

# Water Environmental Management in Asia

Mitsumasa Okada<sup>1</sup> & Tetsuo Kuyama<sup>2</sup>

<sup>1</sup>Professor, The Open University of Japan

Chair of WEPA Advisor Meeting

<sup>2</sup>Freshwater Task Manager

Institute for Global Environmental Strategies (IGES)

## Water Environment Partnership in Asia (WEPA)

The Ministry of the Environment of Japan proposed WEPA at the 3rd World Water Forum in 2003 recognizing the critical situations of water quality in Asia

- WEPA aims to strengthen water environmental governance in Asia through
  - the collection and dissemination of information, and
  - capacity development of relevant stakeholders in partnership with partner countries in the region
- WEPA is a forum which allows partner countries
  - to discuss their experiences, and
  - identify potential solutions to improve the water environment.

# Water Environmental Partnership in Asia (WEPA)

- WEPA was launched in 2004 by the ministry of the Environment, Japan
- WEPA conducts its activity on a 5-year cycle and the second phase started in April 2009

WEPA has partners in **13** Asian countries

1. Democratic Socialist Republic of Sri Lanka (Sri Lanka)
2. Federal Democratic Republic of Nepal (Nepal)
3. Japan (Japan)
4. Kingdom of Cambodia (Cambodia)
5. Kingdom of Thailand (Thailand)
6. Lao People's Democratic Republic (Lao PDR)
7. Malaysia (Malaysia)
8. People's Republic of China (China)
9. Republic of Indonesia (Indonesia)
10. Republic of Korea (Republic of Korea)
11. Republic of the Philippines (Philippines)
12. Socialist Republic of Viet Nam (Viet Nam)
13. Union of Myanmar (Myanmar)



## Focal Points of WEPA



**Ministry of Environment ,  
Cambodia**



**Ministry of Environmental  
Protection, China**



**Ministry of Environment,  
Indonesia**



**Ministry of the Environment,  
Japan**



**National Institute of  
Environmental Research, Korea**



**Ministry of Natural Resources and  
Environment, Lao PDR**



**National Hydraulic Research  
Institute of Malaysia**



**Ministry of Agriculture and  
Irrigation, Myanmar**



**Water and Energy Commission,  
Nepal**



**Department of Environment and  
Natural Resources, Philippine**



**Ministry of Natural Resources  
and Environment, Thailand**



**Central Environmental Agency,  
Sri Lanka**



**Vietnam Environment  
Administration, Vietnam**

# Activities of WEPA

## 1<sup>st</sup> Phase of WEPA:

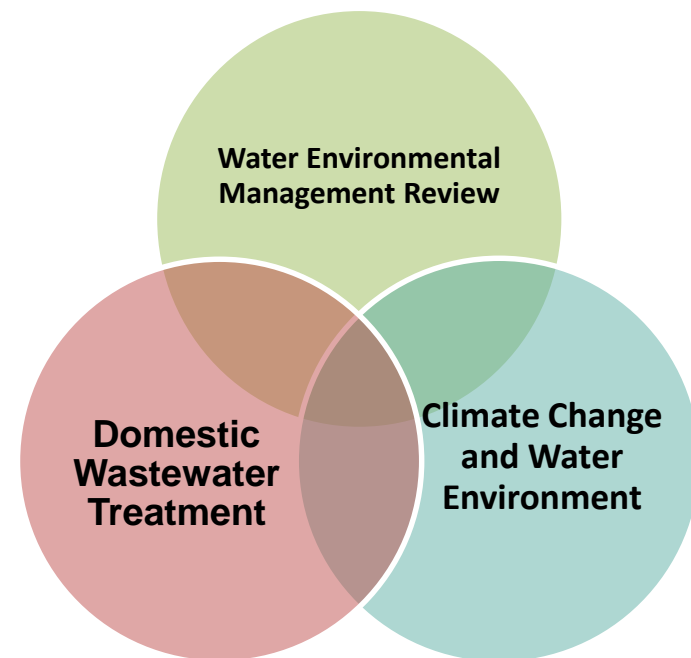
Development of Information Platform of Water Environmental Management



WEPA database [www.wepa-db.net](http://www.wepa-db.net)

## 2<sup>nd</sup> Phase of WEPA:

Knowledge Sharing for Solution Finding



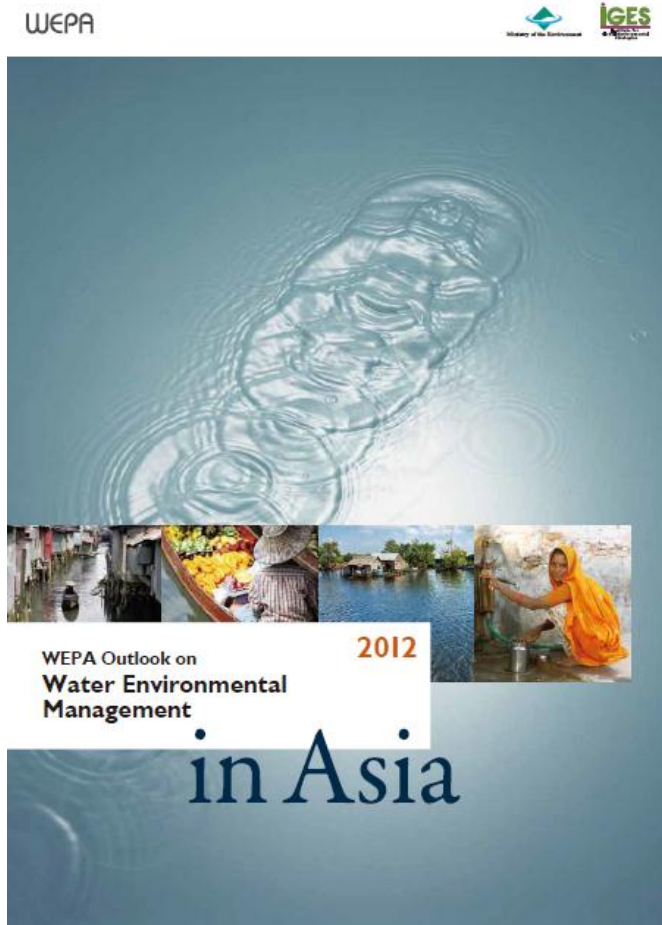
Identified Issue for 2<sup>nd</sup> Phase

## Organization of International Workshop

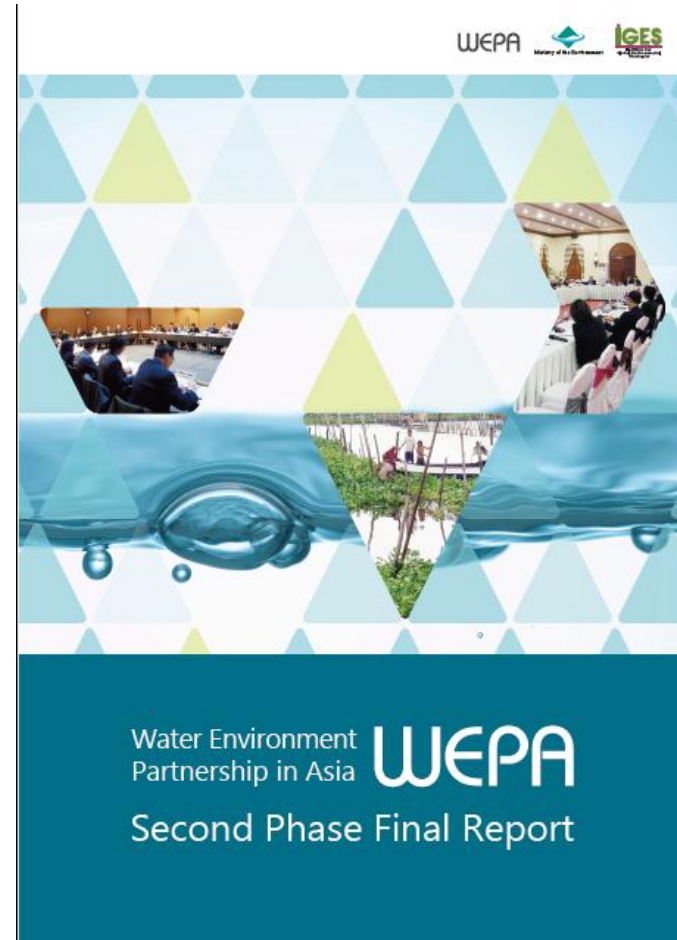


**International Workshop (at Manila in 2011)**

# Publications



**WEPA Outlook**



**Second Phase Final Report**

# Water Environmental Management Framework in Asia



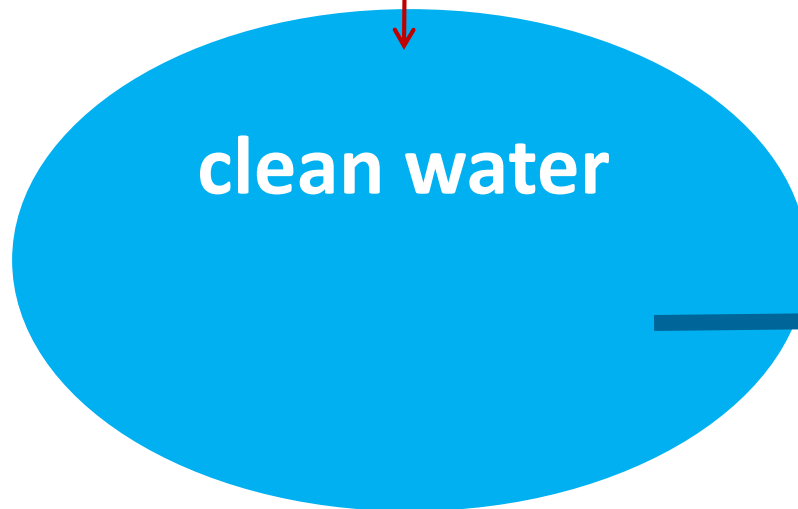
## Review Points of Water Environmental Management in WEPA

- 1) Legislation, policies and strategies for water environmental management**
- 2) Measures to ensure implementation and compliance**
- 3) Monitoring of ambient water and effluent**
- 4) Other factors contributing to enforcement and removal of incorrect practices**

## Basic concepts for the water management review in WEPA

### Clean water + good water ecosystem/water use

*No/little human impacts*



**clean water**

*Satisfactory water use  
without health damage*

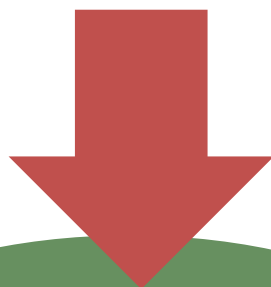


*Healthy/natural water ecosystem*

# Polluted/deteriorated water environment

## *Human impacts:*

- wastewater discharge,
- inappropriate water use
- destructive development, ...



## *health damage and hindered water use*



- *odor*
- *drinking water*
- *irrigation*
- *fishery*
- *recreation, ...*

*deteriorated water ecosystem*

## Minamata disease: Japanese experience

- 1908 : Japan Carbide & Co. (Nippon Chisso Hiryo, Chisso Corporation) established the Minamata Plant
- ca. 1955 : dead fishes on the sea surface, illness and death of cats and pigs
- 1956 : hospitalization of a patient with brain damage
  - Organomercury accumulation in humans (animals) from the mercury contaminated fish or shellfish
  - Lack of appropriate attention : another Minamata disease in the Agano River basin in 1965

**Itai-itai disease (1955) patients cried “itai-itai (ouch-ouch)” caused by cadmium in wastewater from the mineral mining company upstream**

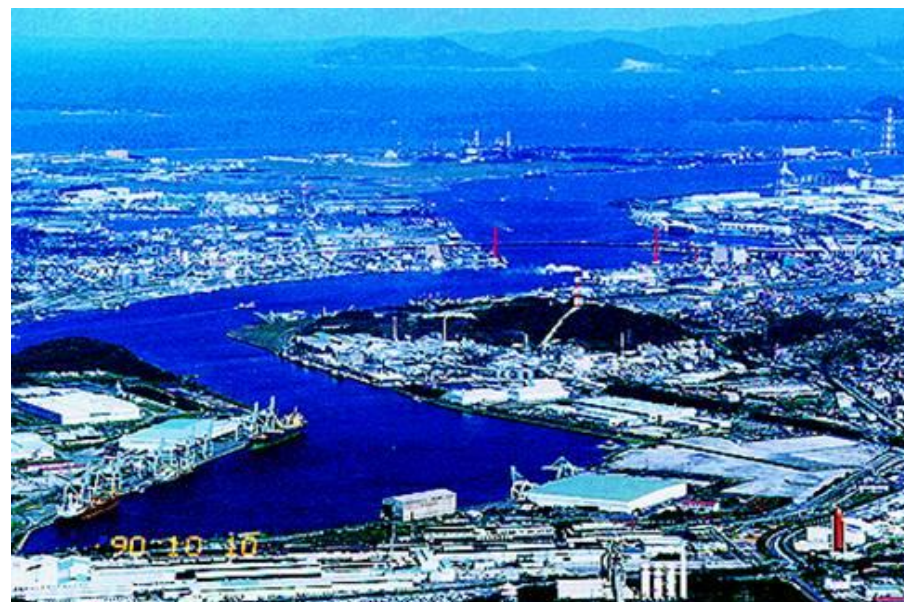
## Water pollution by industrial wastewaters: Japanese experience



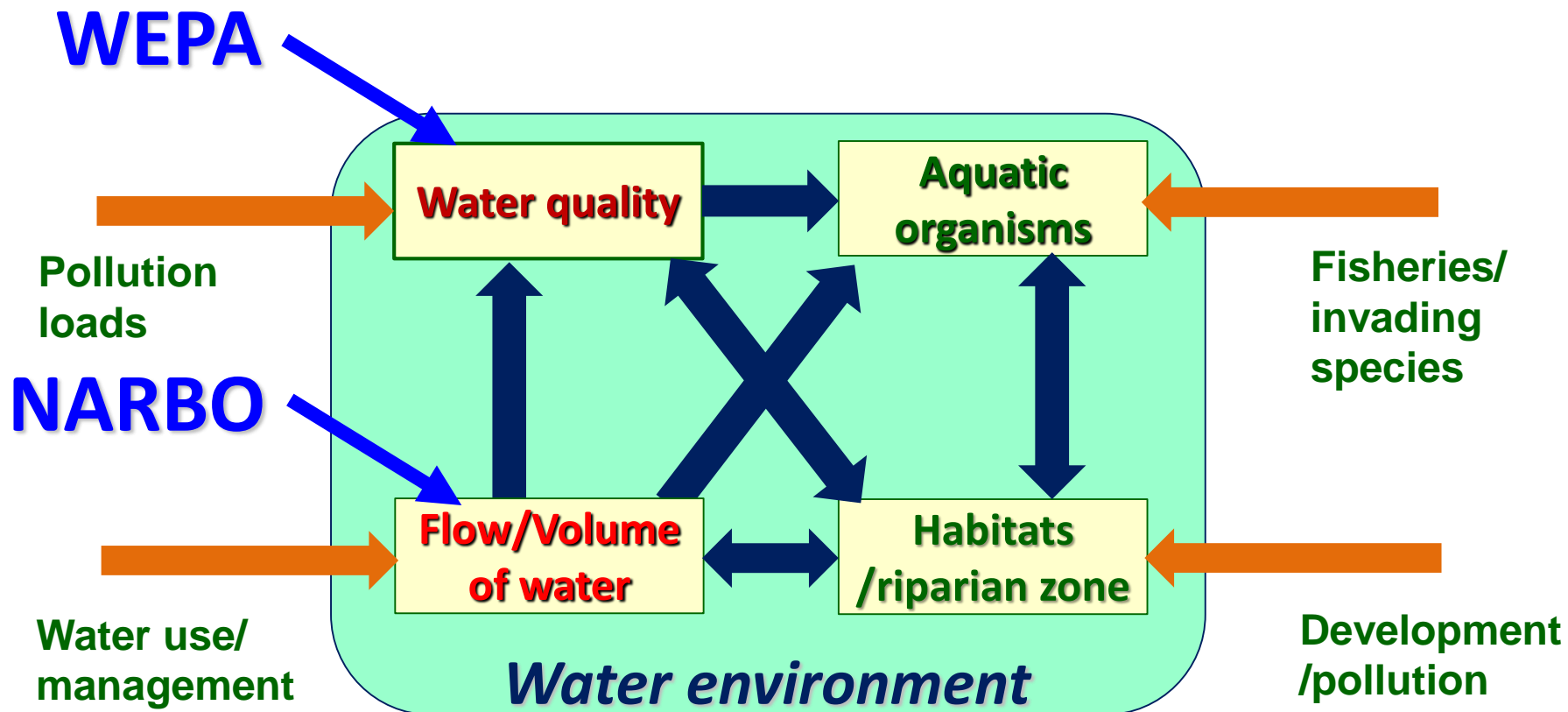
Ca. 1960s Dead sea

### *Dokai Bay, Kita-Kyushu*

1990 Restored bay



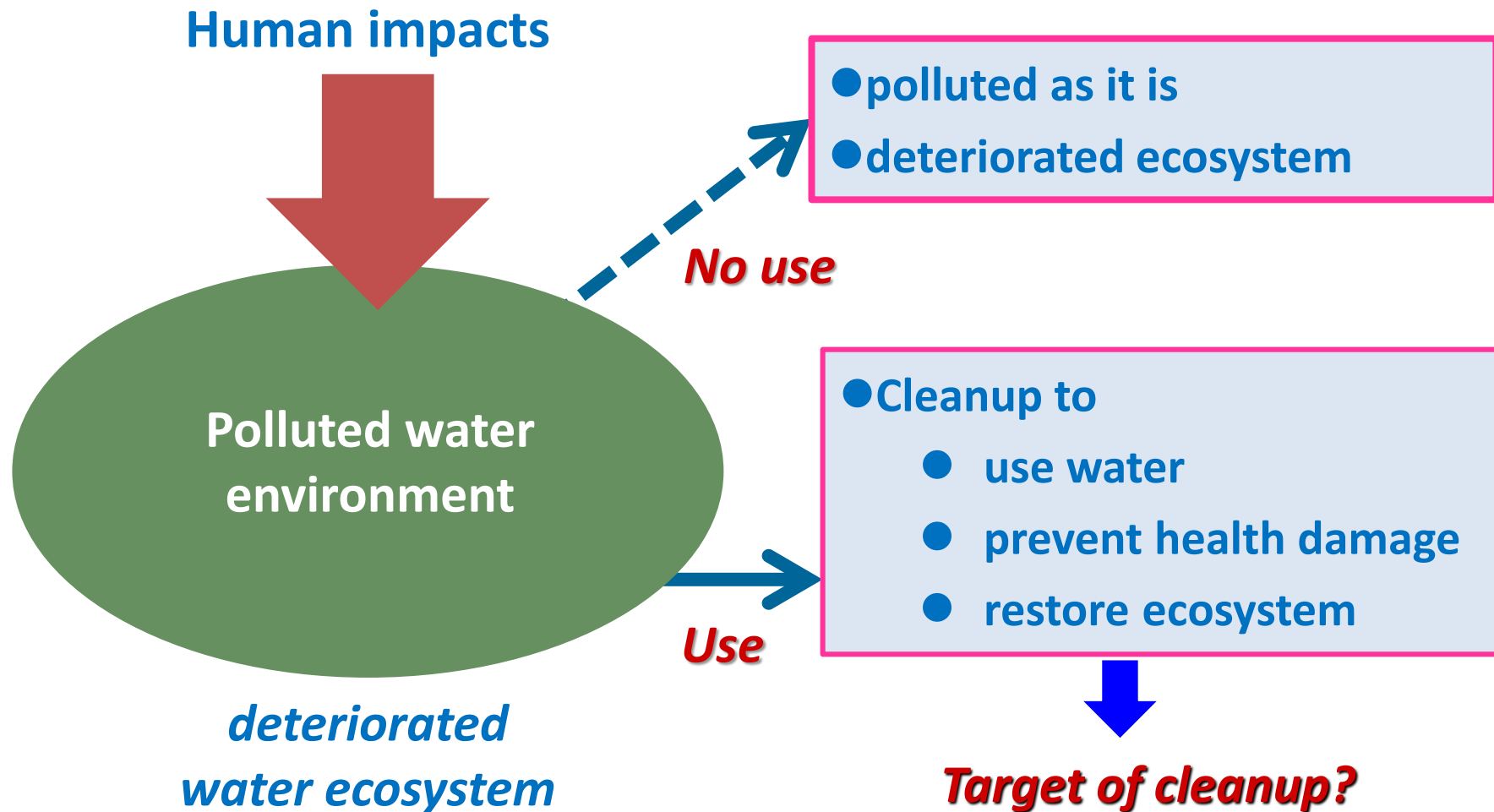
# Basic elements of water environment: Japan



***Water quality control is not enough for the restoration!***

The Fourth Basic Environment Plan, Japan (2012.3)

## How to manage Polluted water environment?



## The target of cleanup on water environment

### *What is the desirable conditions of water environment?*





























- Ideal conditions without any human impacts
  - cf. EU Water Framework Directive
  - Feasible/realistic with large population and economic growth?
- Necessary and sufficient conditions for human use
  - What do we expect for water?
    - Cleaner the better? *cf. A clear stream is avoided by fish?*
    - How do we define water use?
      - Drinking water, irrigation, fisheries, recreation, ...



## Review Points of Water Environmental Management in WEPA

- 1) Legislation, policies and strategies for water environmental management**
  - Objectives of water environmental management, ambient water quality standards as the administrative target, strategies or plans for water environment
- 2) Measures to ensure implementation and compliance**
  - Effluent standards, inspections and penalties for non-compliance
- 3) Monitoring of ambient water and effluent**
  - Ambient water quality monitoring, Effluent quality monitoring, Recording, maintenance and evaluation of monitoring results
- 4) Other factors contributing to enforcement and removal of incorrect practices**
  - Disclosure of ambient water quality monitoring results, review cycle of water environmental policy

## Water Environmental Standards in WEPA Countries

	Ambient water quality standards			 Human health  Living environment  Ecosystem/Biodiversity  One type  Others
	For surface water*	For groundwater	For marine and coastal waters	
Cambodia	 			
China				
Indonesia				
Japan	   *		 	
Philippines	 			
Sri Lanka				
Thailand				
Viet Nam				

MOEJ-IGES "WEPA Outlook on Water Environmental Management in Asia" (2012)

## The targets of water quality : Japan

### *Water quality necessary and sufficient for human use*

- Environmental water quality standards
- Desirable water quality to protect
  - human health
  - living environment
    - All the properties closely related with daily human life
    - The living environment for plants and animals closely related to human life
    - Water uses: Drinking water, irrigation, fishery, recreation, ...

## Environmental Water Quality Standards to Protect Human Health

cadmium	0.003	1, 1, 1-trichloroethane	1.0
total cyanide	N.D.	1, 1, 2-trichloroethane	0.006
lead	0.01	trichloroethylene	0.03
chromium (VI)	0.05	tetrachloroethylene	0.01
arsenic	0.01	1, 3-dichloropropene	0.002
total mercury	0.0005	thiuram	0.006
alkyl mercury	N.D.	CAT (simazine)	0.003
PCB	N.D.	thiobencarb	0.02
dichloromethane	0.02	benzene	0.01
carbon tetrachloride	0.002	selenium	0.01
1, 2-dichloroethane	0.004	Nitrate and nitrite	10
1, 1 -dichloroethylene	0.02	fluoride	0.8
cis- 1, 2-dichloroethylene	0.04	borate	1.0
		1,4-dioxane	0.05

(mg l<sup>-1</sup> or less)

- To be applied both for surface and groundwater
- annual average value except for total cyanide (maximum value)

## Environmental Water Quality Standards for Rivers

category	water use	standards				
		pH	BOD	SS	DO	CG
AA	Water supply class 1 ; conservation of natural environment, and uses listed in A-E	6.5-8.5	1	25	7.5	50
A	Water supply class 2 ; fishery, class I; bathing and uses listed in B-E	6.5-8.5	2	25	7.5	1,000
B	Water supply class 3 ; fishery, class 2, and uses listed in C -E	6.5-8.5	3	25	5	5,000
C	Fishery class 3 ; industrial water, class I, and uses listed in D -E	6.5-8.5	5	50	5	-
D	Industrial water class 2 ; agricultural water; and uses listed in E	6.0- 8.5	8	100	2	-
E	Industrial water class 3 ; conservation of living environment	6.0-8.5	10	*	2	-

*\*no floating matters like garbage*

## Review Points of Water Environmental Management in WEPA

### 1) Legislation, policies and strategies for water environmental management

- Objectives of water environmental management, ambient water quality standards as the administrative target, strategies or plans for water environment

### 2) Measures to ensure implementation and compliance

- Effluent standards, inspections and penalties for non-compliance

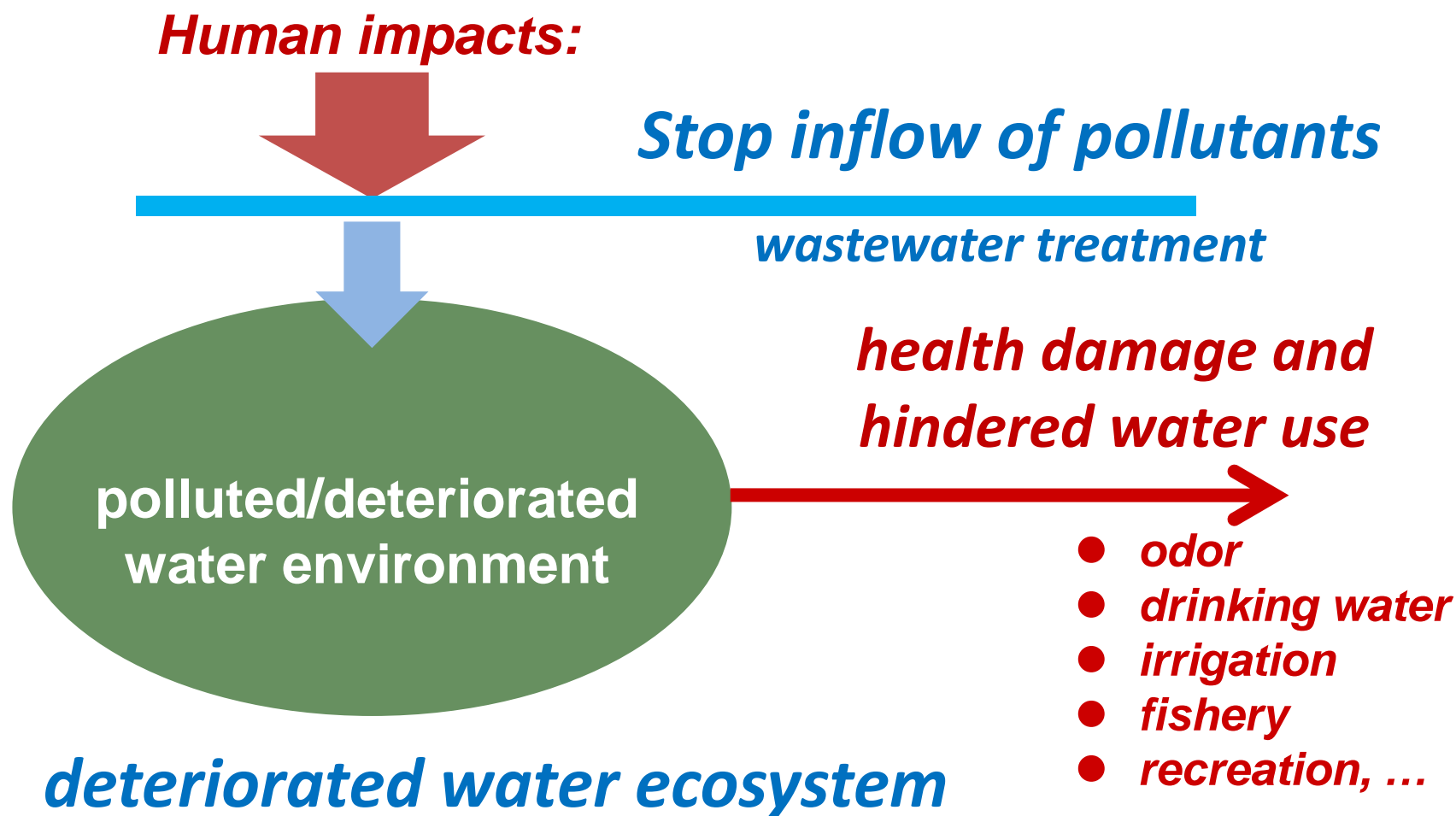
### 3) Monitoring of ambient water and effluent

- Ambient water quality monitoring, Effluent quality monitoring, Recording, maintenance and evaluation of monitoring results

### 4) Other factors contributing to enforcement and removal of incorrect practices

- Disclosure of ambient water quality monitoring results, review cycle of water environmental policy

## How to restore polluted/deteriorated water environment?



## Effluent Standard in WEPA Countries

Country	Industry	Domestic	Remarks
Cambodia	○	○	For 67 pollution source
China	○	○	Domestic: for urban wastewater treatment facility
Indonesia	○	○	
Japan	○	○	
Korea	○	○	
Lao PDR	○	○	Domestic: For urban area
Malaysia	○	○	
Myanmar	-	-	Yangon has effluent standard. National government starts discussion for establishment national standard
Nepal	○		Domestic: unknown
Philippine	○	○	Domestic: municipal wastewater
Sri Lanka	○	○	
Thailand	○	○	
Vietnam	○	○	

MOEJ-IGES “WEPA Outlook on Water Environmental Management in Asia” (2012)



## NATIONAL MINIMUM EFFLUENT QUALITY STANDARDS

parameters	standard values
pH	5.8-8.6
BOD, COD	160 (daily average = 120)
SS	200 (daily average = 150)
n-hexane extract	5.0 (mineral oil), 30 (animal fat and vegetable oil)
phenols	5.0
copper	3.0
zinc	5.0
dissolved Fe, Mn	10.0, 10.0
chromium	2.0
fluorine	15
number of C.G.	3,000 (ml <sup>-1</sup> daily average)
nitrogen	120 (daily average = 60)
phosphorus	16 (daily average = 8)

(mg l<sup>-1</sup> or less)

## Review Points of Water Environmental Management in WEPA

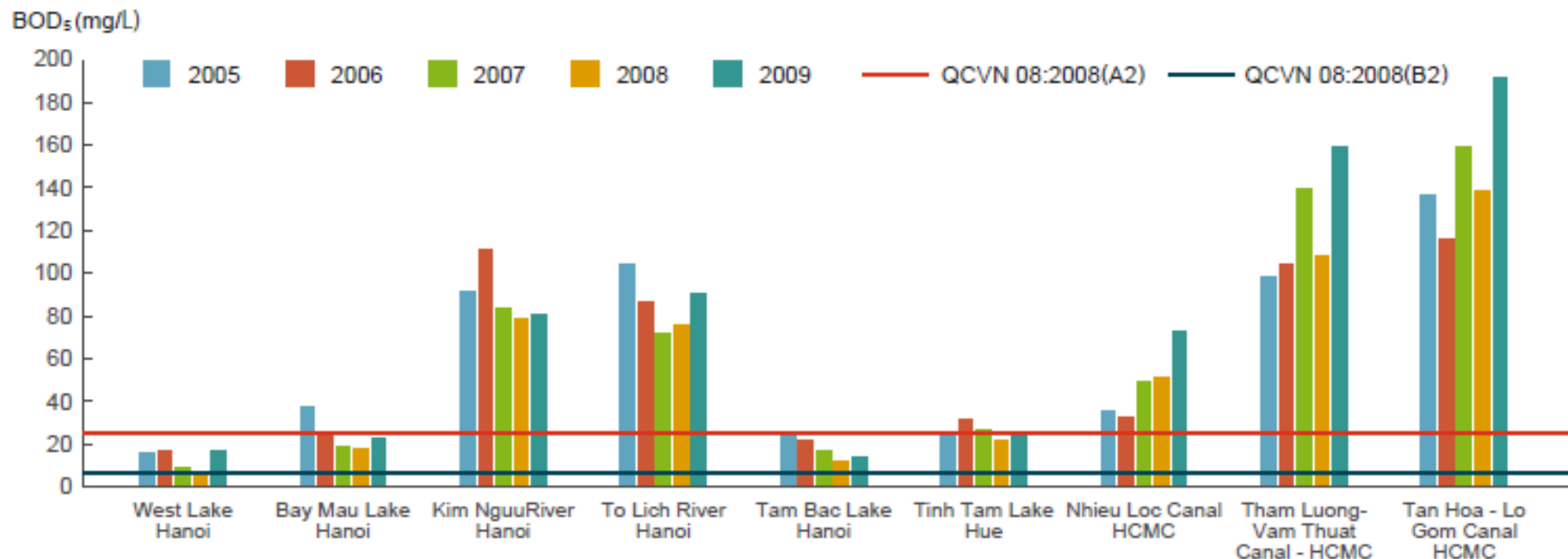
- 1) Legislation, policies and strategies for water environmental management**
  - Objectives of water environmental management, ambient water quality standards as the administrative target, strategies or plans for water environment
- 2) Measures to ensure implementation and compliance**
  - Effluent standards, inspections and penalties for non-compliance
- 3) Monitoring of ambient water and effluent**
  - Ambient water quality monitoring, Effluent quality monitoring, Recording, maintenance and evaluation of monitoring results
- 4) Other factors contributing to enforcement and removal of incorrect practices**
  - Disclosure of ambient water quality monitoring results, review cycle of water environmental policy

## Water Quality Monitoring and Disclosure

- **Implementation of Ambient Water Quality Monitoring**
  - Regular monitoring systems in most countries with different monitoring points, parameters, and frequency.
  - Monitored on a project basis or for a specific benefit (e.g., irrigation and drinking water) in Nepal, Myanmar and Sri Lanka.
- **Disclosure of the result**
  - Mainly reported to the general public via annually published environmental quality reports in many countries.
  - Public access on websites are available in China, Japan, Republic of Korea, Malaysia, Thailand, and Viet Nam.

# Water Quality in WEPA Countries

## Increase Stress of Water Quality (Viet Nam: 2005-2009)

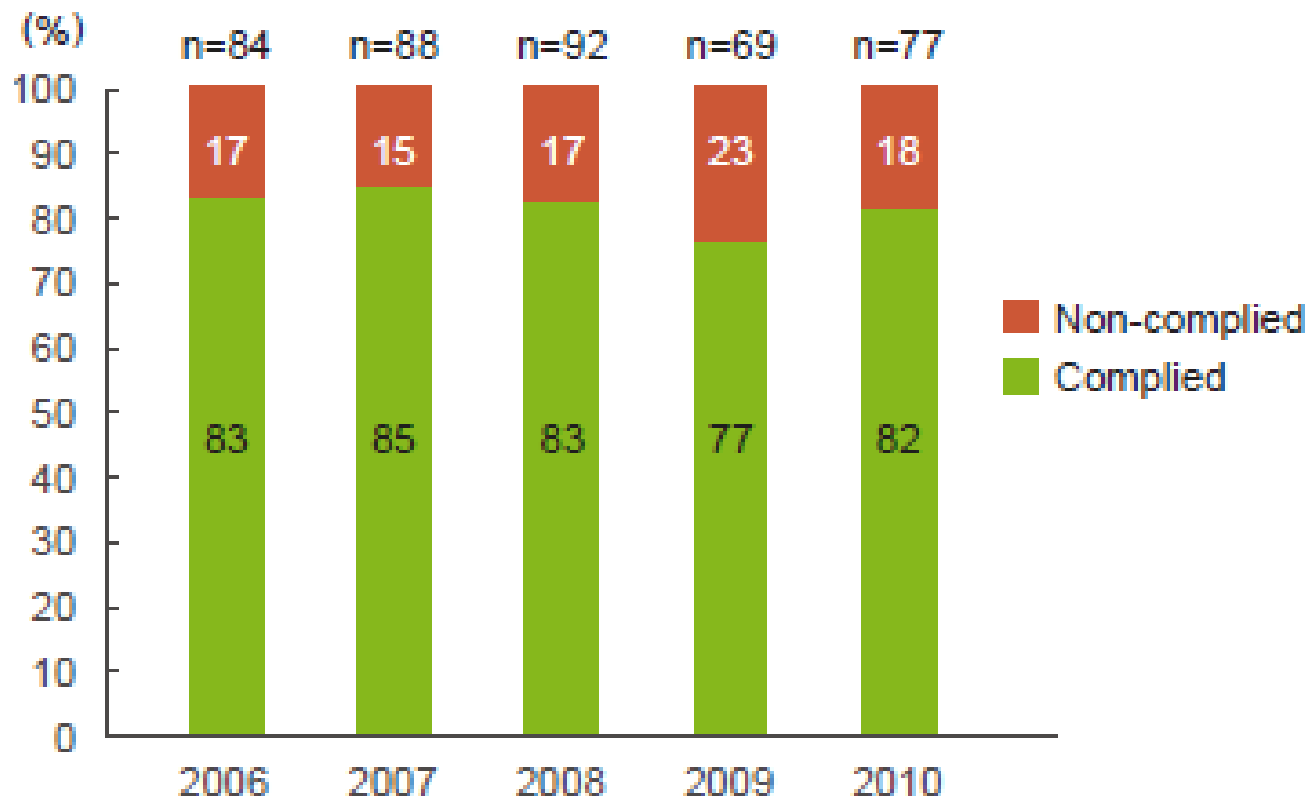


### Annual average BOD in some rivers, lakes and inside city canals

QCVB 08:2008 (A2) : water for domestic water supply with appropriate treatment

QCVB 08:2008 (B2) : water for water transportation and other purposes with demand for low quality water

## Increase Stress of Water Quality (Philippine: 2006-2010)



Percent compliance of DO in class C rivers

Class C: Water for fishery production, Recreation water class II (boating etc.), Industrial Water Supply Class I

## Increase Stress of Water Quality (Philippine: 2003 - 2010)

Rivers	Annual average of BOD (mg/L)		% Change
	2003	2010	
Marikina River	18.2	31	Increased by 70%
Paranaque River	42	38	Improved by 10%
Balili River	14.8	37	Increased by 150%
Meycauayan River	38.2	59	Increased by 54%
Marilao River	32.3	24	Improved 26%
Bocaue River	12.2	11	Improved 10%
Imus River	8	12	Increased by 50%
Ylang-ylang River	24.4	119	Increased by 388%
Anayan River	8.9	4	Improved 55%
Iloilo River	2.4	12	Increased by 400%
Luyang River	2.4	4	Increased by 67%
Sapangdaku River	7.6	6	Improved 21%

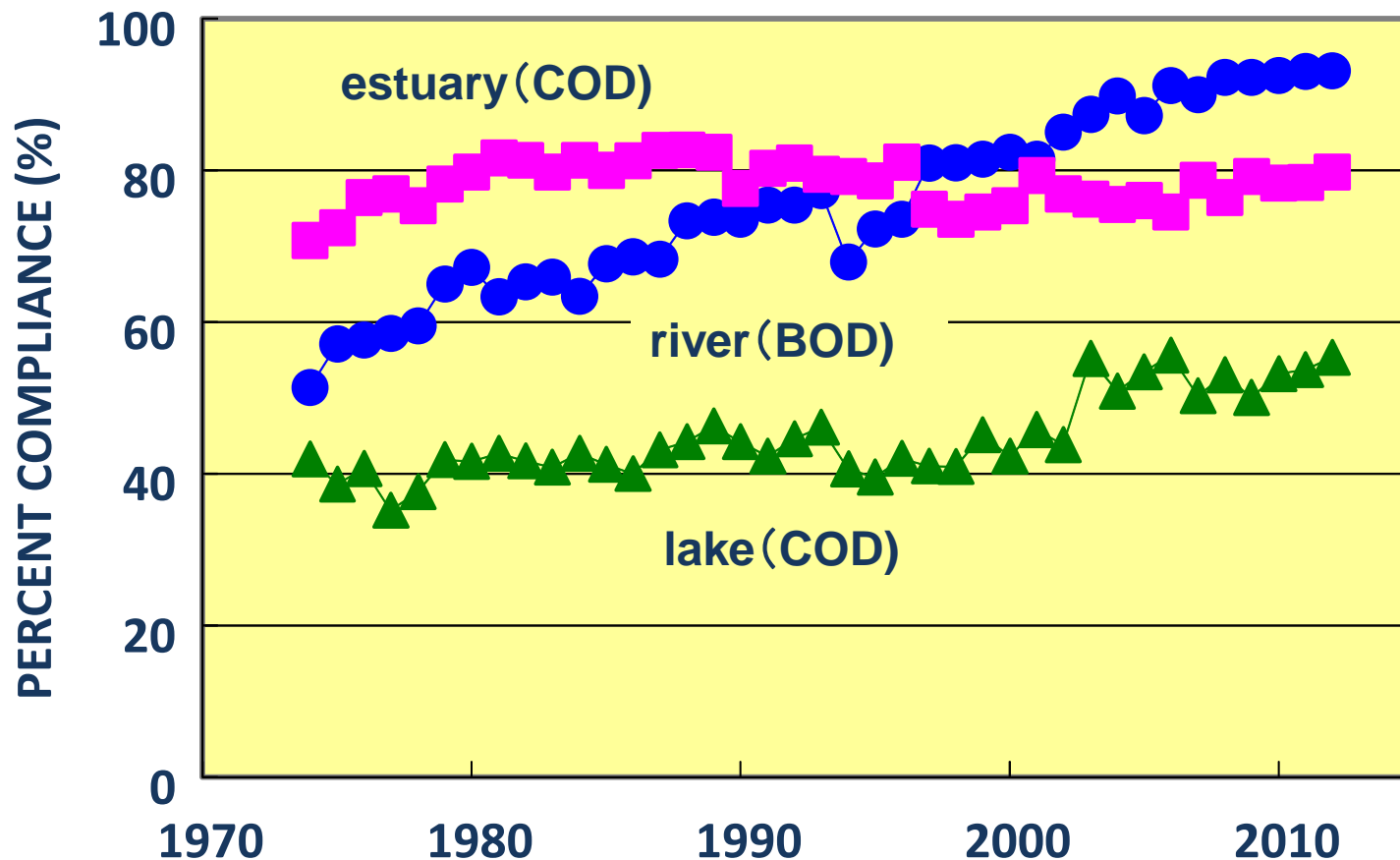
(Source: Data provided by the focal person in 2011)

**Annual average BOD in selected priority rivers**

***Although water quality in some rivers are improved, there are many rivers with significant deterioration***

# PERCENT COMPLIANCE FOR WAETR QUALITY STANDARDS

*Parameters on living environment : Japan*

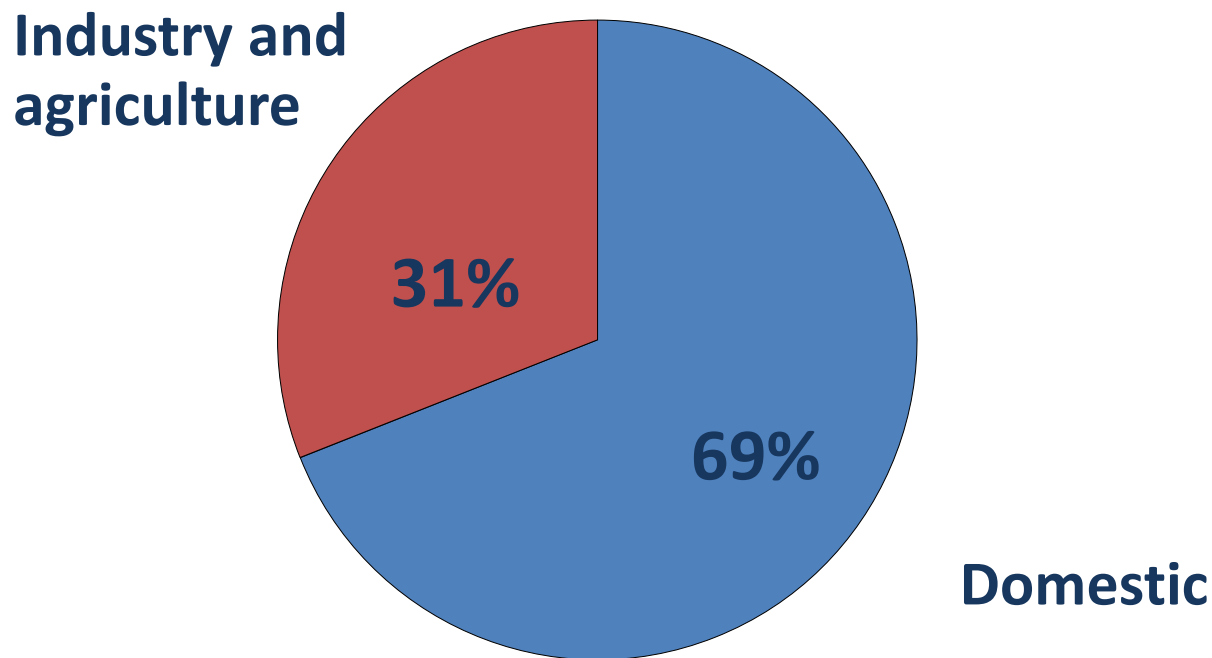




# Pollution Sources in WEPA Countries

*Domestic , Industrial, Agricultural, etc.?*

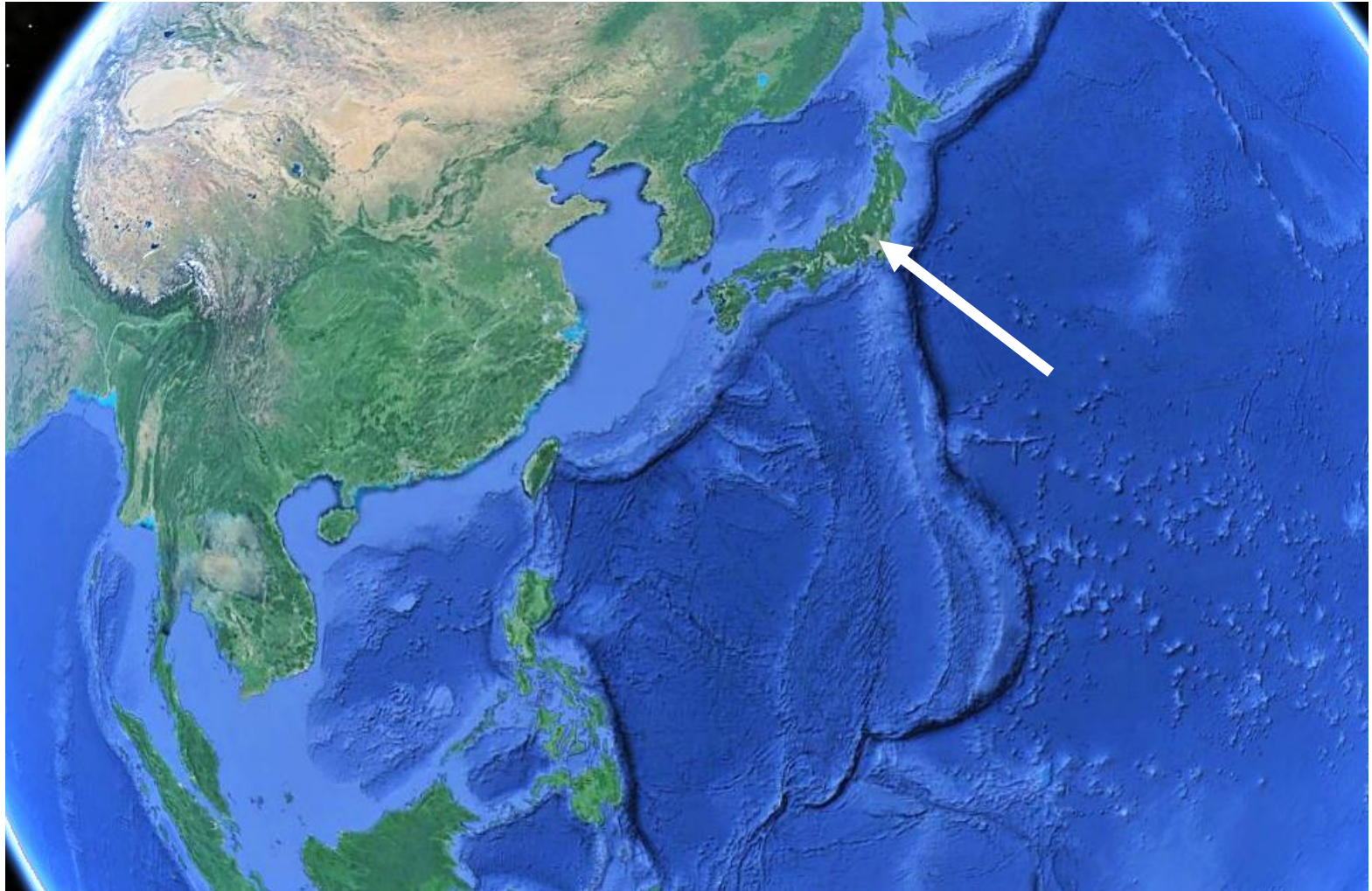
## Pollution Sources of Laguna Lake



**BOD loads from key potential sources to Laguna lake (2003)**

Source: World Bank, Philippine Environment Monitor 2003

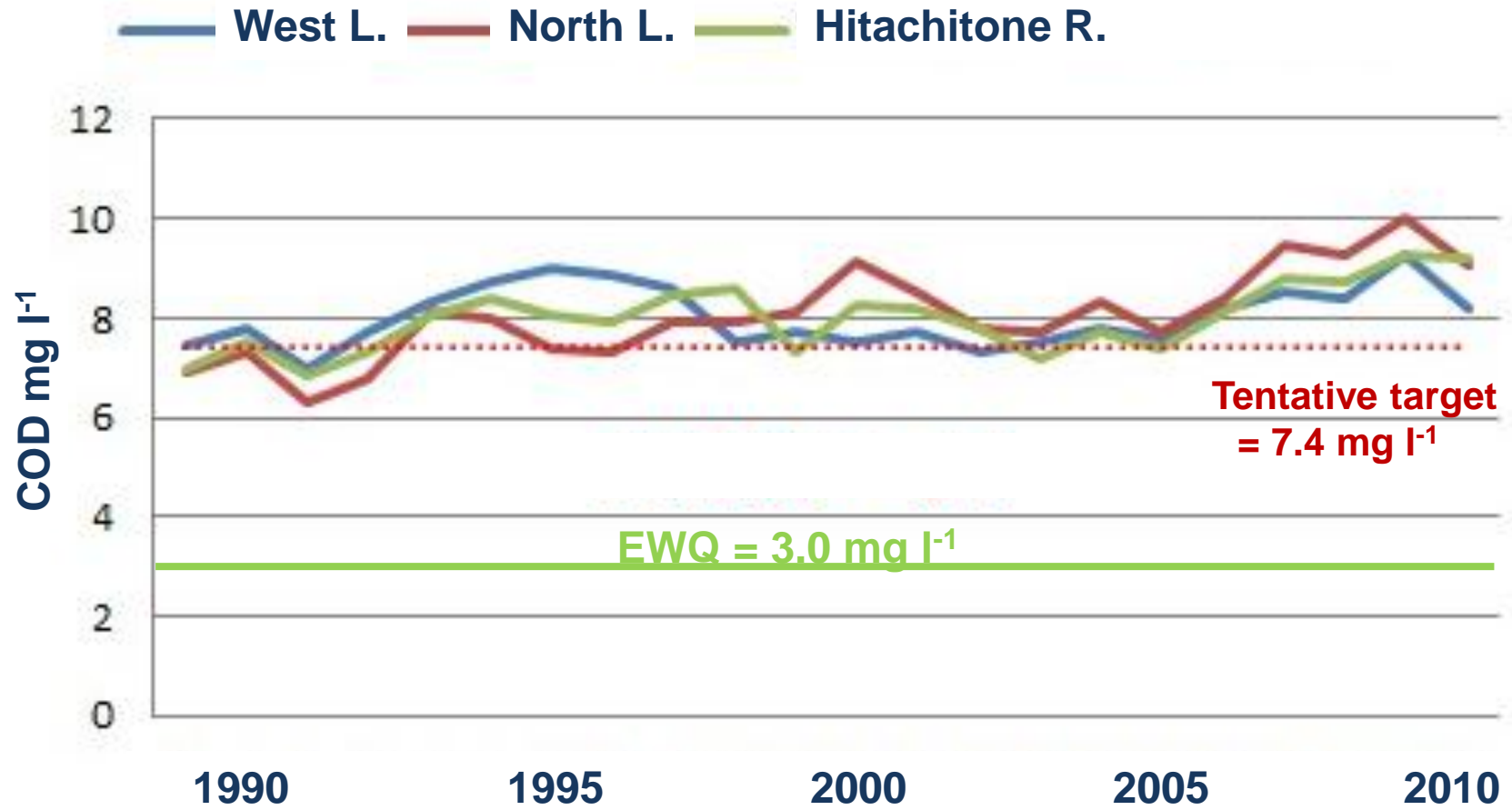
## Lake Kasumigaura, Japan



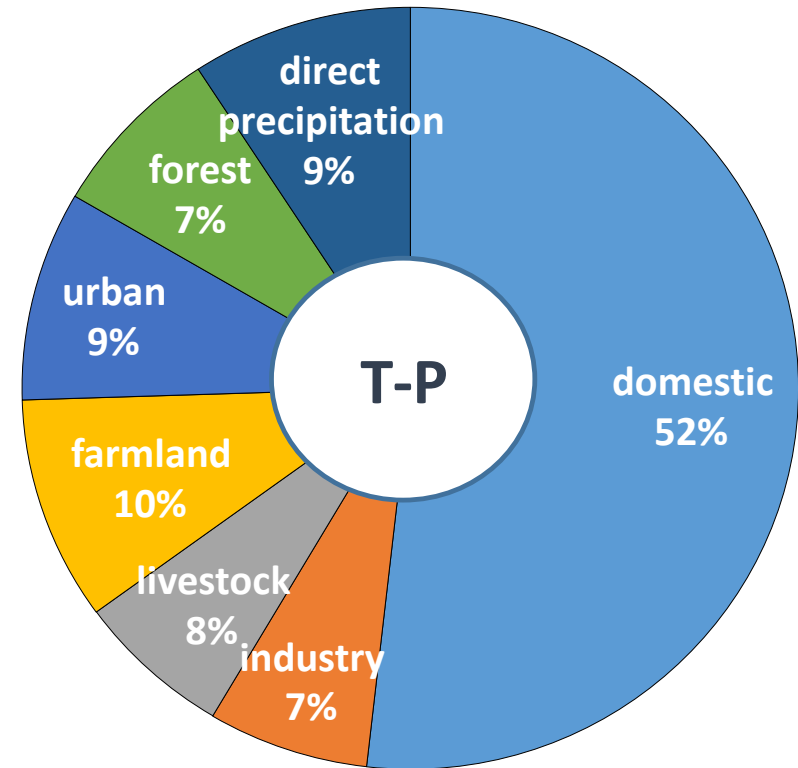
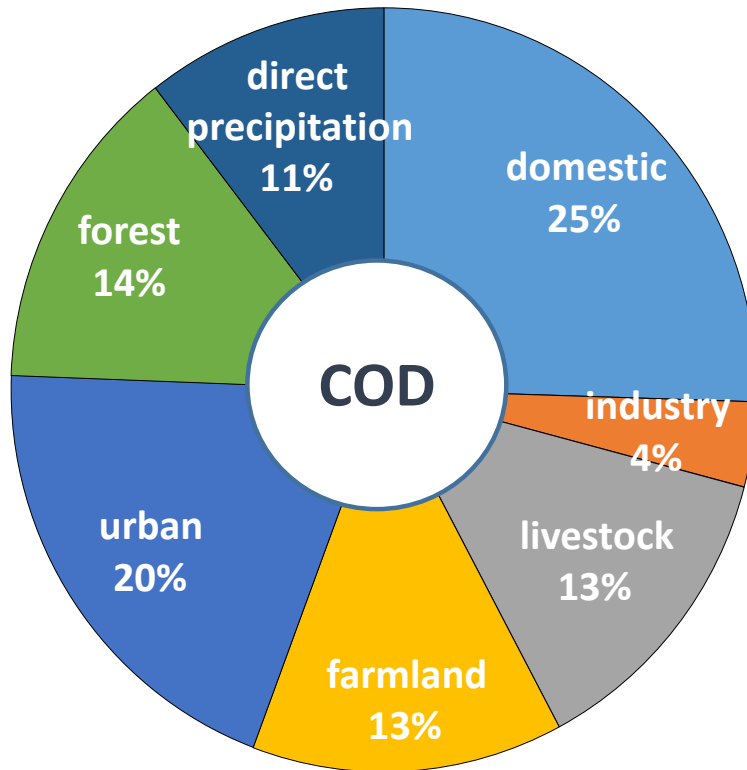
## Lake Kasumigaura, Japan



# COD in Lake Kasumigaura, Japan



## COD and T-P loads into Lake Kasumigaura, Japan



***Domestic Wastewater Treatment is an urgent issue!***

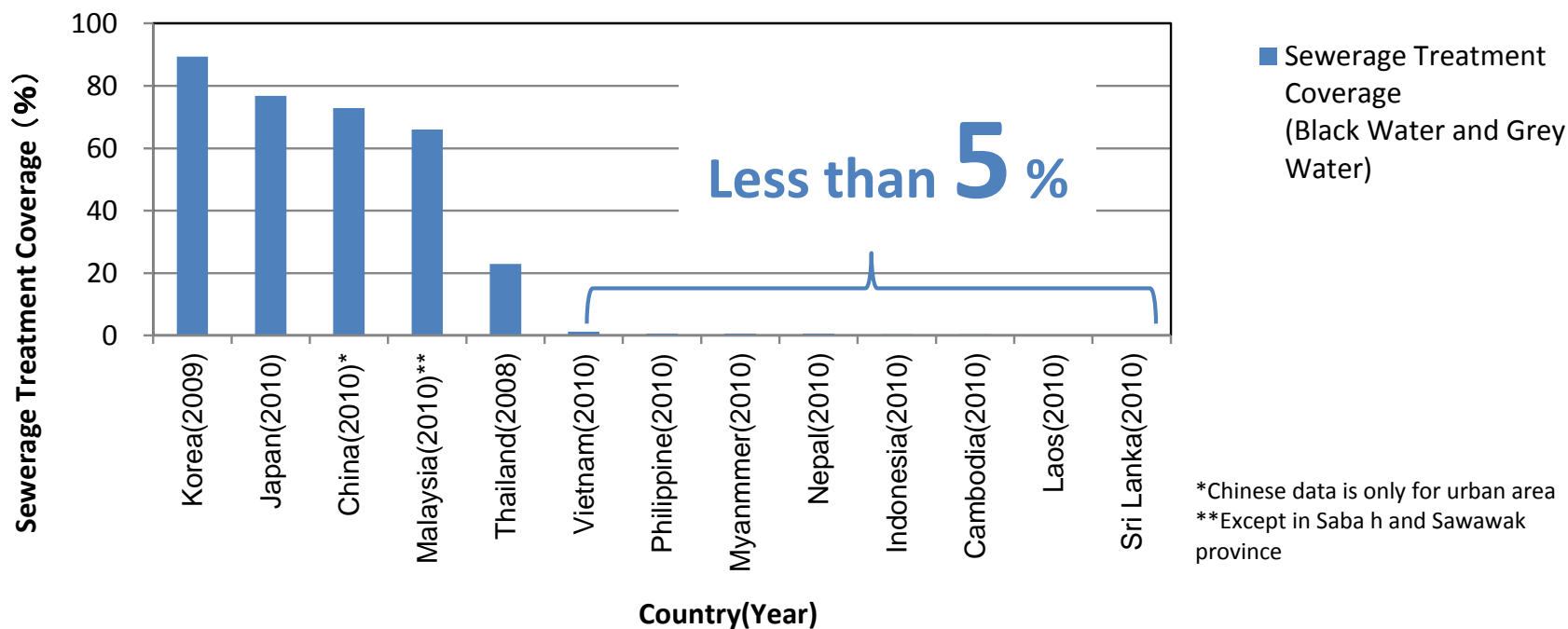
# Domestic Wastewater Treatment in Asia

## WEPA's approach for issues on domestic wastewater treatment

- To accumulate and share the knowledge of **current situation and issue** on domestic wastewater treatment in Asia
- To share **“Good Practices”**
- **Policy Framework** as well as technology



# Centralized Treatment Coverage in Asian Countries

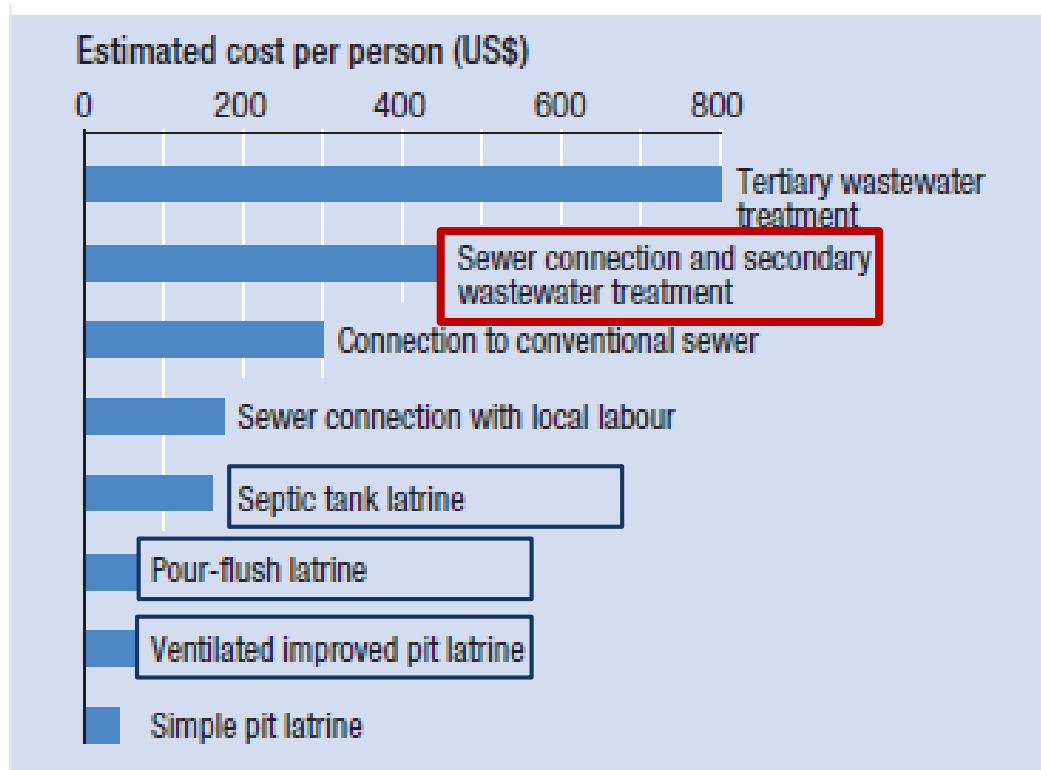


Service coverage ratio of sewerage treatment in selected Asian countries

## Septic Tank Coverage Population in selected WEPA Countries

<b>Malaysia (2010)</b>	<b>20%</b>
<b>Vietnam (2008)</b>	<b>41%</b>
<b>Indonesia (2012)</b>	<b>53%</b>
<b>Cambodia (2008)</b>	<b>43%</b>
<b>Manila/Philippine (2010)</b>	<b>71%</b>

# Challenge in Centralized Approach



Source : Human Development Report 2006, UNDP

## Cost of different domestic wastewater treatment methods

# Decentralized Approach as Alternative of Centralized Treatment

## Decentralized Approach

### Centralized Treatment

Wastewater collection and treatment system for more than two communities (sewerage treatment plant)



### Cluster Treatment

Wastewater collection and treatment system for two or more households but less than an entire community (such as community based treatment plant)

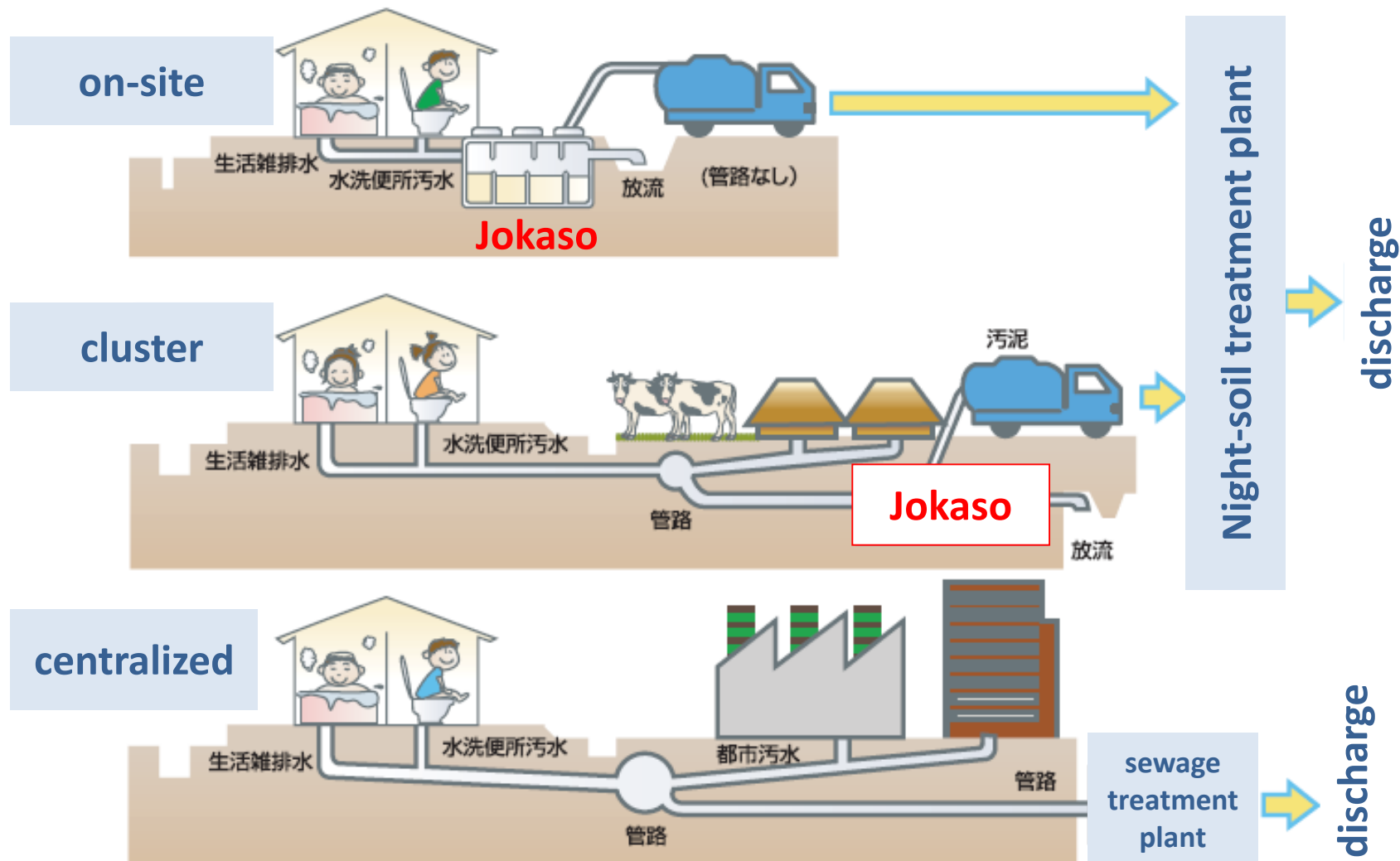


### On-site Treatment

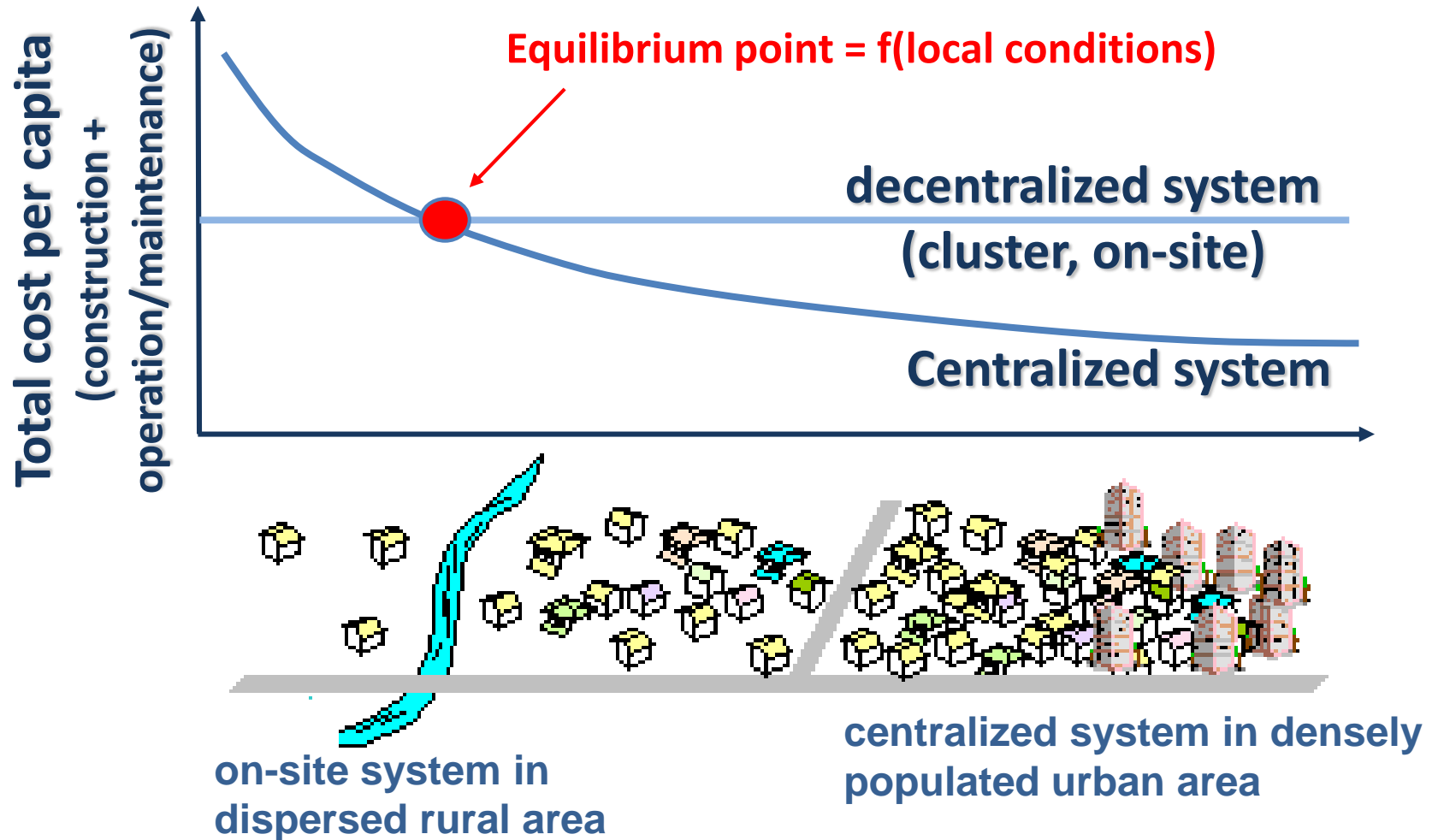
Treatment system to collect, treat and discharge domestic wastewater from individual households without the use of community-wide sewers (such as septic tank, Johkasou)



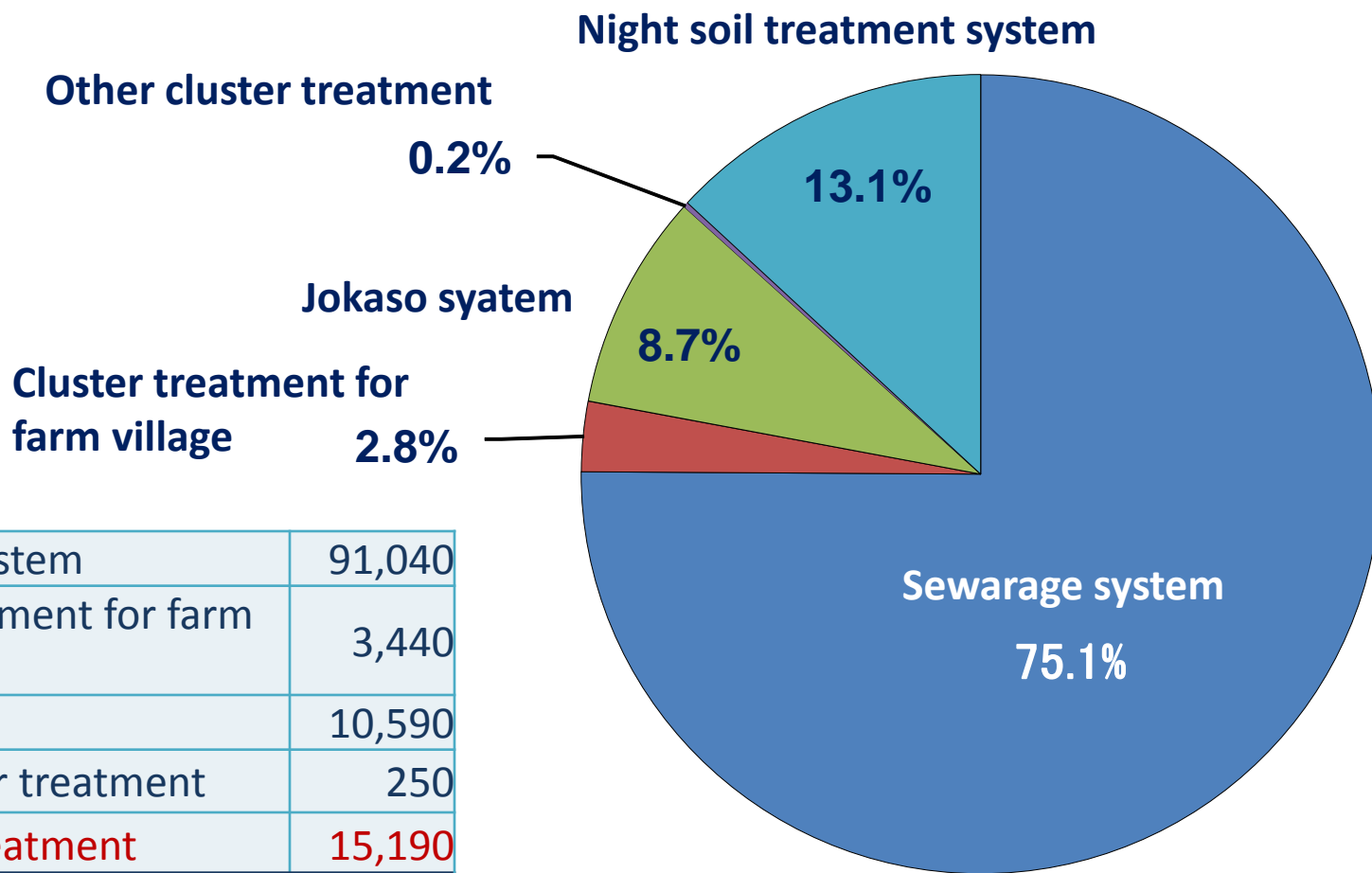
# Domestic Wastewater Treatment Systems: Japan



## Costs for centralized vs. decentralized (cluster/on-site) systems



## Population served by wastewater treatment systems: Japan, 2010



Sewerage system	91,040
Cluster treatment for farm village	3,440
Jokaso	10,590
Other cluster treatment	250
<b>Night soil treatment</b>	<b>15,190</b>
<b>Total population</b>	<b>121,230</b>

# Focus points for decentralized systems

## Technology

- Targeted wastewater (Black/Grey)
- Methodology for collection and treatment
- Removal rate/Effluent water quality
- Cost for construction and operation/maintenance
- Methodology of sludge treatment/disposal

## Management Framework (Obligation/Responsibility)

- Responsible body (Who has responsibility for construction and operation?)
- Obligation and responsibility in legal framework

## Management Framework (Governmental Support)

- Subsidy system
- Technological guideline
- Other support

## Management Framework (Operation and Monitoring)

- Methodology of operation and maintenance
- Charging system
- Monitoring and reporting



## Lessons learned on domestic wastewater treatment

- **Appropriate technology** should be decided considering natural and socio-economical condition and level of development, etc. at the site.
- In order to encourage **proper installation and operation**, regulations alone are not sufficient. Governmental support in the respect of technological standardization, financing, outsourcing and education is needed.
- Proper Operation and Maintenance including Charging and Periodical Monitoring is required for **sustainable management of domestic wastewater treatment system.**

## Overall Summary

- **Basic water environmental management framework** such as legal system, policy and strategies has already been developed in most WEPA countries. However, **level of its implementation and enforcement** is different in different countries. Especially, many countries face implementation and enforcement of **wastewater management framework**.
- **Appropriate wastewater management system (technology and framework)** should be decided **considering natural and socio-economical condition and level of development, etc. at the site.**

*Thank you for your listening!*  
*Time for Q & A*



**Akitsu, Higashi-Hiroshima, The Seto Inland Sea, Japan**