



HOKKAIDO UNIVERSITY

GRADUATE SCHOOL OF ENGINEERING

DEPARTMENT OF ENVIRONMENTAL ENGINEERING

Developing Sustainable Sanitation System and Its Implementation to Asian Countries

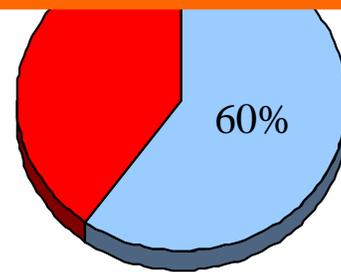
NAOYUKI FUNAMIZU

To achieve the Millennium Development Goals

Water Supply and Sanitation 2000

Up to 5.5 billion people will be without sanitation by the year 2035, if sanitation provisions continue to be installed based on the current standards.

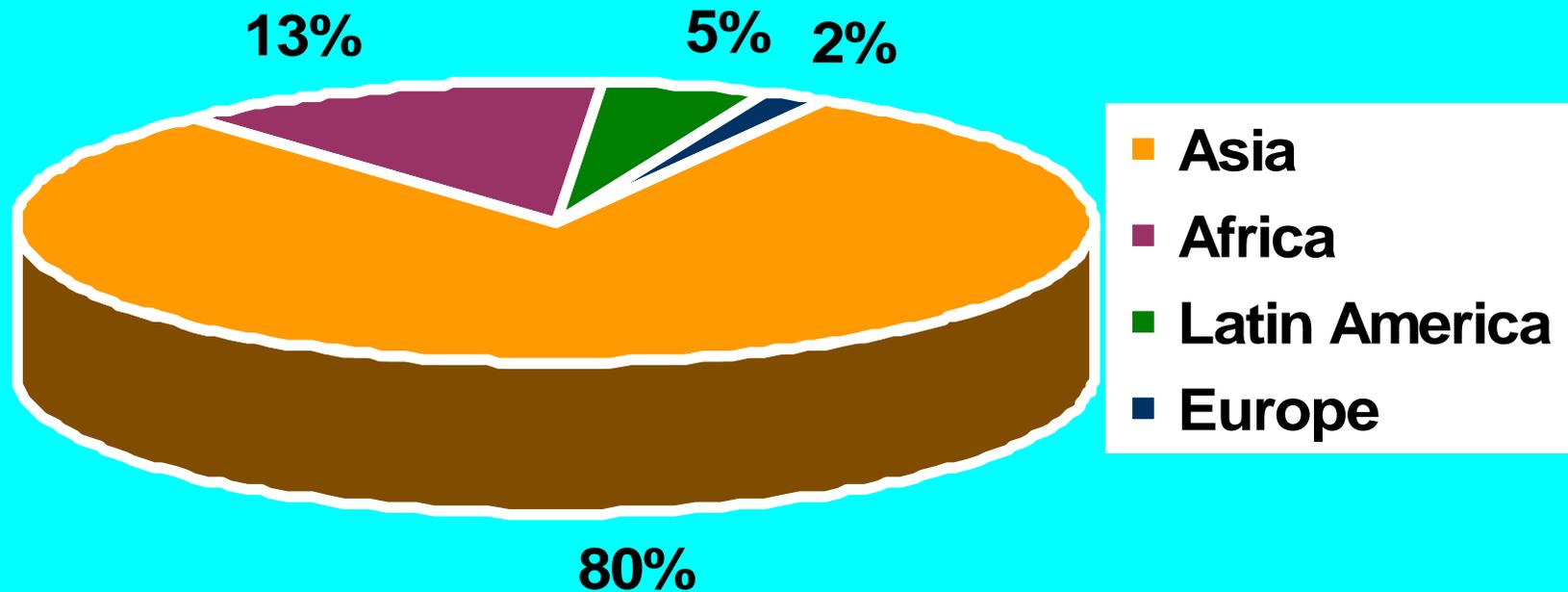
Sanitary means for excreta disposal



Sanitation

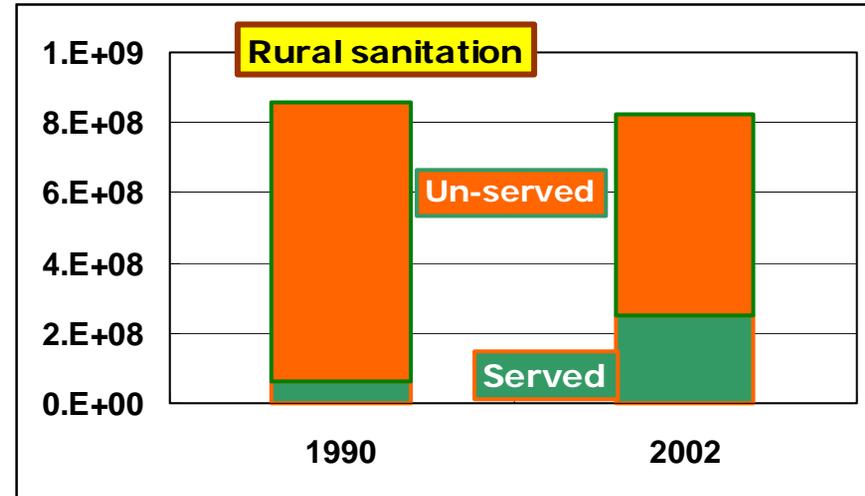
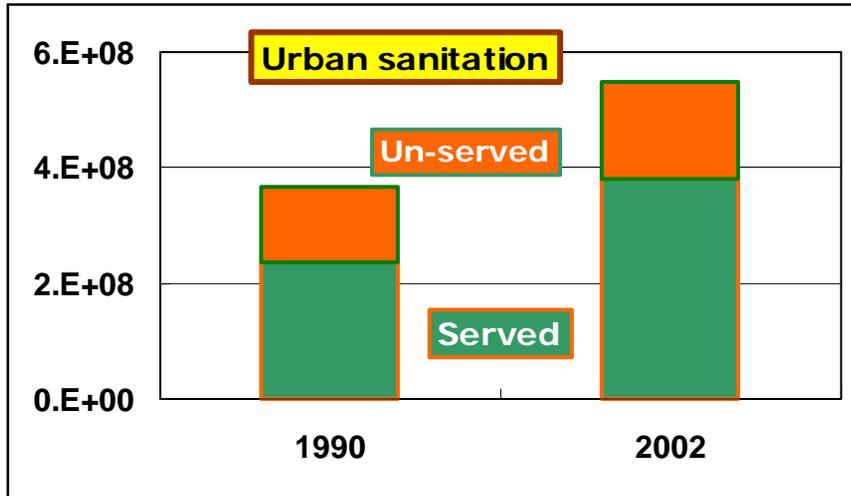
Background -1 Sanitation Issues

Distribution of the global population not served with improved sanitation (WHO, 2001)

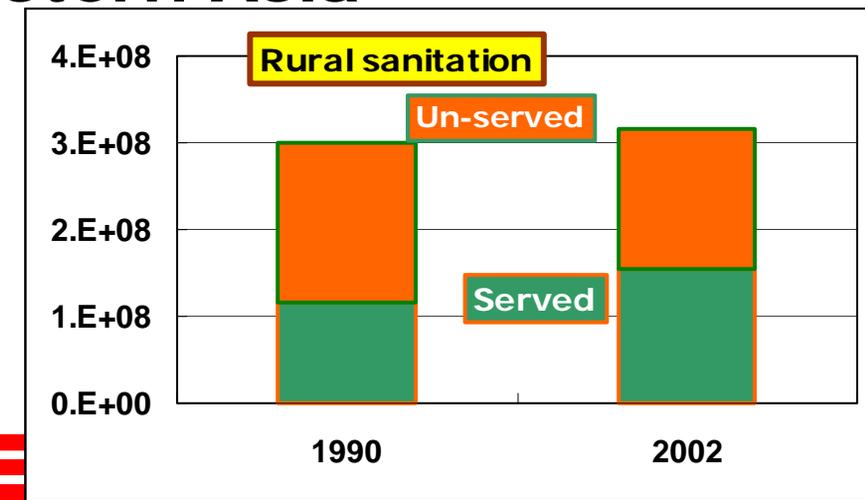
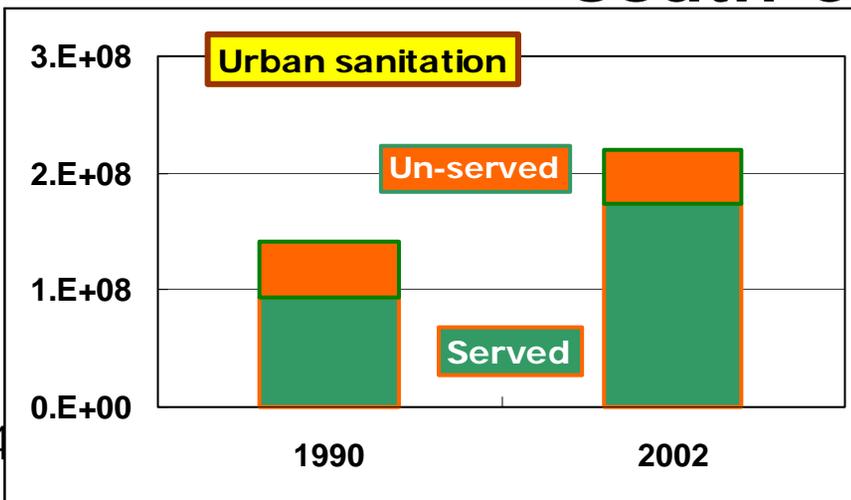


Population served and un-served sanitation (WHO, 2005)

Eastern Asia

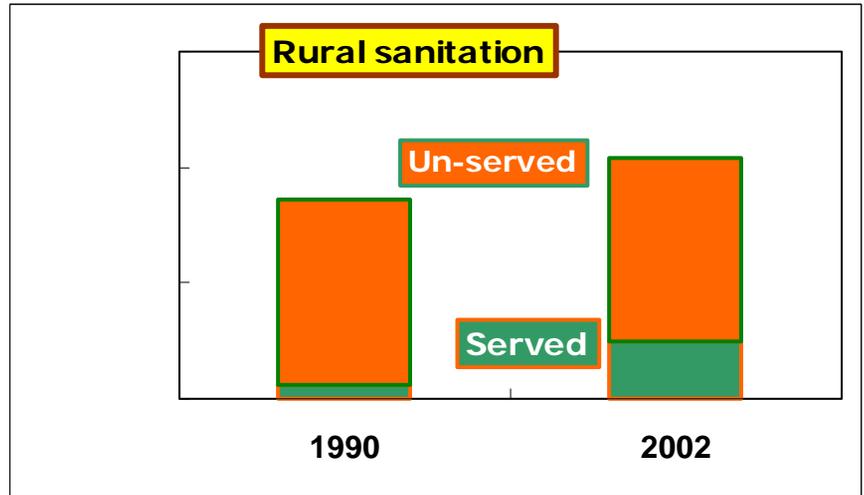
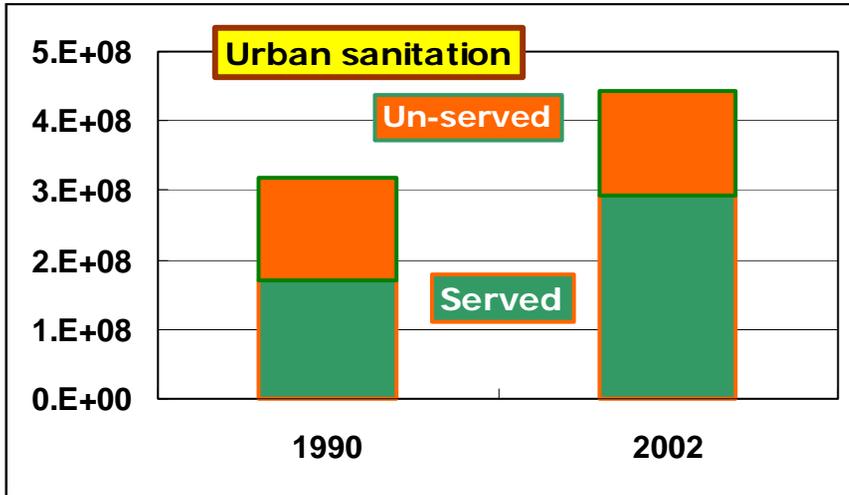


South-eastern Asia

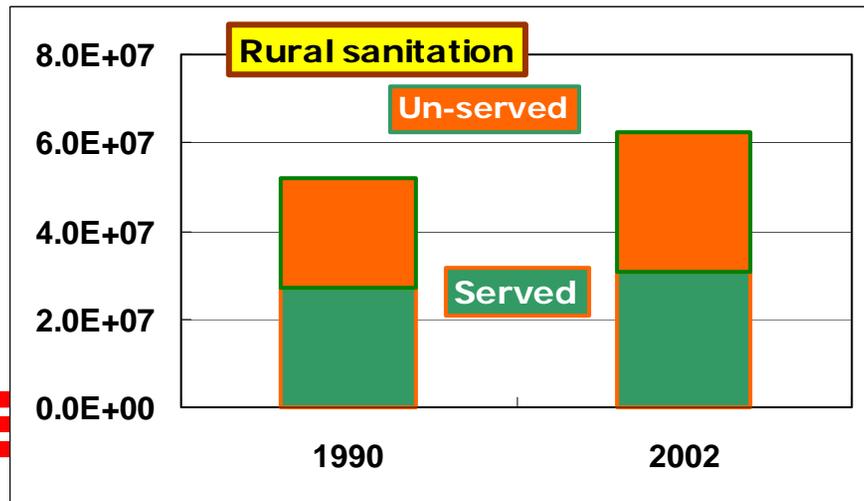
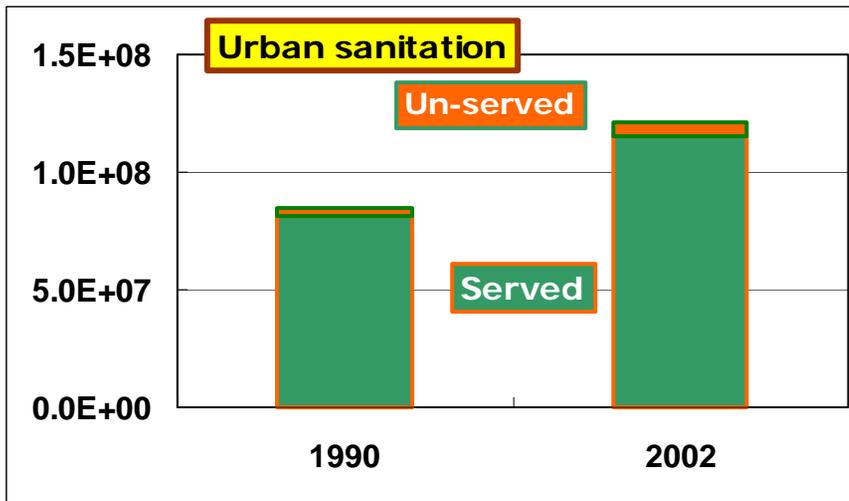


Population served and un-served sanitation (cont.)

South Asia



Western Asia





● > 1.2 million
tons of fresh
excreta
deposited in the
environment and
water sources
each day



Economical Issues

(Peter Wildere, 2002).

- It becomes evident that the capacity of the global money market would not be sufficient to cover the need for investment capital for centralized system **Don't collect**
- The **rehabilitation** cost for the **pipng system** in Germany is estimated to be in the range of **100 billion** euros
- The cost of the installation of **the pipe system** is almost one order of magnitude higher than the cost of building the treatment facilities



Watershed Management

Don't collect

- Taking water from a discrete location and discharging it to a distant surface water body may have a negative effect on the water cycle in that area.
- sewers and water mains are leaking





Water Resource

Don't collect

- A significant amount of the drinking water is used as a means to transport the pollutants
- Reuse wastewater by retaining water near the point of origin



Resources in wastewater

Annual discharge from one person

- **Nitrogen (N)** 4.5 kg
- **Phosphorus (P)** 0.6 kg
- **Potassium (K)** 1.0 kg
- **Organic matter (BOD)** 35 kg

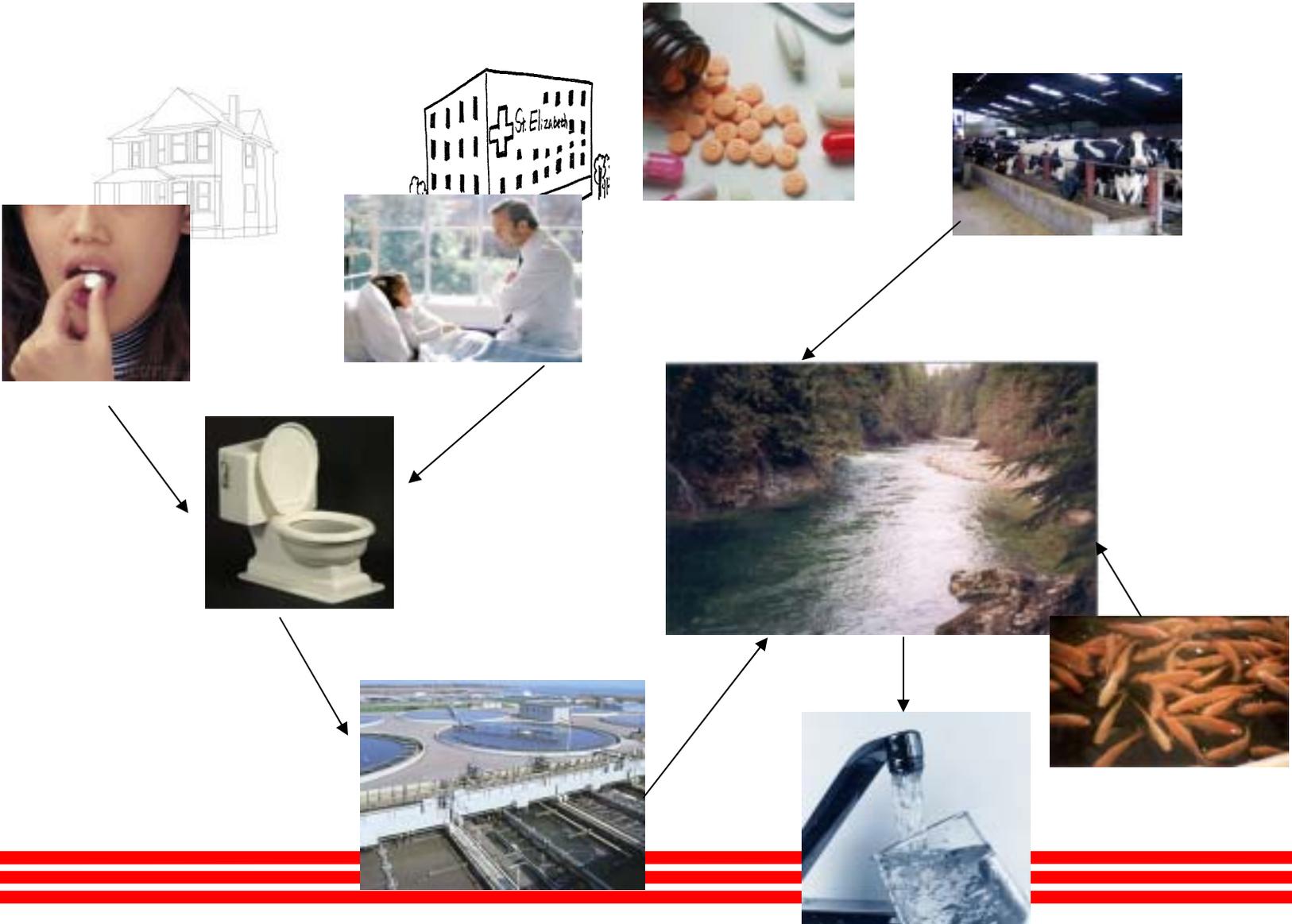


Managing raw wastewater quality to recycle nutrients and to use simple treatment process

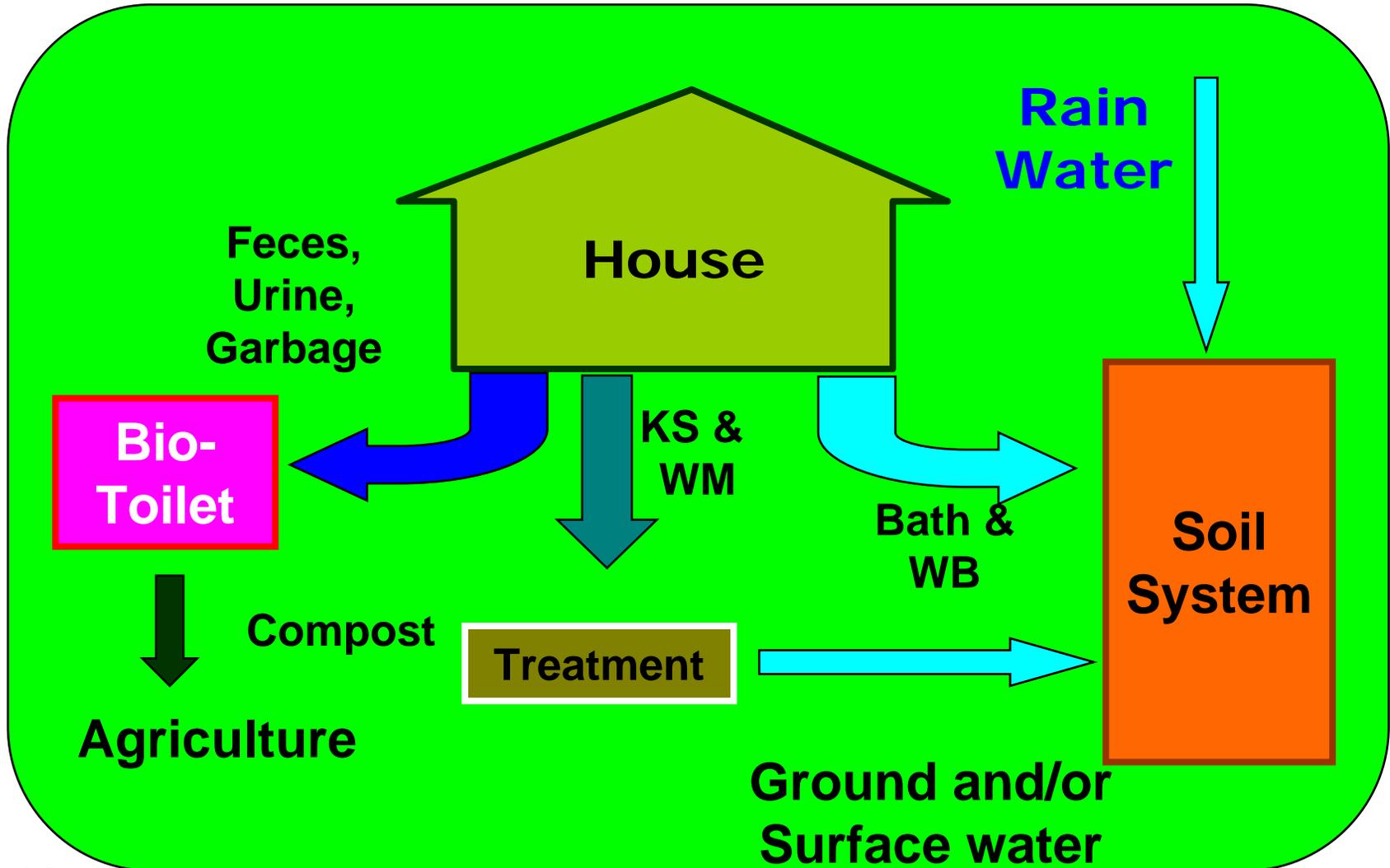
Appliance	Volume	COD	NH ₄ -N	NO ₃ -N	PO ₄ -P	TSS
WC	31%	44%	97%	3.8%	80%	77%
Kitchen sink	13%	23%	0.3%	38%	9.4%	10%
Wash Basin	13%	1.7%	0.1%	11%	1.3%	2.1%
Bath	16%	2.5%	0.6%	15%	1.1%	1.3%
Shower	12%	6.4%	0.7%	25%	4.1%	5.1%
Washing machine	16%	22%	1.2%	7.6%	4.3%	4.0%

Don't Mix

Controlling micro-pollutants



ONSITE WASTEWATER DIFFERENTIABLE TREATMENT SYSTEM

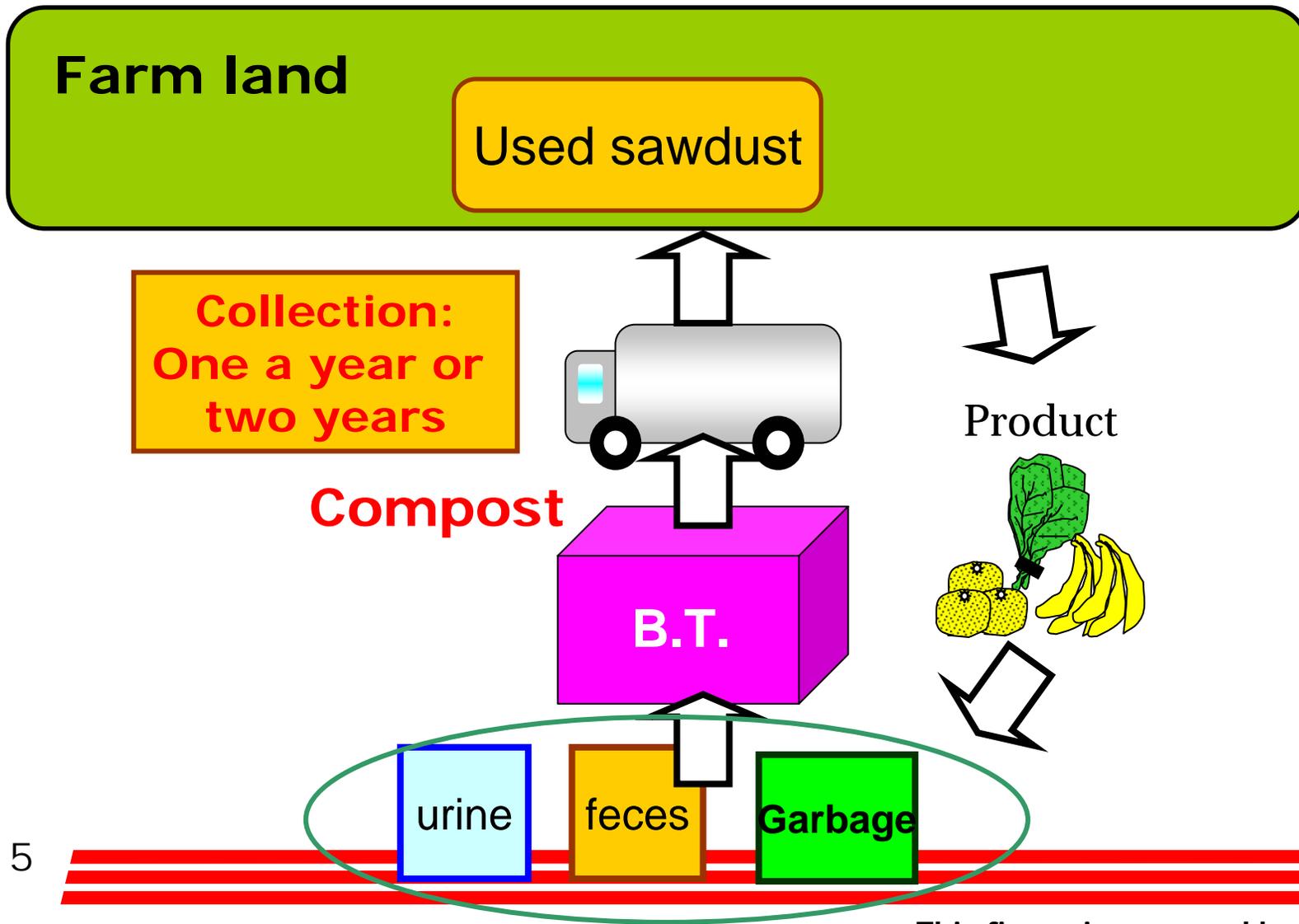




Benefits

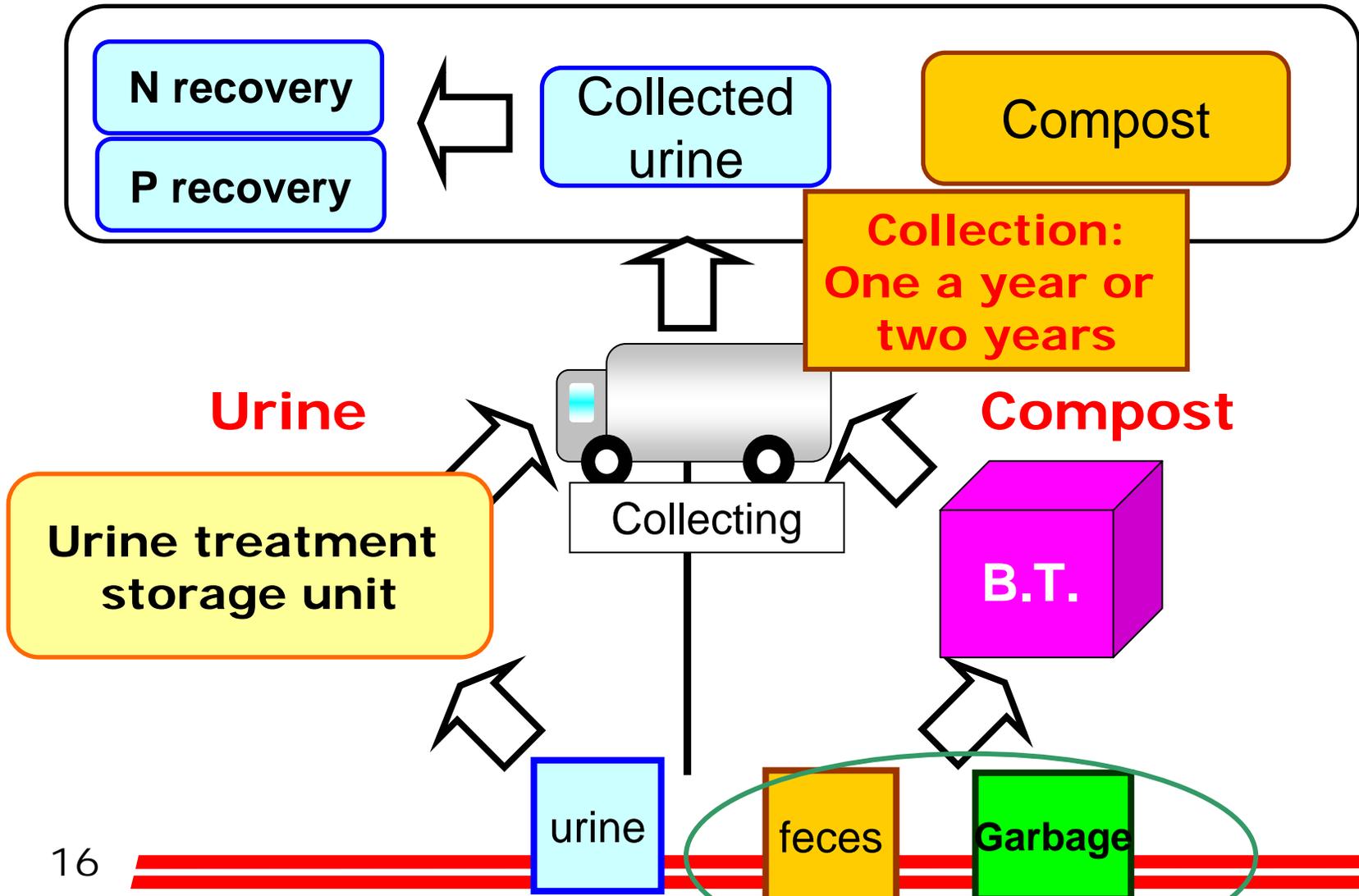
- **Separating black water gives**
 - Recovery and recycle of nutrients
 - Elimination of micro-pollutants in urine
 - Elimination of sources of pathogens
 - Reduction of wastewater flow
 - Conservation of water resources
- **On-site treatment gives**
 - No requirement of pipes
- **The system creates**
 - Material cycle (organic matter and nutrients)
 - New social system such as M&O NPO or company.

Example -1 Treat Black water at House

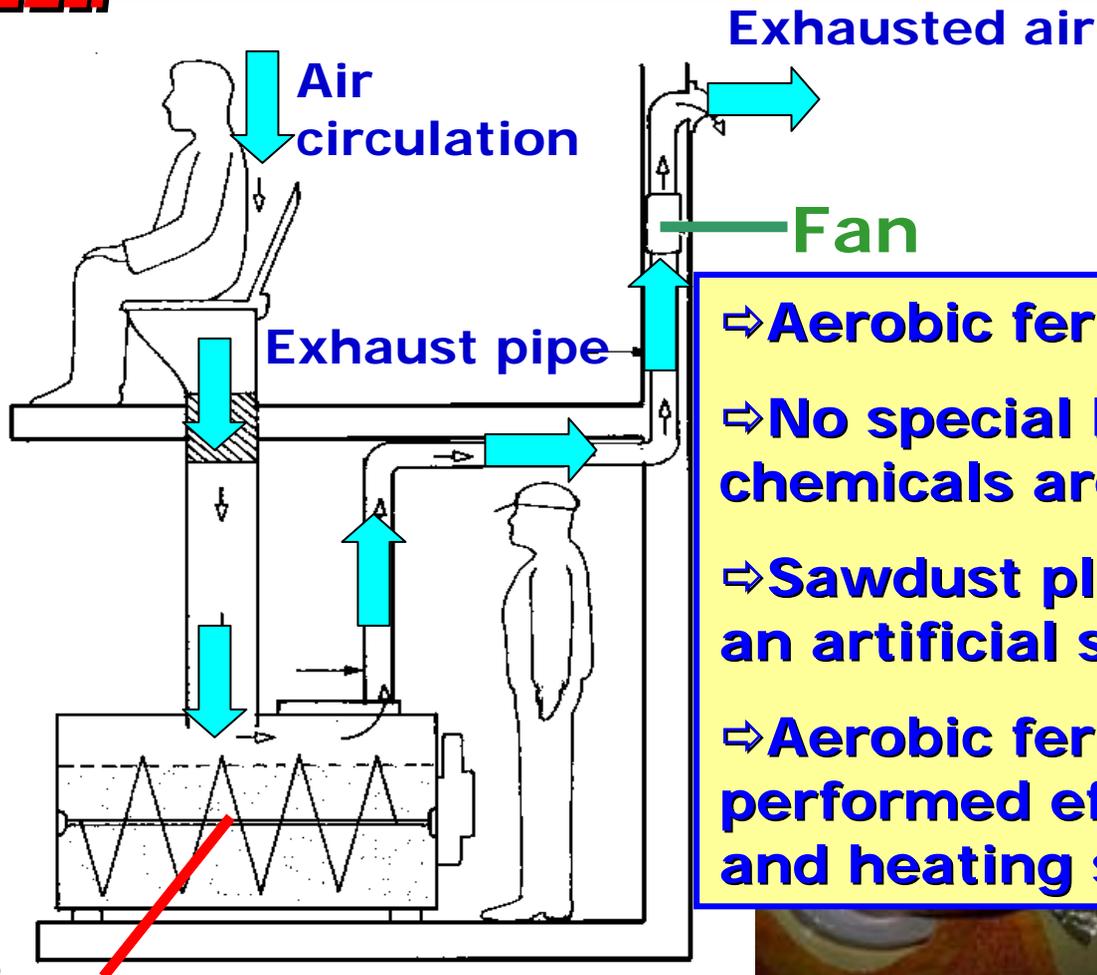


Example -2: Treat Black water at House

With source separation B.T.



Composting Toilet



- ⇒ Aerobic fermentation system
- ⇒ No special bacteria and chemicals are used at all.
- ⇒ Sawdust plays important role as an artificial soil matrix.
- ⇒ Aerobic fermentation is performed effectively by mixer and heating system.

Mixing mechanism

Research activities on Black Water Treatment at Hokkaido University

- 1. Biological activity of aerobic bacteria in composting toilet**
- 2. Characterization of organic matter in feces**
- 3. Modeling composting process in the toilet**
- 4. Temperature effect on composting process**
- 5. Effect of moisture content on composting process**
- 6. Fate of nitrogen**
- 7. Pathogenic microorganisms and health risk assessment**
- 8. Drying kinetics of water**



Research activities on Black Water Treatment (cont.)

- 9. Design of Composting toilet**
- 10. Character of organic matter in compost**
- 11. Fate of estrogens in composting process**
- 12. Fate of pharmaceuticals**
- 13. Urine: NH₃ production in urine storage**
- 14. Urine: Concentration of urine by Electrolysis**
- 15. Urine: Oxidation of pharmaceuticals by ozonation**



CREST project

- An interdisciplinary research project has launched since 2002
 - With 6 research groups from ten organization
- Goals of our project are
 - **Developing** ONSITE WASTEWATER DIFFERENTIABLE TREATMENT SYSTEM ,
 - **Proposing** tactics for implementation of this system to the developing countries in Asia
 - **Based on**
 - The concept of sustainability
 - Consideration on water cycle and material cycle
 - Bio- and eco- technology from Japan



Strategic International Cooperative Program: China and Japan

by Japan Science and Technology Agency

- **Title: A Study on the Improvement of Sanitary Conditions and Reduction of Health Risk by a New Approach of Sustainable Sanitation Systems**
- **China-Japan Bilateral Symposium on Sustainable Sanitation Systems and Reduction of Health Risk**
 - *December 14, 2006, Xi'an*

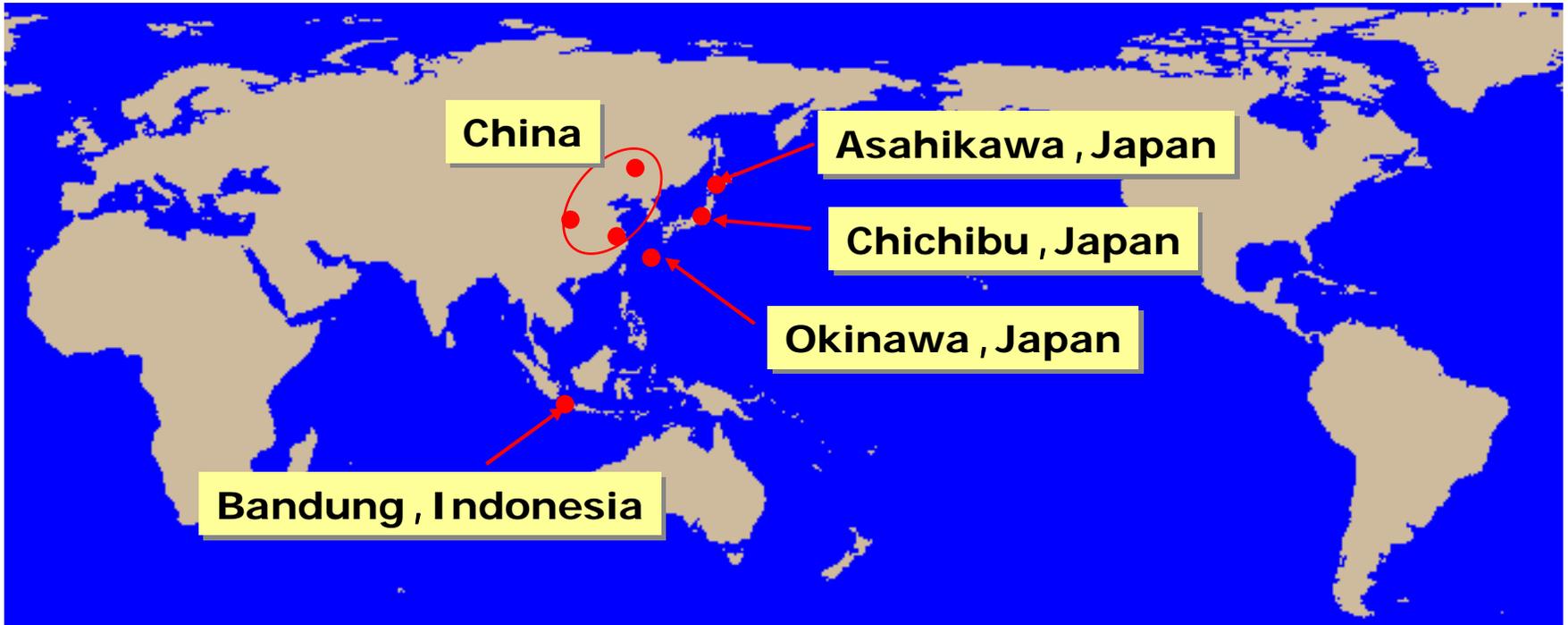
We have already started International Cooperation.



**International Symposium on Sustainable Sanitation
2003 Nanjing University
2004 Northeast Normal University
2005 Xi'an University of Architecture & Technology
2006 Indonesian Institute of Science (LIPI)**



Pilot project



OWDTS IMPLEMENTED AT THE ZOO OF ASAHIKAWA CITY, JAPAN

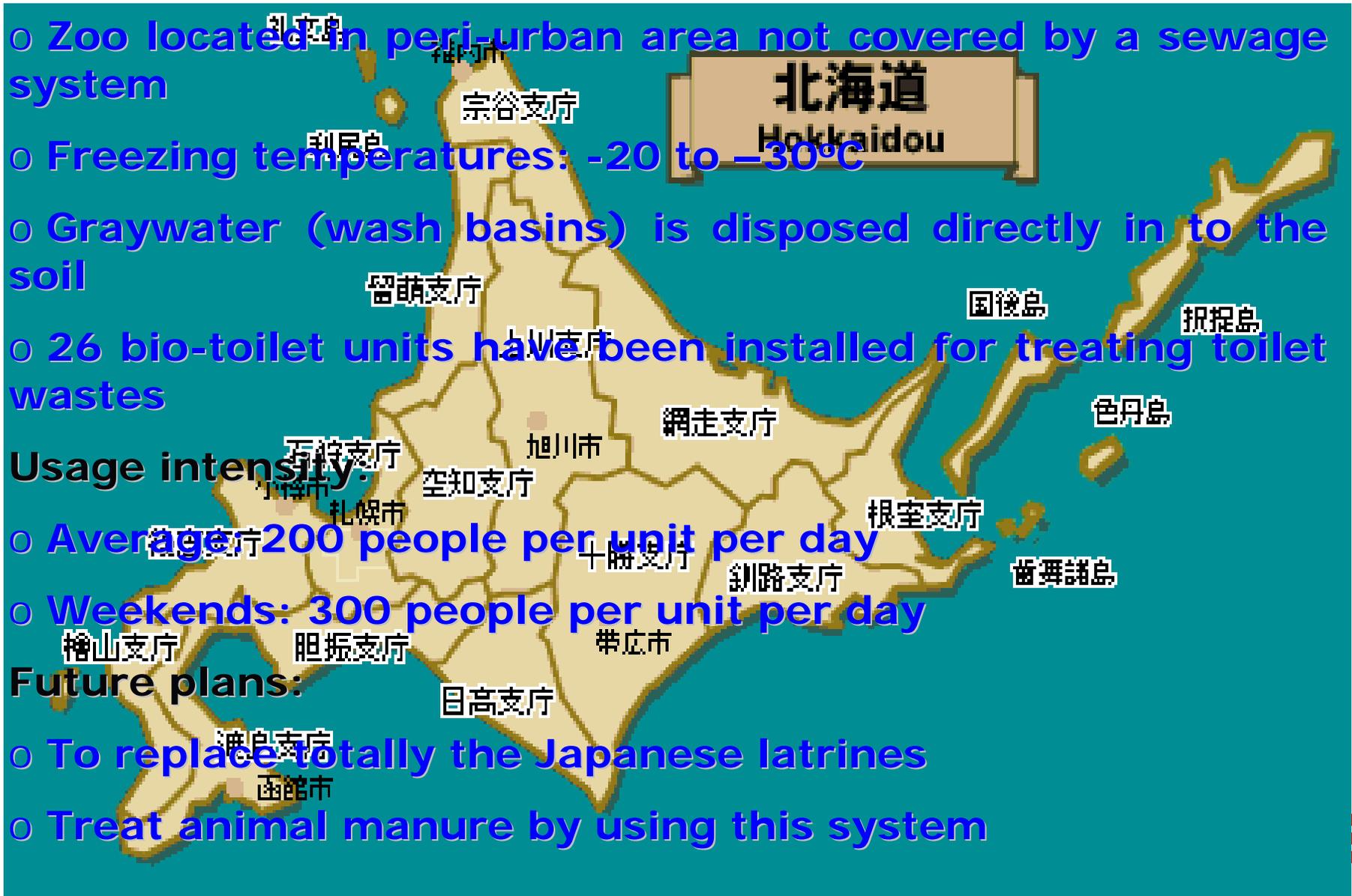
- o Zoo located in peri-urban area not covered by a sewage system
- o Freezing temperatures: -20 to -30°C
- o Graywater (wash basins) is disposed directly in to the soil
- o 26 bio-toilet units have been installed for treating toilet wastes

Usage intensity:

- o Average 200 people per unit per day
- o Weekends: 300 people per unit per day

Future plans:

- o To replace totally the Japanese latrines
- o Treat animal manure by using this system



TWO INDEPENDENT PORTABLE TOILETS FOR TREATING BOTH FECES AND URINE in Asahikawa Zoo



PERMANENT BIO-TOILET FOR HANDICAPPED PEOPLE, FECES AND URINE ARE TREATED in Asahikawa Zoo



COMPOSTING REACTORS OF THE PERMANENT BIO-TOILET SYSTEMS in Zoo





Summary

- **“Don’t mix ! “ , “Don’t collect !”**
- **Onsite Wastewater Differentiable Treatment System**
- **An interdisciplinary research project has launched in Japan since 2002**
- **JST *Strategic International Cooperative Program***