

ON-SITE DOMESTIC WASTEWATER TREATMENT IN THAILAND

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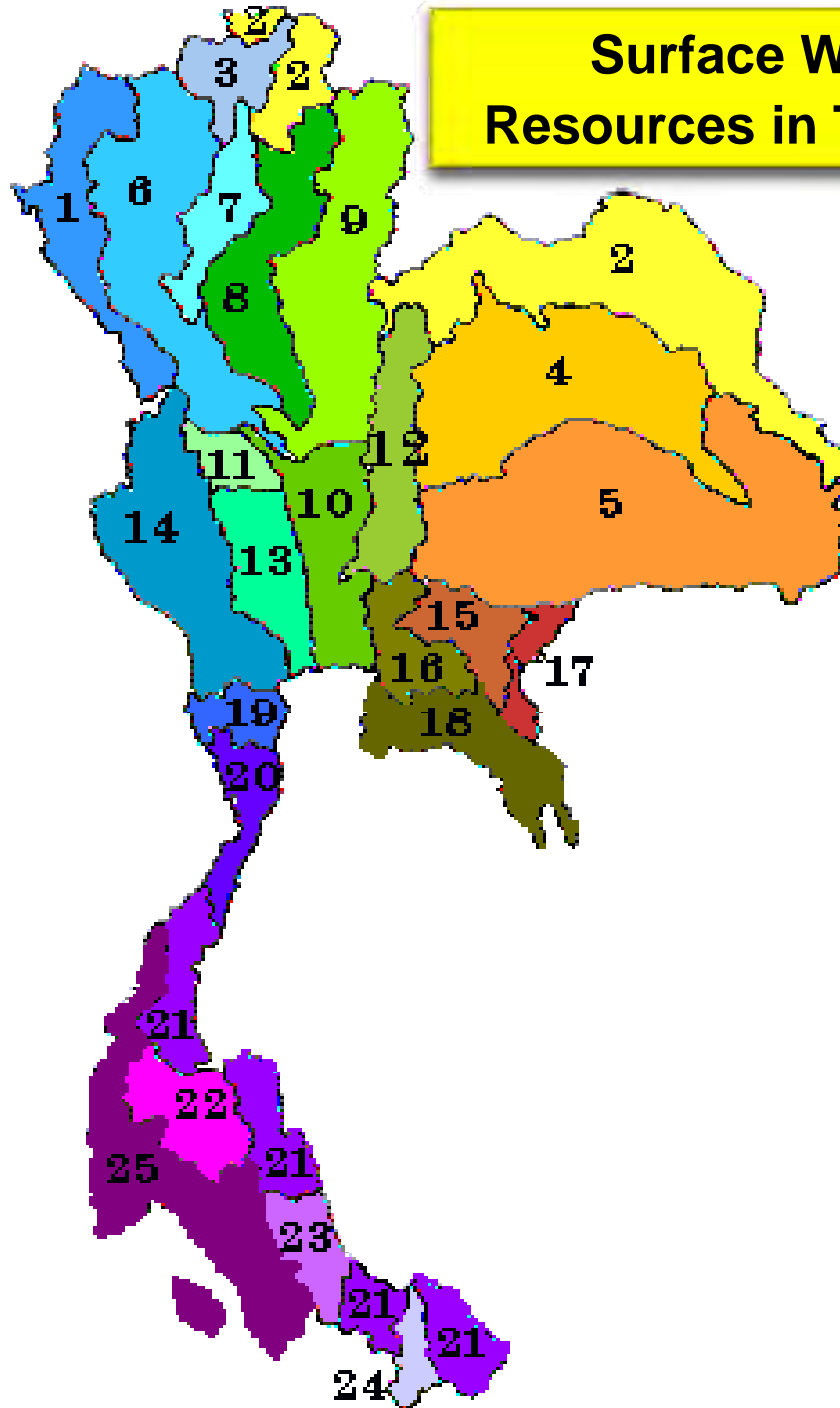
Workshop on On-site Domestic Wastewater Treatment in Asia
November 20-21, 2013, Tokyo, Japan

Population

- 64,623,000 million
- City = 29,662,000 million
- Local area = 34,961,000 million

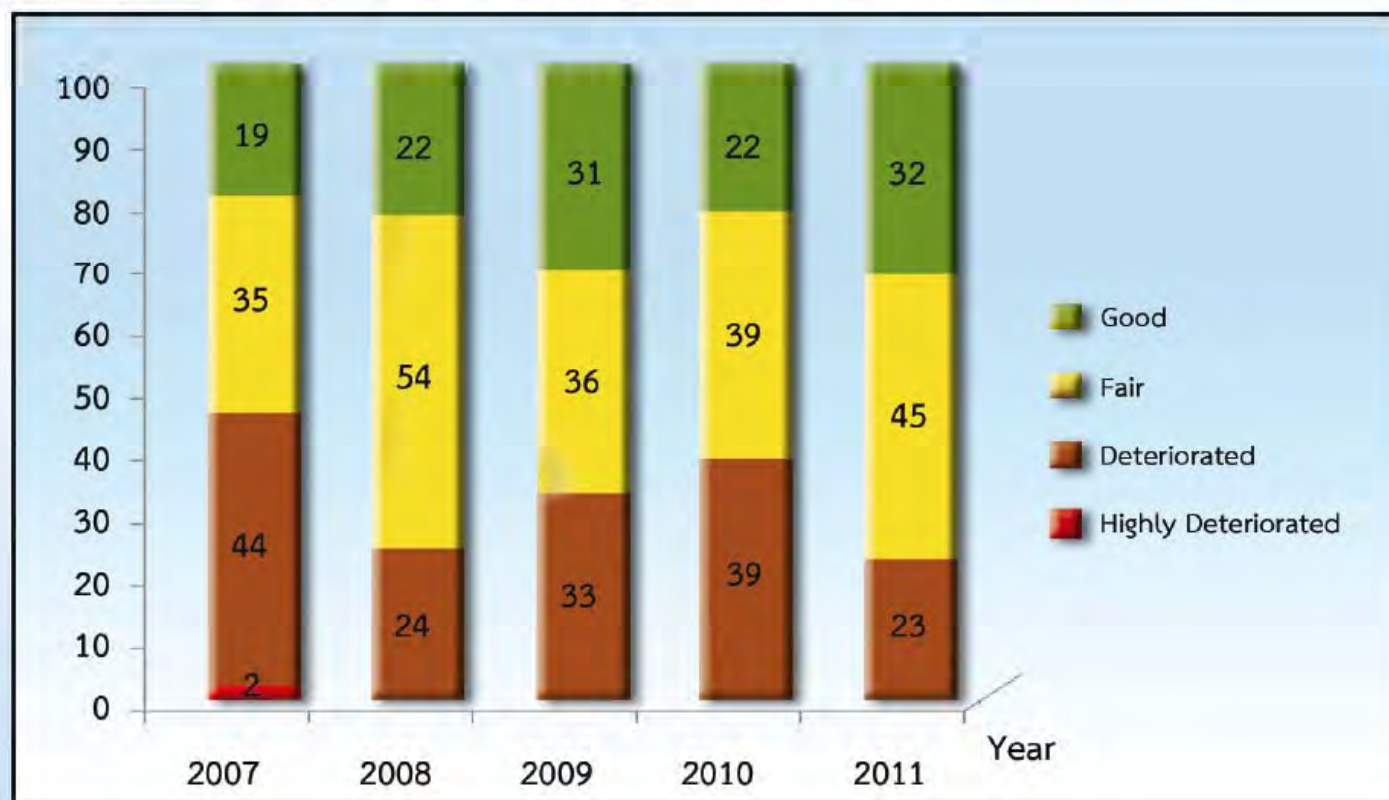
Surface Water Resources in Thailand

Surface Water Resources:
divided into 25 River Basins



- | | |
|----------------|---------------------|
| 1 Salaween | 14 Mae Klong |
| 2 Khong | 15 Prachinburi |
| 3 Kok | 16 Bang Pakong |
| 4 Chi | 17 Tonele Sap |
| 5 Mun | 18 Eastern Coast |
| 6 Ping | 19 Phetchaburi |
| 7 Wang | 20 Western Coast |
| 8 Yom | 21 South-East Coast |
| 9 Nan | 22 Tapi |
| 10 Chao Phraya | 23 Songkhla Lake |
| 11 Sakae Krang | 24 Pattani |
| 12 Pasak | 25 South-West Coast |
| 13 Tha Chin | |

Overall water quality of water resources during 2007-2011, tended to improve. The number of water resources at a deteriorated level was decreased and no water resource at a highly deteriorated level had been found since 2008. One of the important factors of water quality was rainfall, such as 2008 and 2011. However, the water quality had decreased in some areas (Figure 17 and Table 12).



Year	2007	2008	2009	2010	2011
Rainfalls (mm.)	1,630.9	1,751.4	1,609.8	1,650.5	1,947.9

Figure 17 : Percentage of Water Resources at Good, Fair, Deteriorated and Highly Deteriorated and Rainfalls during 2007 – 2011

Source : Thai Meteorological Department

The main causes of deteriorated water quality were municipal wastewater that was not sufficiently treated because there were only 101 wastewater treatment plants around the country, which treated only 10% of all wastewater, and industrial and agricultural untreated wastewater drainage into water resources. Steps taken to decrease water pollution were measures determining to control water drainage from different sources, water use reduction promotion, waste and wastewater reduction and legal waste disposal and water treatment. In addition, local administrative organizations created efficient municipal wastewater treatment systems so that water quality met the standard and collected wastewater treatment fees. Communities were also encouraged to take part in water protection campaigns. However, many businesses did not have a clear pollution control measures such as cultivation, water use in irrigable areas, livestock farming, municipal industry, etc. Water protection or wastewater drainage standards were not consistent with wastewater treatment capacity of water resources, considering from current water quality problems in each region.



The main reason causing water quality deterioration, considering from the parameters, was **due to the wastewater from communities**. This also included wastewater from other activities, such as industrial activities and agricultures which discharged wastewater to water sources without prior water treatment. As a solution to these causes, there should be campaign encouraging the public to reduce water usage in order to reduce wastewater and to manage wastewater at the point source by treating the wastewater from household and recycling the wastewater.



The main reason causing water quality deterioration, considering from the parameters, was due to the wastewater from communities.

As a solution to these causes, there should be campaign encouraging the public to **reduce water usage** in order to reduce wastewater and to manage wastewater at the source by **treating the wastewater from household and recycling the wastewater**. The local government should **construct community wastewater treatment system**.

Following by

- charge a fee for wastewater treatment
- encourage the business owners to apply clean technologies
- enforce wastewater treatment before draining to the environment
- control low quality water drainage through irrigation or agricultural areas to reduce
- enforce the law on the drainage water standard



MUNICIPAL WASTEWATER MANAGEMENT IN THAILAND

Status of Municipal Wastewater Treatment Facilities in Thailand

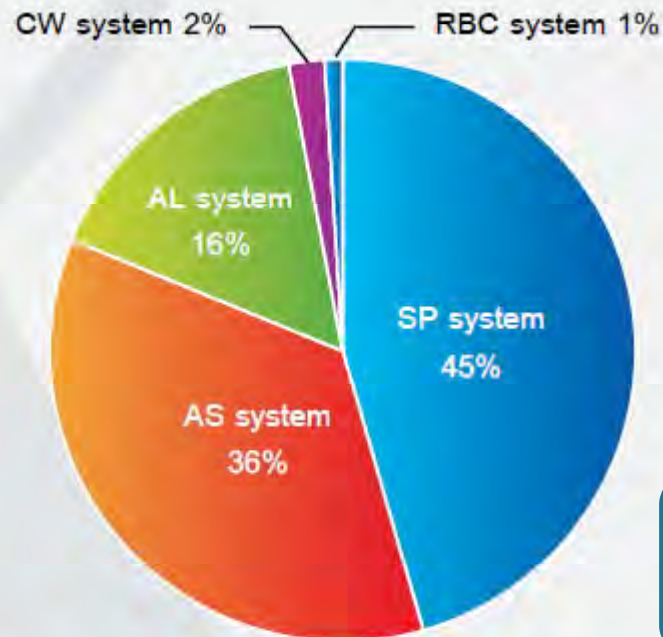
Location of 101 Municipal Wastewater Treatment Facilities in Thailand



- ● Constructed 92 Plants
- ▲ Under Construction 8 Plants
- Delayed (Samutprakan Province) 1 Plant



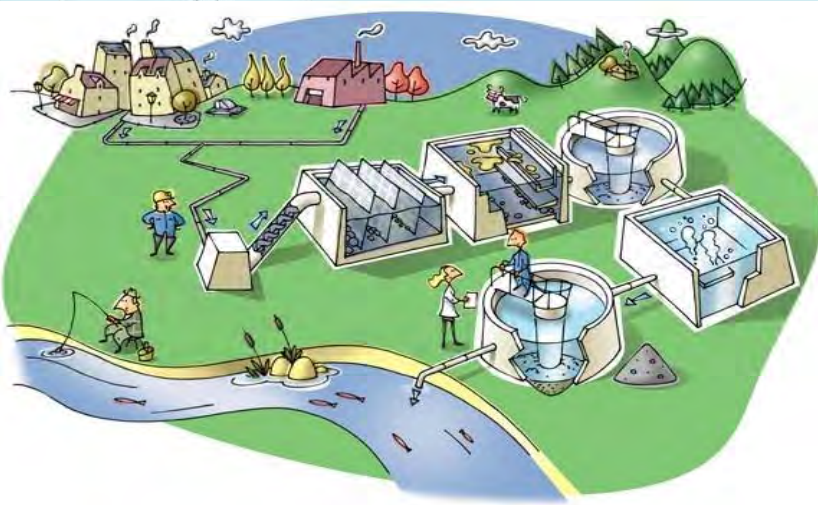
Technology for Wastewater Treatment Facilities in Thailand



SP system	46 plants
AL system	16 plants
AS system	36 plants
CW system	2 plants
RBC system	1 plant

Municipal Wastewater Treatment Systems defined by System

Types of Collection Systems



Central Wastewater Treatment

Design Criteria for Central Wastewater Treatment

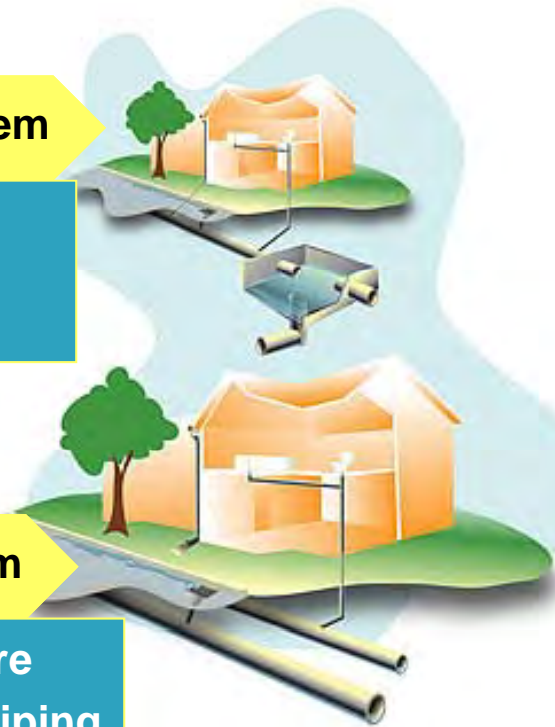
The type of collection systems	BOD (mg/l)	SS (mg/l)
Combined Sewer System	65 - 110 (80)	40 - 110 (80)
Separate Sewer System	(160)	(160)

Combined Sewer System

drain both runoff and sewerage within one system

Separate Sewer System

sewerage and runoff are collected in separate piping systems



Number and Capacity of Municipal Wastewater Treatment System

Organization	Completed construction (plants)				Under construction (plants)		Delayed project (plant)	Total (plant)
	Running operation (plants)	Testing operation (plants)	Not deliver (plants)	Under maintenance (plants)	Under construction (plants)	Delayed Construction (plants)		
1. Municipality	62 (1,057,475)	1 (36,000)	2 (66,000)	13 (137,400)	7 (150,820)	2 (20,600)	-	87 (1,468,295)
2. Provincial Administrative Organization	1 (22,500)	-	-	-	-	-	-	1 (22,500)
3. Subdistrict Administrative Organization	2 (600)	-	-	-	-	-	-	2 (600)
4. Pattaya City	2 (85,000)	-	-	-	-	-	-	2 (85,000)
5. Samut Prakan	-	-	-	-	-	-	1 (525,000)	1 (525,000)
6. Bangkok Metropolitan Administration	7 (992,000)	-	-	-	1 (120,000)	-	-	8 (1,112,000)
Total	74 (2,157,575)	1 (36,000)	2 (66,000)	13 (137,400)	8 (270,820)	2 (20,600)	1 (525,000)	101 (3,213,395)
Total	90 (2,396,975)				10 (291,420)		1 (525,000)	

Note: (...) Means the capacity in accepting wastewater in cubic meter per day

Source: Department of Public Works and Town & Country Planning, Bangkok Metropolitan Administration, Office of Natural Resources and Environmental Policy and Planning and Pollution Control Department

The collection of wastewater treatment fee



The implementation of municipal wastewater treatment requires the budget for operation and maintenance which include the compensation to personnel. Currently, there were only 7 Local Administration Offices that issued the regulation to set and collect the wastewater treatment fee. They were Hat Yai City Municipality, Songkhla province, Mueang Pattaya Municipality, Chon Buri province, Karon Subdistrict Municipality, Phuket province, Pa Tong District Municipality, Phuket province, Si Racha Town Municipality, Chon Buri province, Saensuk Town Municipality, Chon Buri province, and Banpae Subdistrict Municipality, Rayong province.

During 2008 - 2009, the National Environmental Board set the wastewater treatment fee and published in the Royal Government Gazette an increase of another 6 areas that will utilize the Environmental Fund (under Section 88 of the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992)). They were Tha Rae Subdistrict Municipality, Sakon Nakhon province, Mae Sod Town Municipality, Tak province, Huakwang Subdistrict Municipality, Maha Sarakham province, Mukdaharn Town Municipality, Mukdaharn province, Hua Hin Town Municipality, Prachuab Khiri Khan province and Pa Tong Town Municipality, Phuket province.

Bangkok Metropolitan Administration (BMA) had not yet collected the wastewater treatment fee but had issued a BMA regulation entitled The Collection of Wastewater Treatment Fee 2003 and published in the Royal Government Gazette, Volume 121, Special section 61 D, dated 31st May, 2003 (B.E. 2548). The BMA had coordinated with Metropolitan Waterworks Authority (Thailand) to prepare an agreement to assign the Metropolitan Waterworks Authority (Thailand) to collect the wastewater treatment fee for the BMA.

Sources of Water Pollution

Domestic :

- 1,687 Municipalities,
- 6,089 LAOs,
- BMA, Pattaya City
- Approximately 9.8 M m³/d

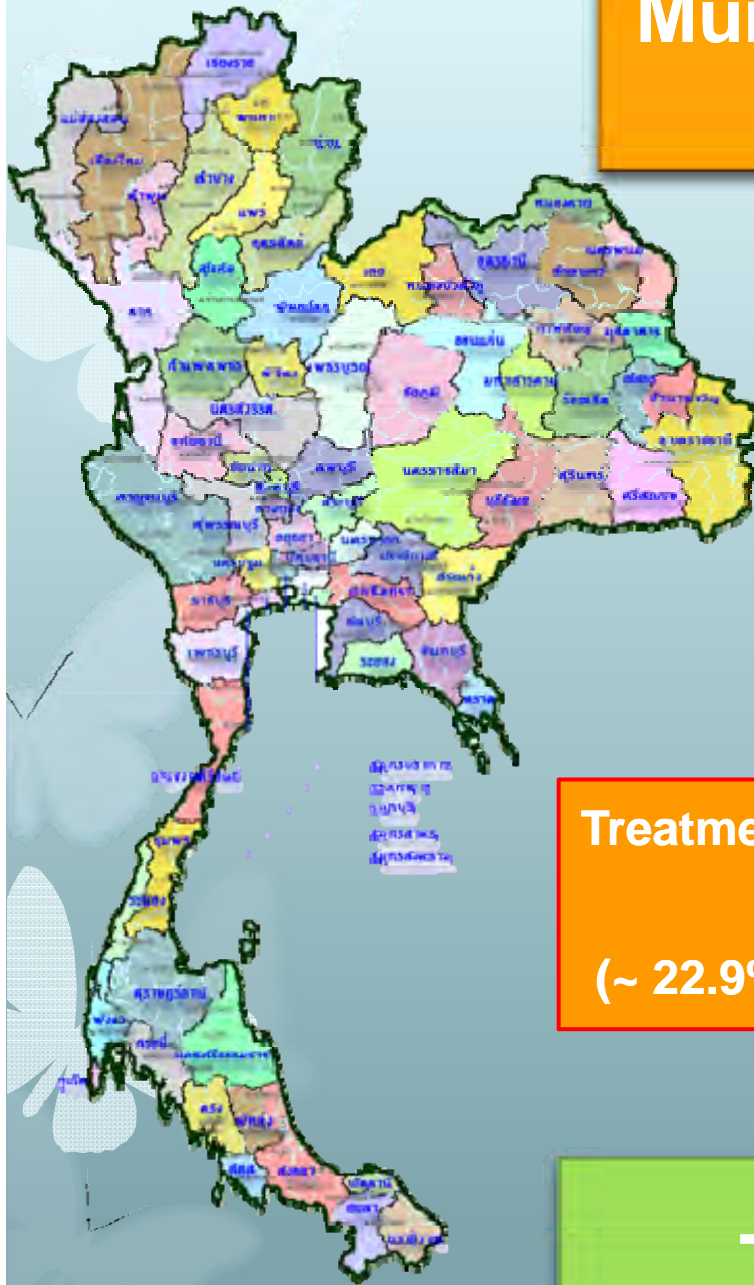
Industry :

- >120,000 factories
- Approximately 2.8 M m³/d

Agriculture :

- Pig farm+ Aquaculture (Point source) 0.1 M m³/d
- Paddyfield (Non Point source) 150 M m³/d

Municipal Wastewater Management in Thailand



(1,687) Municipalities

MWW~2.5 M m³/d

BMA, Pattaya City

MWW. ~2.5 M m³/d

(6,089) LAOs

MWW~ 9.0 M m³/d

Treatment capacity ~ 3.2
M m³/d
(~ 22.9% of total MWW)

Total MWW~14M m³/day

Total BOD Loading
~ 2,600 Ton BOD/day

Total Budget 83,152 M Baht

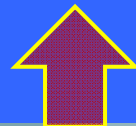


The Main Problem

Municipal Wastewater Management in Thailand

Municipal Wastewater:

- ❑ is one of the most serious environmental problems in Thailand.
- ❑ approximately 14 M m³/day of municipal wastewater generated by the population around the country in year 2008, including :
 - ✓ **1,687 Municipalities** ~ 2.5 M m³/d
 - ✓ **6,089 LAOs** ~ 9.0 M m³/d
 - ✓ **BMA, Pattaya City** ~ 2.5 M m³/d
- ❑ 101 Municipal Wastewater Treatment Facilities in the country have been constructed (approximately 3.2 millions m³/day or app 22.9 % of total wastewater treated)



Constraints in Municipal Wastewater Management in Thailand

Constraints :

- Many urban communities lack appropriate municipal wastewater management
- The communities and people still lack understanding in wastewater problem and awareness to protect the environment
- The local administration organizations are still unable to manage municipal wastewater
- Lack of budget for construction of the new wastewater collection system and wastewater facilities

Operational Problems of Municipal Wastewater Treatment System

1. Operation and Maintenance.
2. Management of Central System and Wastewater Treatment.
3. Promotional Campaign and Communities' Involvement in the Central Wastewater Treatment System Management.
4. Law Enforcement, Regulating Mechanism, and Driving Local Administration to Act Progressively.

5. TARGET



The Main Problem in Wastewater Facilities Management

Weak Wastewater : the systems are sized to treat highly diluted wastewater

Sewerage leakage : pumped mains experience substantial leakage with potential contamination of groundwater

Sewer sedimentation : high levels of intrusion and low hydraulic profiles in gravity sewers.

The Main Problem in Wastewater Facilities Management

Staff skills : the treatment technologies require a high level of skilled operator more difficult to resource up-country.

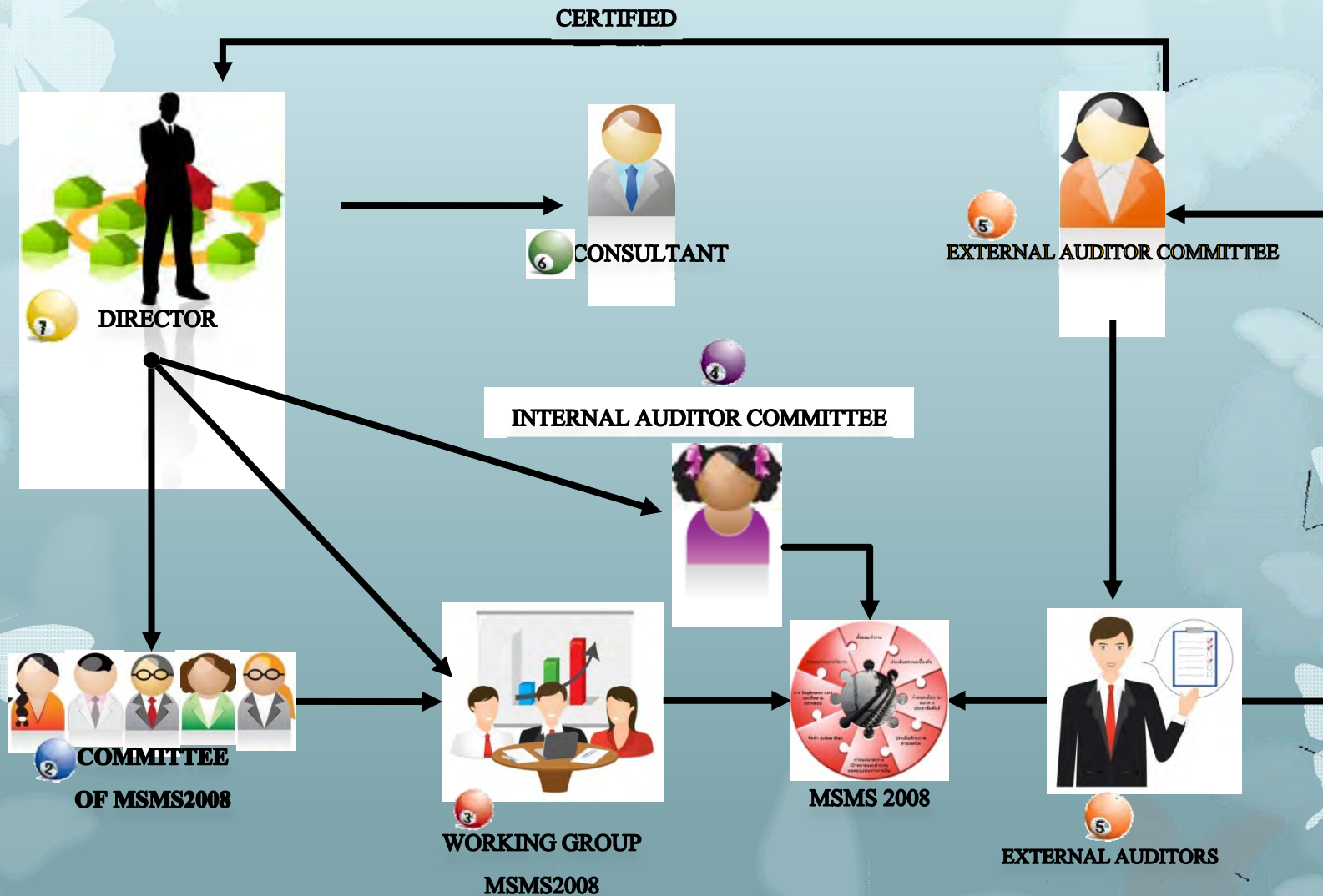
Operational cost : Electrical costs are particularly high.

Tariff charges : as a result of the low perceived benefit and local political considerations, progress in levying tariffs has been limited to 3 municipalities to date.

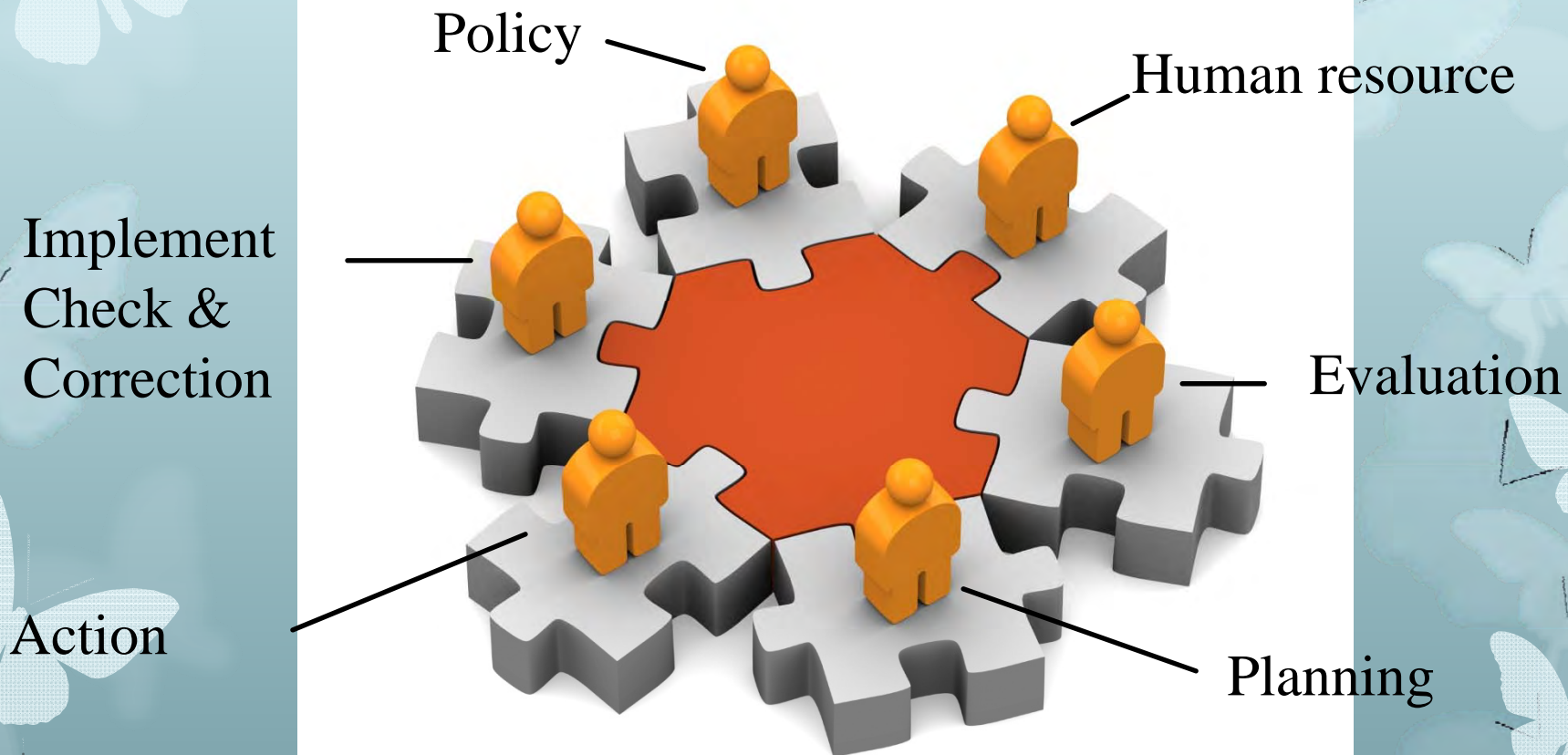
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Solution Problem on Domestic Wastewater Management

Structure of Municipal Sewage Management System (MSMS) 2008



Term of MSMS2008



Bring Back Better Natural Water resources

- Reduce waste at pollution sources by the simple technologies (Ex. Grease Trap and On-site treatment)
- Rehabilitate the existing municipal wastewater facilities
- Construct new wastewater treatment system using appropriate technology
- Polluter Pay Principal (PPP)

Alternatives for Municipal Wastewater Management in Thailand

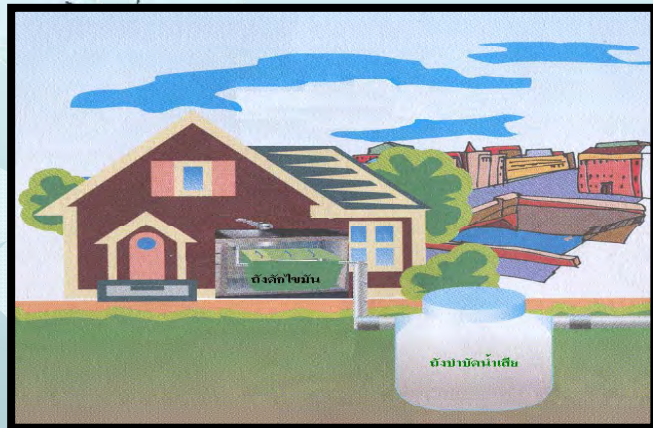
On-site,
(individual house)

Cluster Wastewater Treatment
(Group of House)

Centralized Wastewater Treatment
(High density)

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On-site



Household Wastewater Treatment



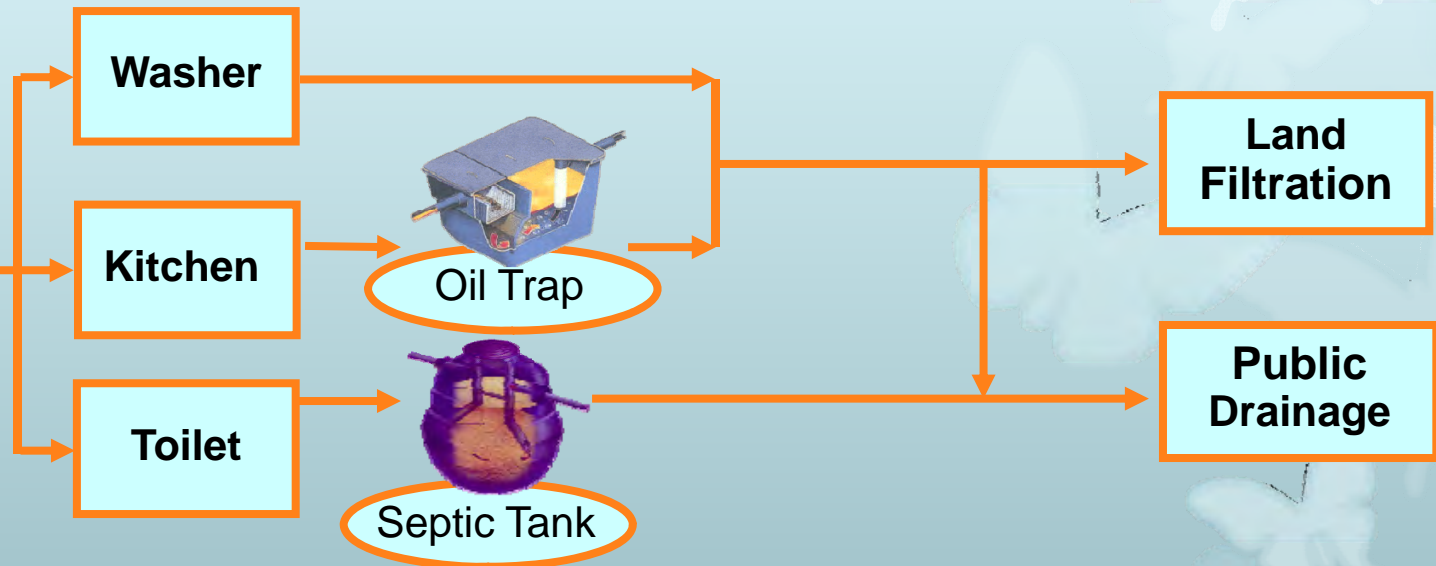
Centralized Wastewater Treatment



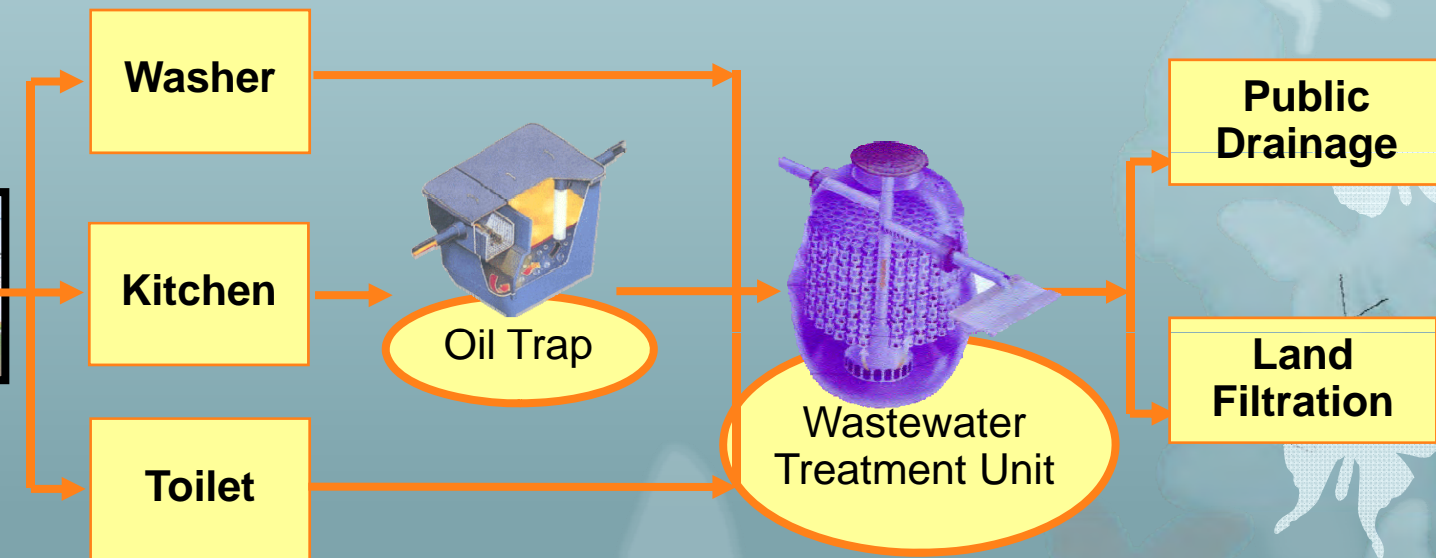
Cluster Wastewater Treatment

Household Wastewater Treatment

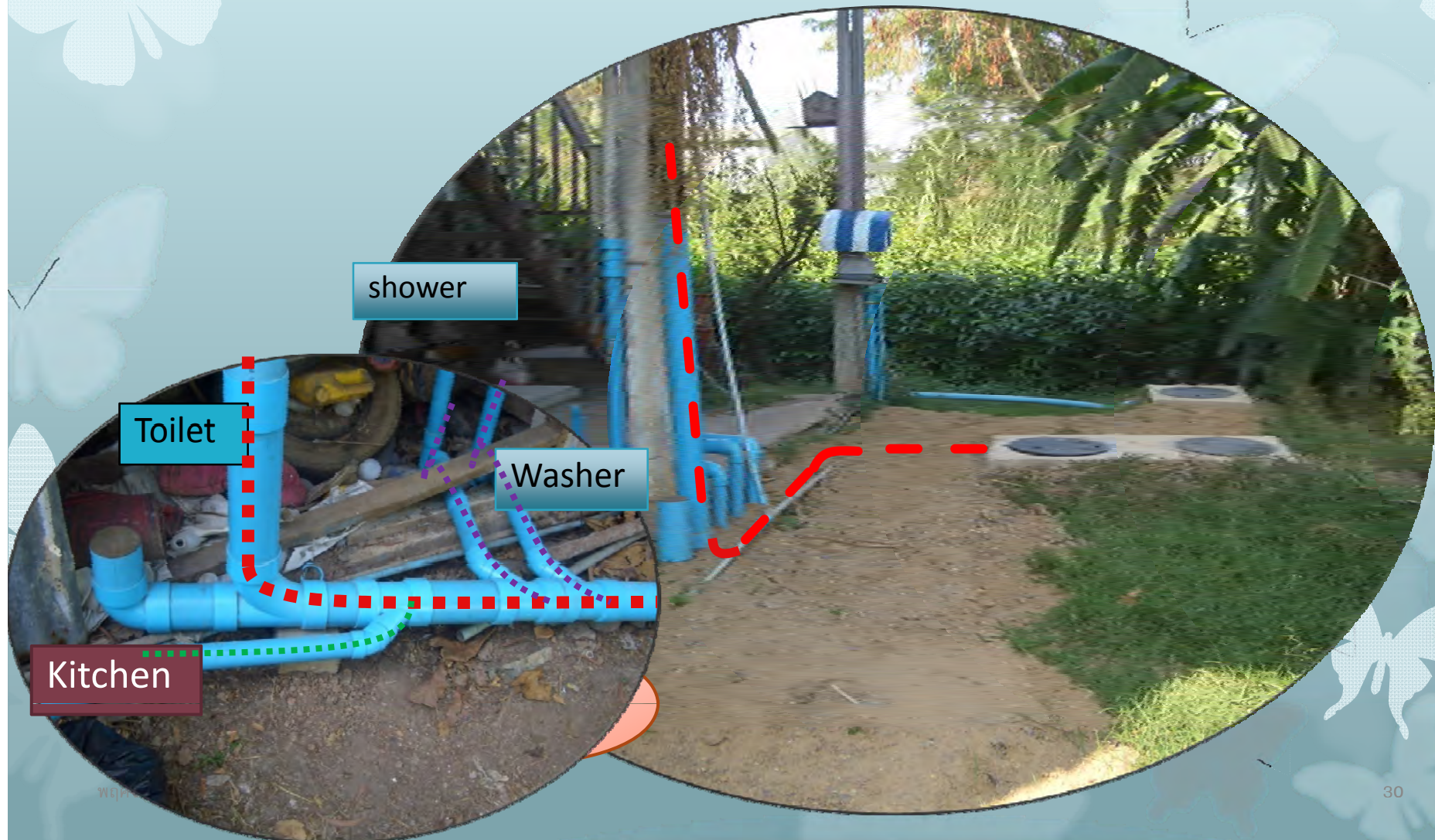
Old House

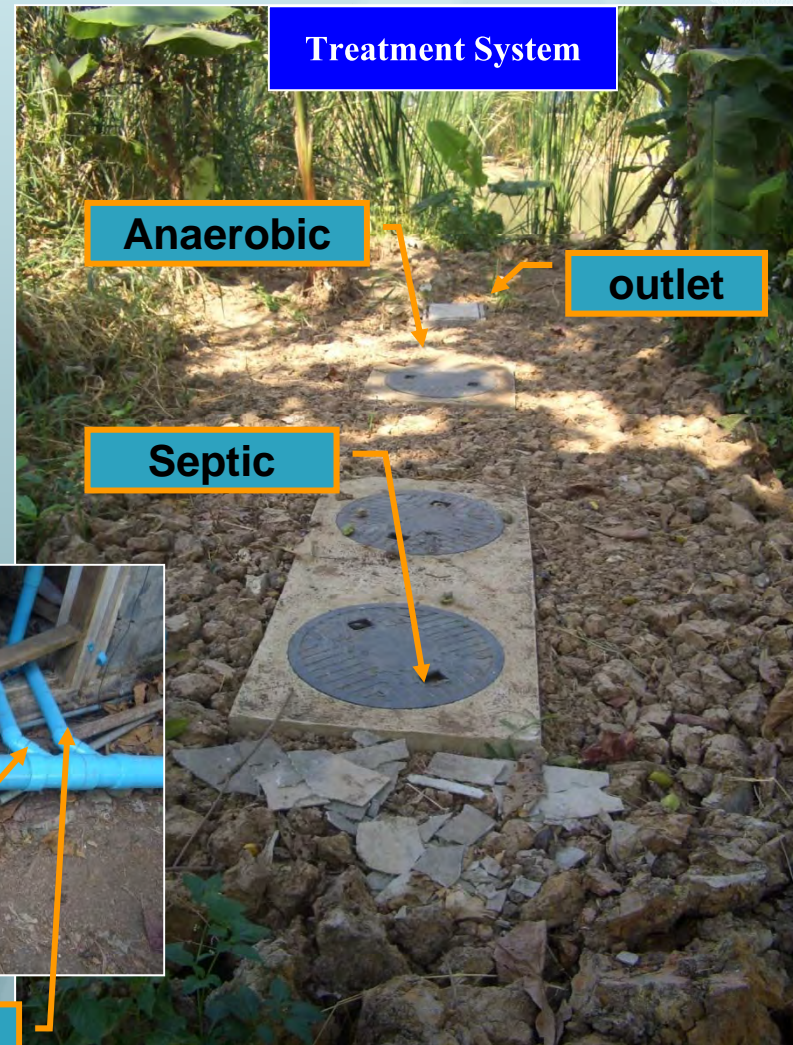
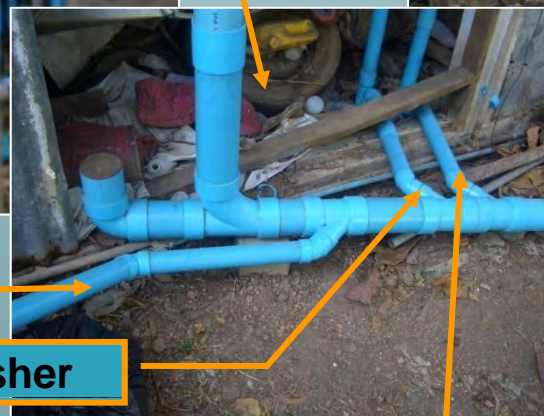


New House



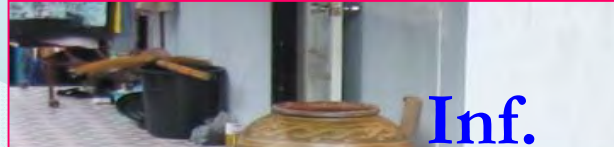
Household







Ko Chang (Trat Province)

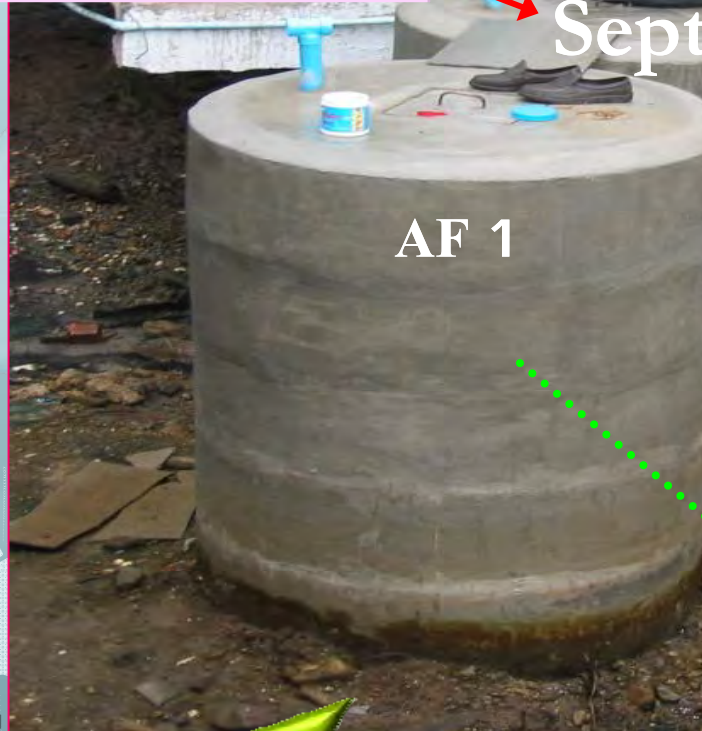


Inf.

Flow 1- 3 m³/d
BOD 200 mg/L

Ko Chang : Anaerobic Filter (AF)

Septic



AF 1



AF 2



AF 3

Eff.

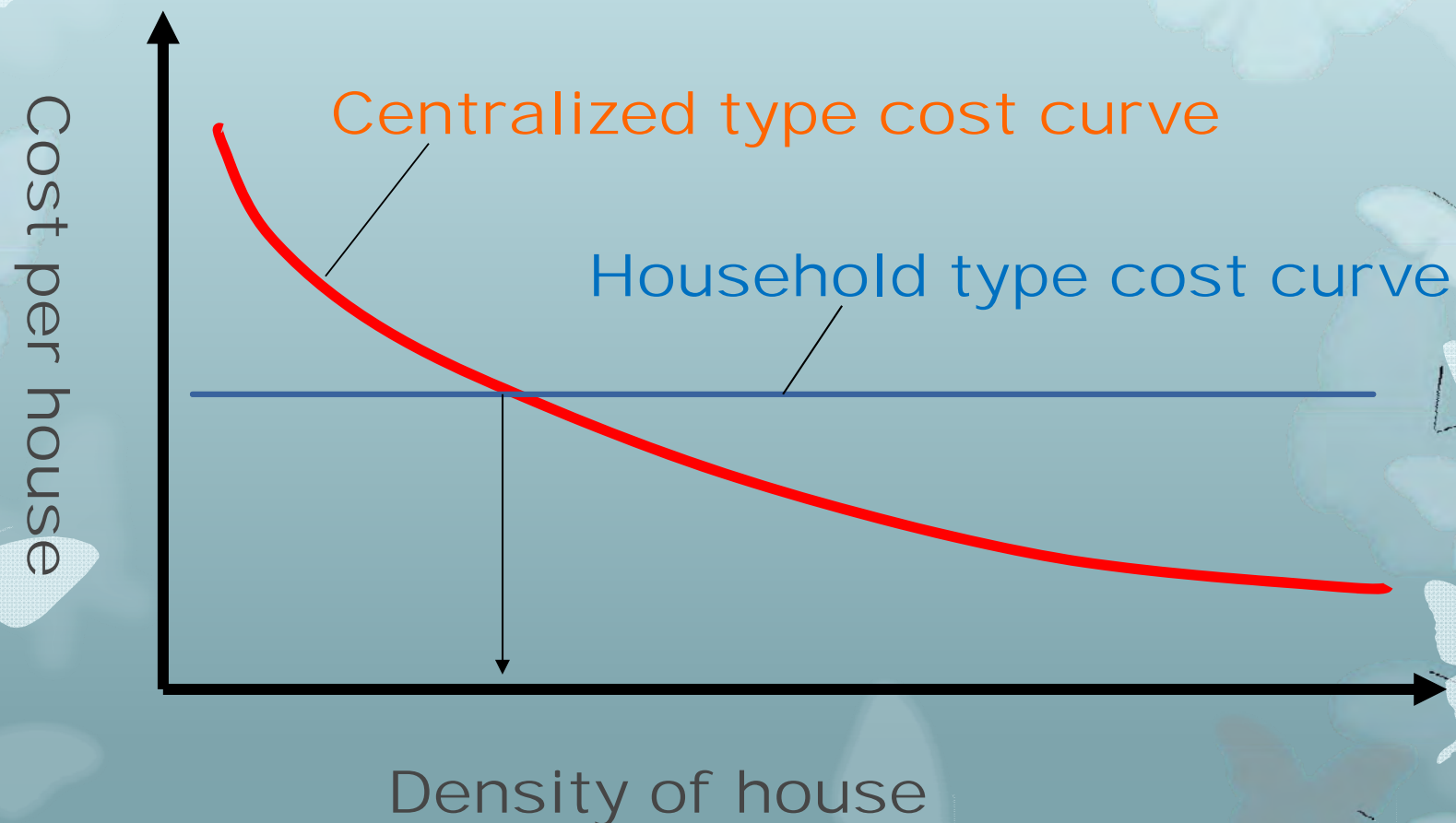
BOD <30 mg/L



Media

Construction Cost 32,200 - 61,600 Baht

Cost comparison between centralized and onsite systems



Water Pollution Control Policy

- Reduce wastewater at pollution sources by simple technologies (Ex. Grease Trap and On-site treatment)
- Rehabilitate the existing municipal wastewater facilities
- Construct new wastewater treatment system using appropriate technologies
- Polluter Pay Principal (PPP)

Wastewater Management

❑ Law Regulation and Enforcement Measures :

- *The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (NEQA 1992)*
- *Water Quality Standards : Ambient Water Quality Standards*
- *Effluent Standards*
- *Other Laws*

❑ Management Measures :

- *Monitor and Evaluate Water Quality*
- *Pollution Control Zone*

❑ Investment Measures :

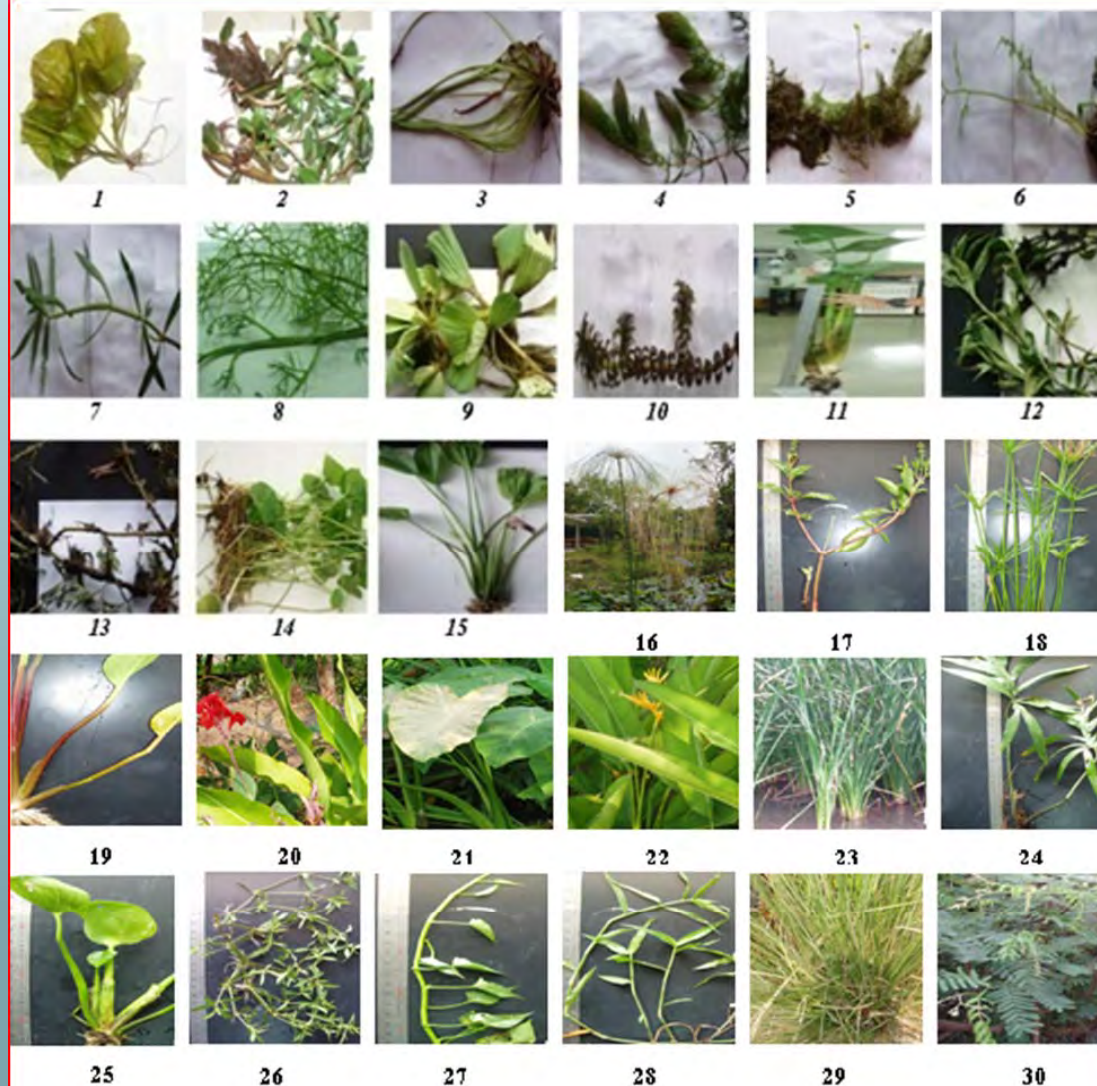
- *Establish Wastewater Treatment Facilities*

Challenges in Municipal Wastewater Management in Thailand

Challenges :

- Review current status and update the data of existing wastewater collection network and the drainage system
- Propose and assess technically and economically feasible options for Centralized, Cluster and Onsite of wastewater treatment system, including identifying types, separate sewage system, or combined sewer system which are appropriate for LAOs

Removal of pharmaceutical residuals and endocrine disrupting compounds by constructed wetlands



The current study of fenton ball research in the constructed wetland of ERTC



Testing of Onsite Commercial Wastewater Treatment Units

various types of commercial wastewater treatment tanks are sold in markets

No procedure of testing and none government authority to guarantee the efficiency of tank.

Because of the lack of technical data to support a verification system



Experimental Set up and operation

Experiment conditions	duration	Operation condition	No. of sampling
Start up	3 months	Influent flow rate 1,000 L/d ($\pm 10\%$)	≥ 5 times
Normal situation	≤ 3 months	Influent flow rate 1,000 L/d ($\pm 10\%$)	≥ 5 times
Stress situation			
- 2 times of normal	≤ 2 months	Influent flow rate 2,000 L/d ($\pm 10\%$), 5 consecutive days and run in normal situation	≥ 5 times
- A half of normal	≤ 2 months	Influent flow rate 500 L/d ($\pm 10\%$), 5 consecutive days and run in normal situation	≥ 5 times
- No influent	≤ 2 months	stop flow 5 consecutive days and run in normal situation	≥ 5 times

Results

- Stress tests do not have effects on removal efficiencies of BOD of the tested tanks.
- Removal efficiencies of BOD are in the range of 61-77 % and the average is 68 %.
- BOD in effluents are in the range of 42-74 mg/L.
- For TKN, Phosphorus, sulfide and TDS removal efficiency couldn't well so should add secondary treatment to increase removal efficiency.

Support system by government

- Design by PCD
- Consulting
- Reduce pollutant from wastewater on-site
- Polluter Pay Principal: PPP
- Discharge standard

Popular on-site treatment technology

- Treatment tank
- Septic tank
- Grease trap tank

Challenges to promote on-site wastewater treatment in Thailand

- Low cost
- Maintenance system
- 30 Baht/month

Thank you for your attention



**We acknowledge the valuable assistance of
PCD and ERTC staffs for results and recommendations**