business, engineering, public policy, and many other areas.
- to identify the risks faced by an institution or business unit, understand how and when they arise, and estimate the impact (financial or otherwise) of adverse outcomes.
- **Quantitative Risk Analysis**
- **Models and Simulation**
- **Monte Carlo Simulation**

26

Risk assessment

> Risk assessment has three parts...

- Risk identify
- Risk analysis
- Risk evaluation
- Risk evaluation is;
 - concerned with assessing **probability** and **impact** of individual risks, taking into account any interdependencies or other factors outside the immediate scope under investigation

27

Risk evaluation

> Probability

- the **evaluated likelihood** of a particular outcome actually happening (including a consideration of the frequency with which the outcome may arise).

> Impact

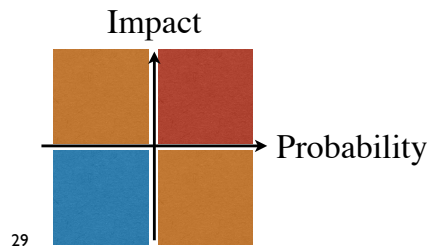
- the **evaluated effect or result** of a particular outcome actually happening.
 - ✓ time
 - ✓ quality
 - ✓ benefit
 - ✓ people/resource

28

Concept of risk management

> Risk = Impact × Probability

- prioritization process
- balancing resources



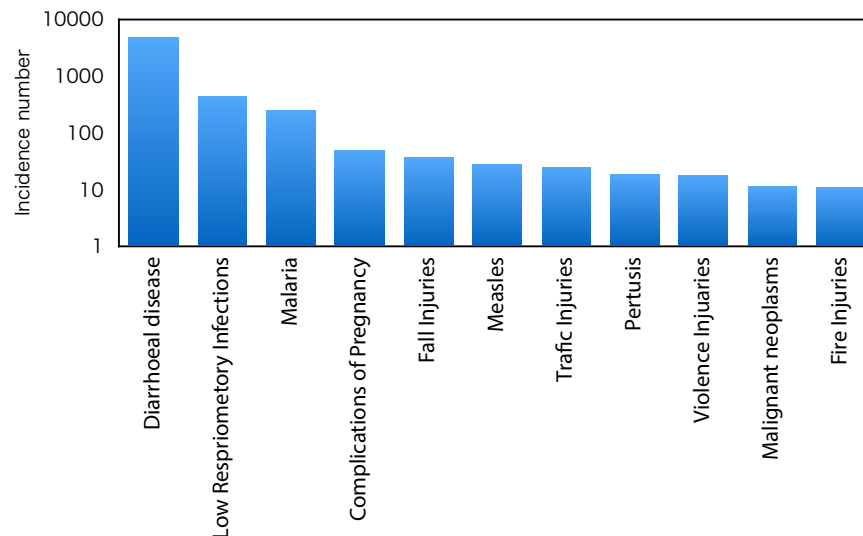
29

Global Burden of Disease

- Global Burden of Disease (GBD) analysis provides comprehensive and comparable assessment of mortality and loss of health due to diseases, injuries and risk factors for all regions of the world.
- The assessment of GBD started from 1990 and the latest open to the public is 2004 by WHO.
- Global health risks, 2009, http://www.who.int/healthinfo/global_burden_disease/en/

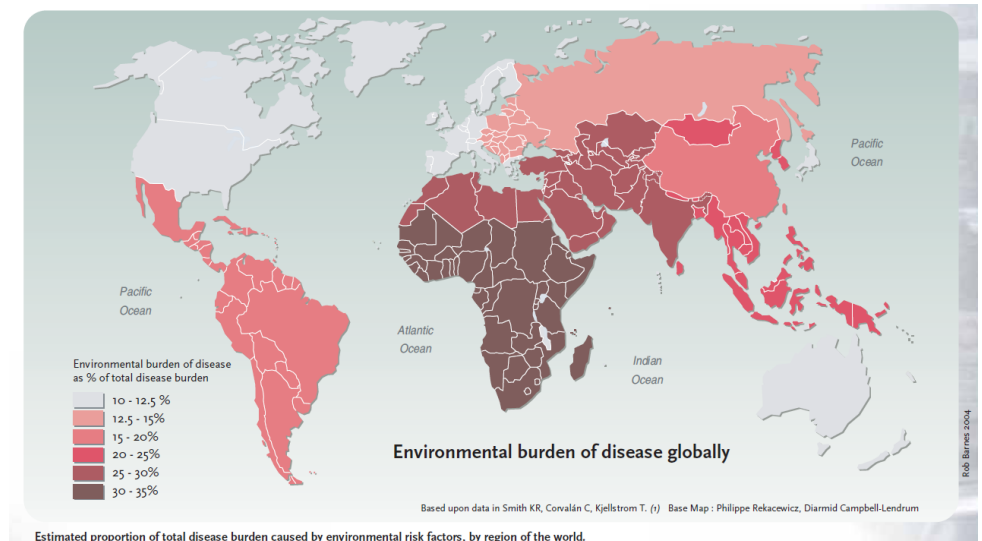
30

Incidence number in 2004



31

Environmental burden of disease globally



32

More damage in developing countries

- The health impacts of environmental risks are **heaviest among poor and vulnerable populations in developing countries.**
- The poor in developing countries generally have the **least access to clean water sources**, and those same populations also may be the most **directly exposed to environmental risks.**
- At the same time, poor people also may be the most dependent on natural resources as sources of livelihoods and well-being, and thus be most impacted by unsustainable exploitation or depletion of those resources.

33

GBD — selected water-related diseases

- **Diarrhoea:**
 - ✓ **1.8 million people**, mostly children, die of diarrhoea every year.
- **Malaria:**
 - ✓ **1 million people**, mostly children, die of malaria every year.
- **Schistosomiasis:**
 - ✓ **200 million** are infected, **20 million** suffer severe consequences.
- **Trachoma:**
 - ✓ **6 million** visually impaired, 146 million threatened by blindness.

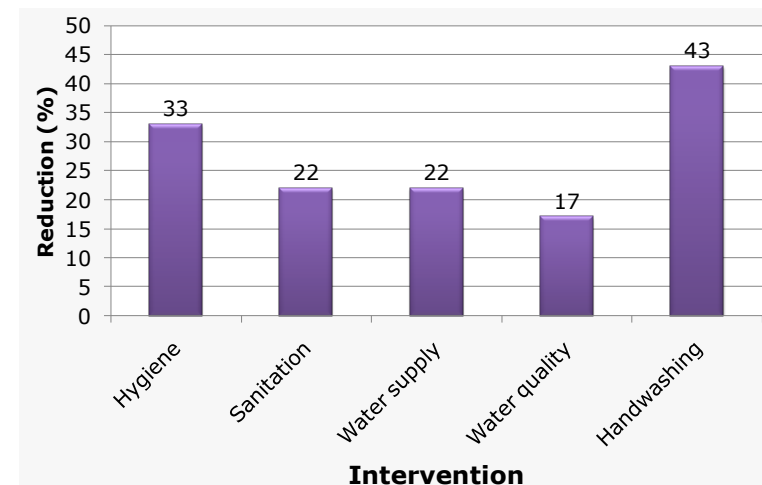
34

What can be done ?

- **Diarrhoea:**
 - ✓ **drinking water and sanitation improvements**
- **Malaria:**
 - ✓ **Better management of water resources reduces Malaria transmission.**
- **Schistosomiasis:**
 - ✓ **Basic sanitation reduces the Schistosomiasis by up to 77%.**
- **Trachoma:**
 - ✓ **Improved sanitary conditions and hygiene practices prevents trachoma.**

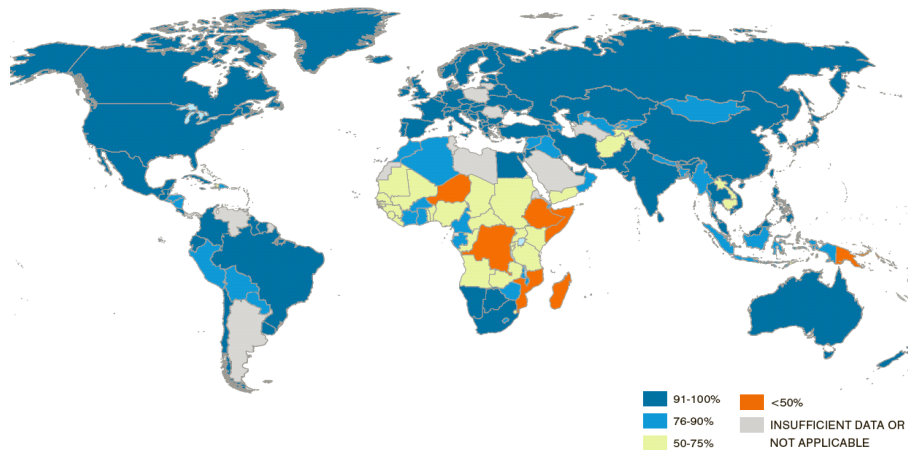
35

Diarrhoeal disease reduction from drinking water and sanitation improvements



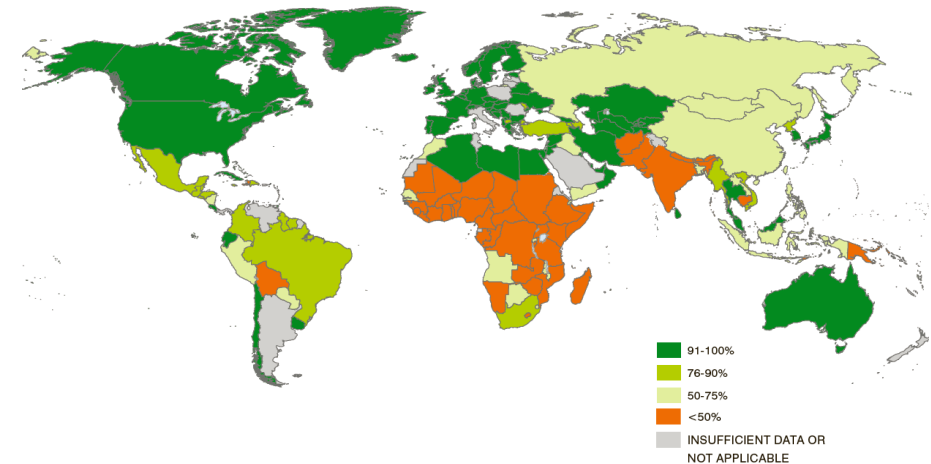
©Fewtrell L et. al., Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. Lancet Infectious Diseases, 2005

Proportion of the population using improved drinking water sources in 2010



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Proportion of the population using improved sanitation in 2010

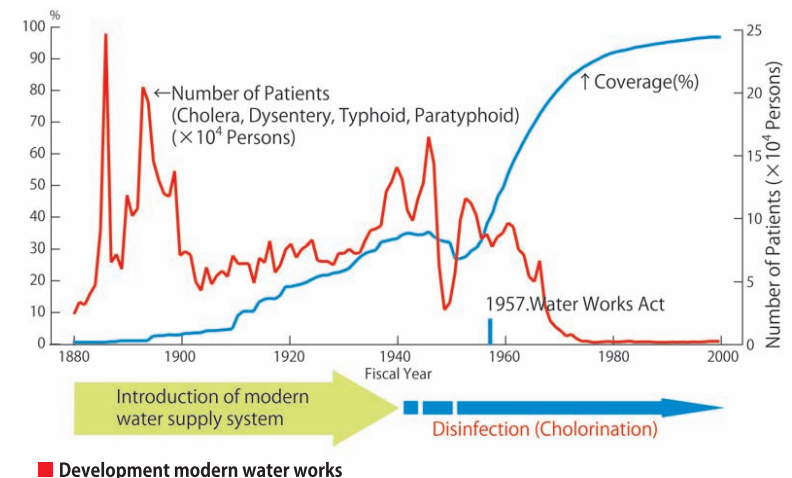


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Water and sanitation

- 2.1 billion people **CANNOT** access clean and safe drinking water, 63% of which are in Asia-Pacific Region (UNICEF/WHO).
- 7.9 % of water supply systems in Asian cities retain appropriate residual chlorine over 0.1 mg/L, 21.5% **CANNOT** comply with national standards (UNEP).
- 2.4 billion people **CANNOT** use appropriate sanitation systems, 3/4 of which are in Asia-Pacific Region (UNICEF/WHO)

History of Water Supply in Japan



Water facts

- 663 million people are still without access to clean drinking water, despite the Millennium Development Goal target for clean water being met in 2010.
- In SDGs, GOAL 6 Clean Water and Sanitation
- 8 out of 10 people without access to clean water live in rural areas.
- 159 million people use untreated water from lakes and rivers, the most unsafe water source there is.
- Since 1990, 2.6 billion people have gained access to improved drinking water and today, 91% of the world's population drink clean water.



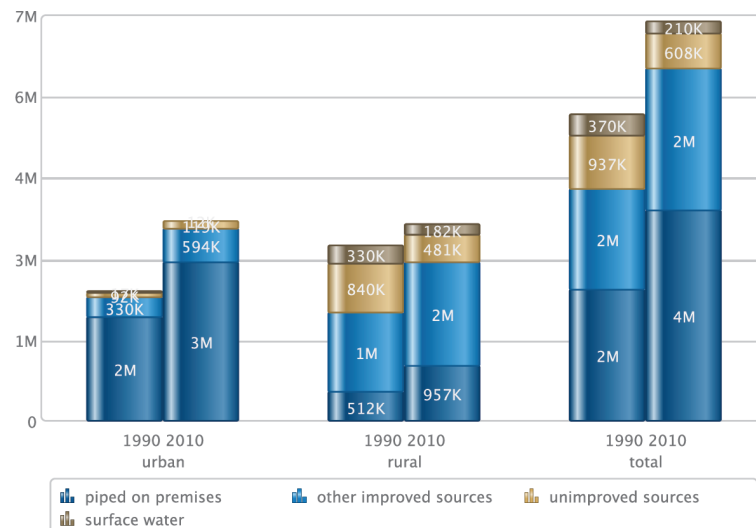
41

Safe drinking water

- Diseases related to contamination of drinking-water constitute a major burden on human health.
- Interventions to improve the quality of drinking water provide significant benefit to health.

42

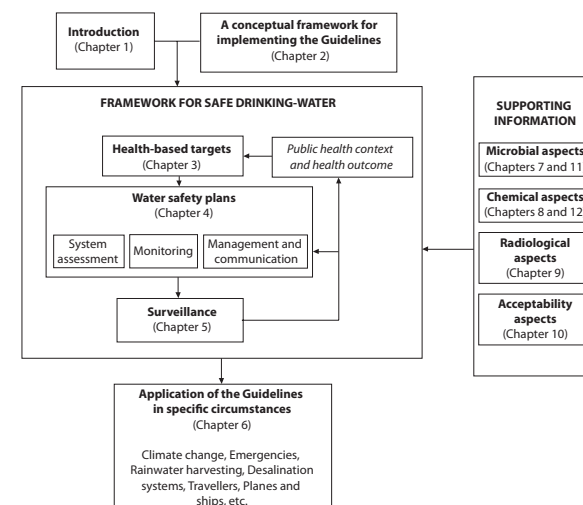
Population with access to drinking water in the world



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43

Framework for safe drinking water



©Guidelines for Drinking-water Quality - 4th ed., WHO, 2011

44