

The 2nd Workshop on On-site Domestic Wastewater
Treatment in Asia @Tailand, Dec 2014

**Economic assessment of the rural wastewater
treatment using different sewage patterns**
——based on the application of the household Johkasou in Changshu

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Outline

- **Introduction of the rural wastewater treatment in China**
- **Engineering demonstration of the house-hold Johkasou in Changshu, China**
- **Economic assessment of different sewage patterns**
- **Conclusions and proposal**

Introduction of the rural wastewater treatment in China

- Current status and the demands of rural wastewater treatment in China

Rural population in China: ~700,000,000 in 2013

~50,000,000



been
built

~200,000,000

~450,000,000 need to be built in
20 years

to live in city in
future

Command of the infrastructure construction:
~3000 billion RMB (500 billion USD)

- Options of the rural sewage patterns in China

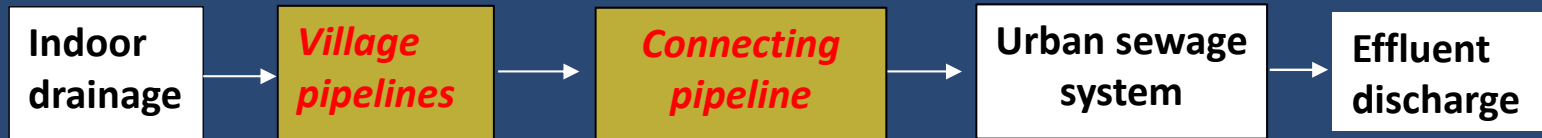
On site treatment pattern (OTP)



Village treatment pattern (OTP)



Urban treatment pattern (OTP)



To optimize the assemble of sewage patterns in a prefectural area is key for economy reason

- **Current problem**

local governments prefer more centralized patterns

UTP > VTP > OTP

Reasons:

- **taking for granted that the decentralized treatment is out of date**
- **the current domestic equipment technology of the decentralized wastewater treatment is not satisfying**

Engineering demonstration of the house-hold Johkasou in Changshu, China

- the practices of the rural wastewater treatment in Changshu



100 km west of Shanghai

- 40% of the treatment rate on rural population (totally in China <10%)
- 90% of the qualified running rate (generally <20%)

Guideline of the integrative government of prefectural urban and rural wastewater treatment (MHURD, 2013)

- Uniformly financing
- Uniformly planning
- Uniformly building
- Uniformly running

- **Current problem in Changshu rural wastewater treatment**
 - The unit investment cost is too high
 - The unit running cost is too high

UTP and VTP are the main patterns being used currently, and a kind of on site SBR had been proved fail before 2012.

main VTP technology used in Changshu

- **SBR**
- **MBR**
- **Biological contact oxidation**

- **Introduction of the demonstration engineering project of household Johkasou**
 - Supported by National Major Project of Science and Technology on Water Pollution Control and Water Environment Improvement (2011ZX07301-003-09)
 - site
 - Fenqiangjing settlement, Dongqing Village, Yushan Town of Changshu
 - plain terrain with the typical characteristics of watery area.
 - 102 families and about 500 persons, housing along river
 - The grounds are hardened and made green with plants

– design

- All domestic wastewater being collected, and load of the wastewater per capita is 120l/(person*day)
- A kind 5-person Johkasou with denitrification was selected, with capacity of 1m³/day/set
- Basically one set for two family, but some remote or big families may independently use one.

The designed influent quality

Item		Design
Quantity of sewage		<=1.0 m ³ /day
Peak factor of quantity		<6
Temperature of sewage		13°C~35°C
Influent quality	pH	5.8~8.6
	BOD ₅	<=200 mg/L
	SS	<=160 mg/L
	T-N	<=45 mg/L
	Fat	<=50 mg/L
	BOD ₅ /T-N	>=3

The designed effluent quality

Effluent quality		Notes
BO D ₅	<=20 mg/L	Average daily
SS	<=15 mg/L	Average daily
T-N	<=20 mg/L	Average daily

– Totally 55 sets of the household Johkasou was installed

- 96 families with two families sharing one
- 6 families with one family one set
- 1 set for the public toilet

45 day of the whole construction period



Distribution of the Johkasou in
Fenqiangjin settlement

– Debugging and running

- Debugging: 15days, dosing with strains offered by the equipment supplier for quick start.
- Running: by a consigned company with averagely 4 times/year.

The main maintenance and running work includes:

- point check of equipment maintenance
- disinfectant adding, dosage is about 1 kg/year
- replacement of the turbine diaphragm, once every 2 years ;
- sludge cleaning, once a year.

- **Effects of the demonstration engineering project**
 - **The demonstration engineering project has been run for 1 year, playing a proper role in improving the housing and public sanitation and the river water quality in the Fengqiang settlement**
 - **Sometimes effluent COD and TN might be over proof because the washing water consumption of some families are still low, but the removal of pollutants are always stably above 80%**

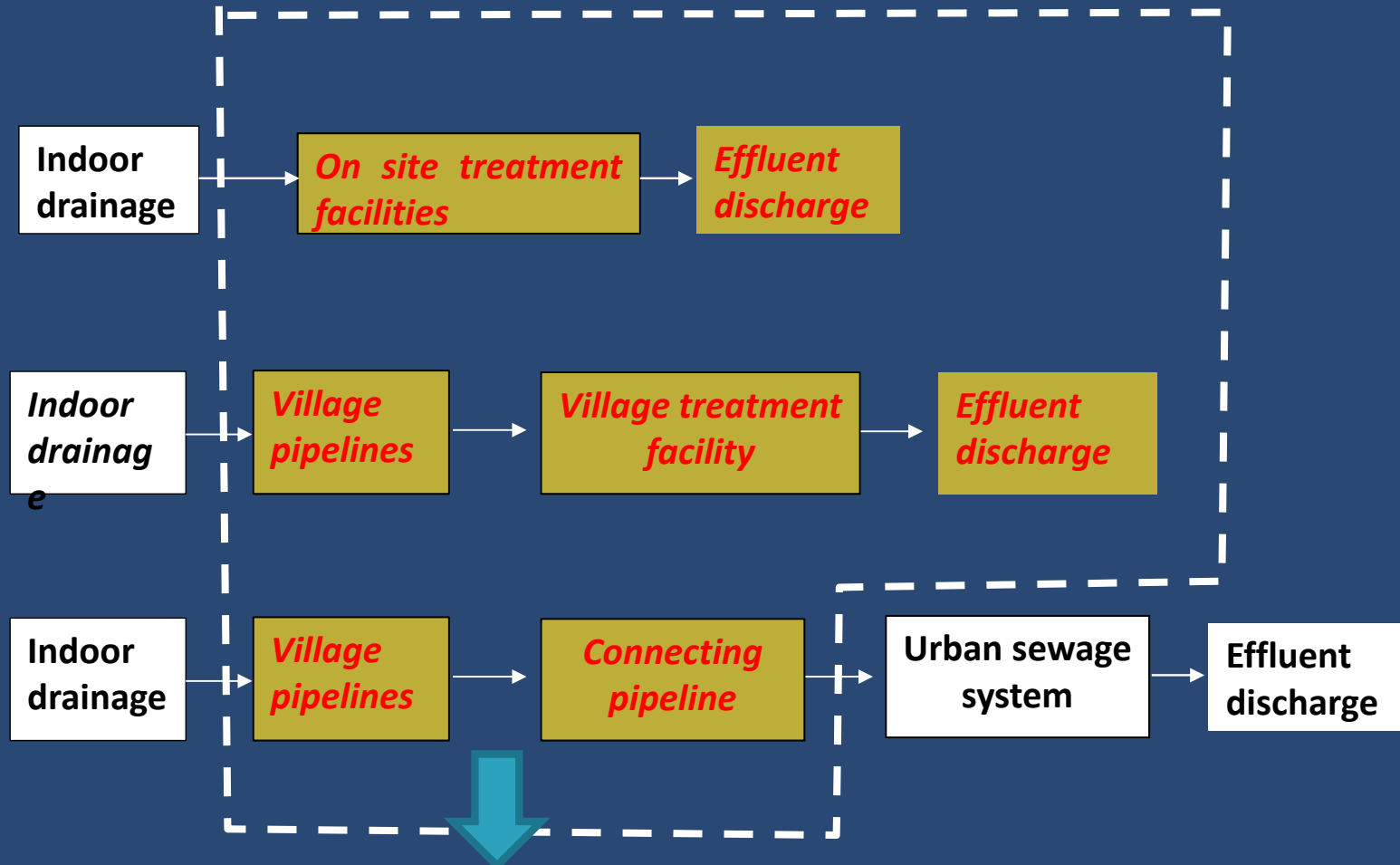
Economic assessment of the different sewage patterns

- **Basics of the assessment**
 - All facilities were built in 2012-2013
 - Assuming all the facilities being assessed are in same function of sanitation and environment protection
 - All the data are from the fiscal audit report

Table 3. facilities having being built in Changshu after 2012

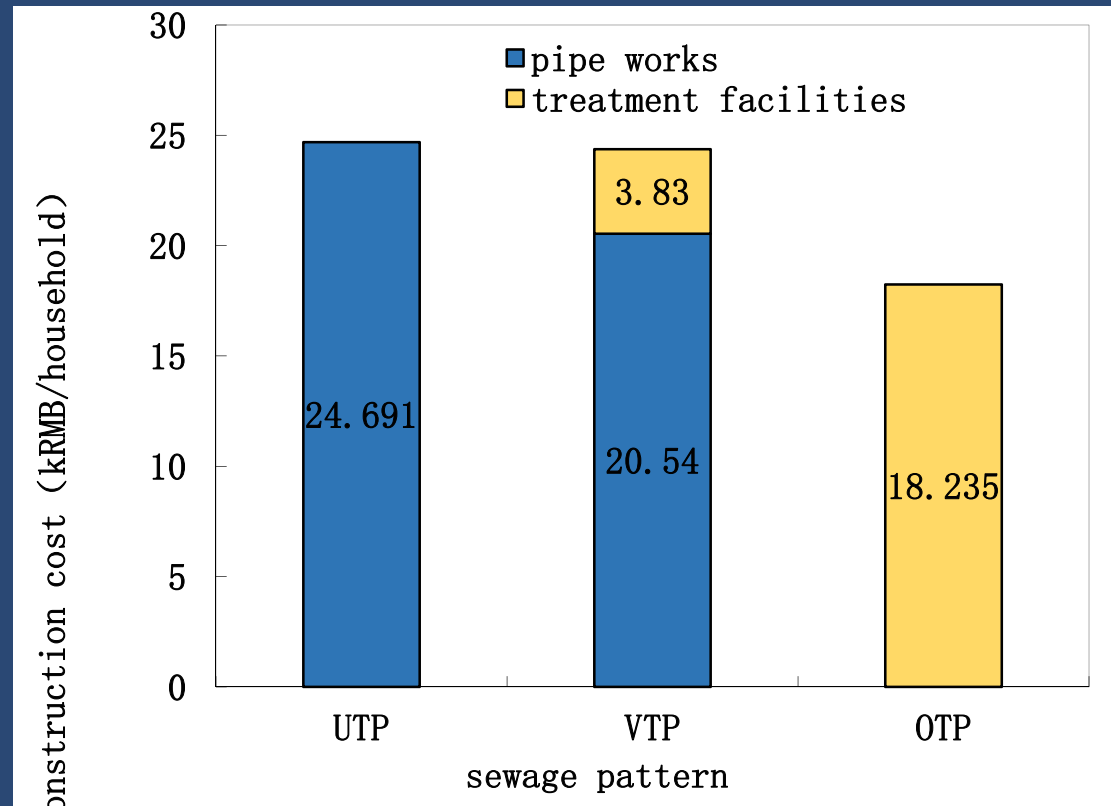
Sewage pattern	number of settlements	number of treatment facilities	Wastewater load (m ³ /day)	number of rural families (household)
UTP	135	-	-	26149
VTP	170	365	4715	7364
OTP (Johkasou)	9	164	164	304

- **Construction cost**



The investment range of the rural wastewater treatment facilities

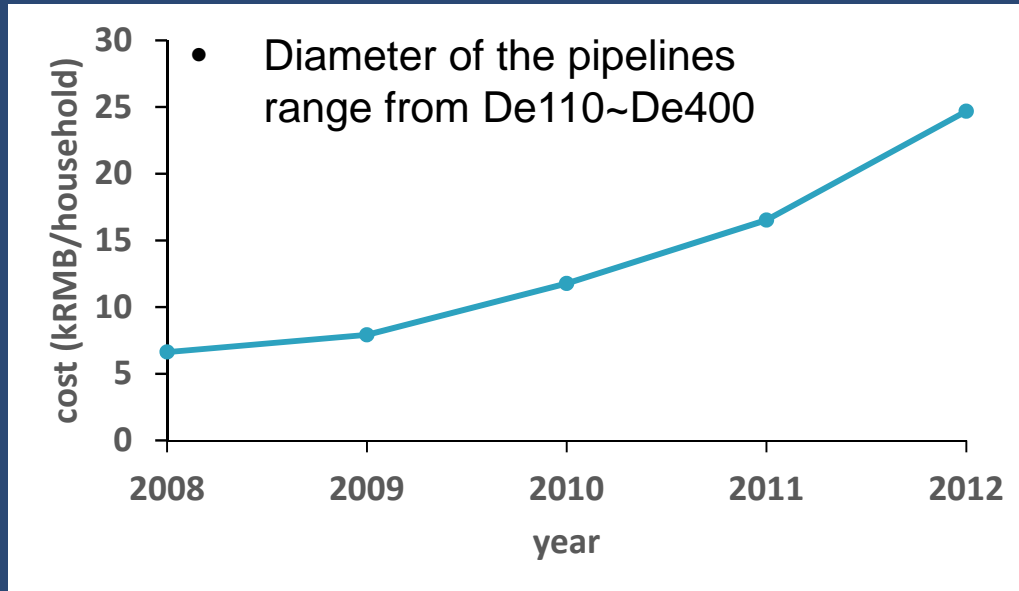
Construction cost of the different sewage patterns



the more concentrated the sewage was, the higher the construction cost was.

UTP>VTP>>OTP

Construction cost of UTP per household of the rural wastewater treatment in recent years



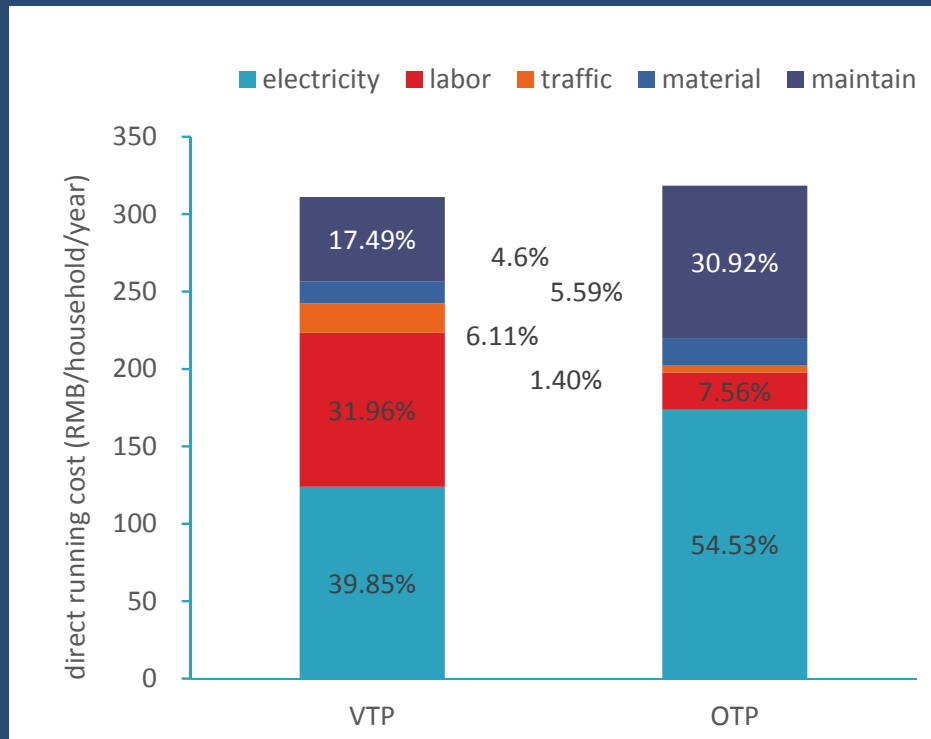
- **623 RMB/m in 2012**
- **The proposed prices in the guideline of Chinese EPA**
 - ✓ De200 pipeline is 50 ~ 130 RMB/m,
 - ✓ De300 pipeline is 150 ~ 250 RMB/m
 - ✓ De400 pipeline is 200 ~ 350 RMB/meter

Reasons include:

1. **high workload of destroying and restoring the roads and plantings;**
2. **narrow spaces and roads limiting the usage of big machine;**
3. **the labor price rises fast in these years.**

- **Running costs of the decentralized wastewater treatment facilities**

Direct running cost



Total running cost

- ✓ **OTP: 399 RMB/household/y**
- ✓ **VTP: 392 RMB/household/y**

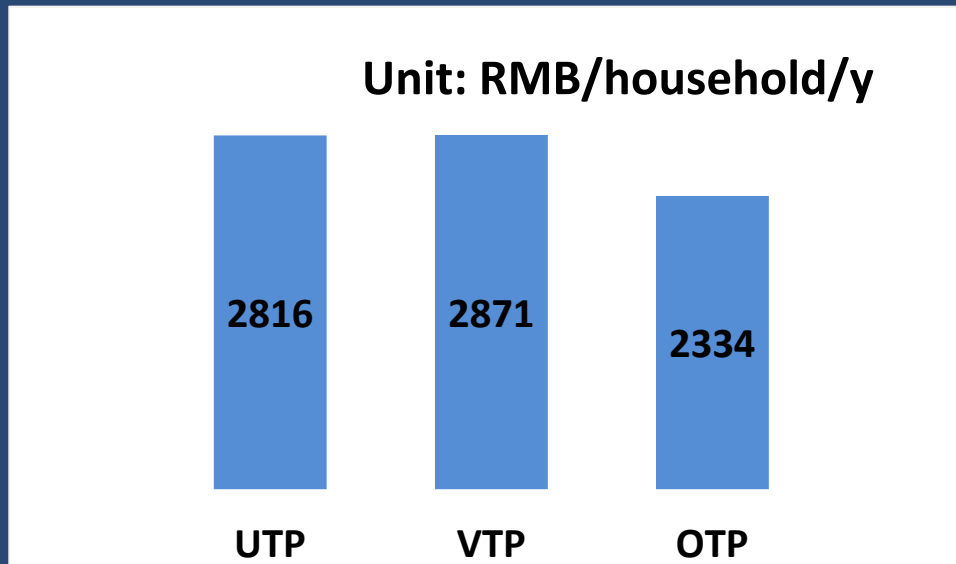
The ratio of the labor cost of VTP facilities is much more than that of the OTP

Routing inspection cycle

- **VTP: 10days**
- **OTP with Johkasou: 3 months**

Urgently to improve the construction quality of VTP facilities

- **Equivalent annual total cost (EATC)**



- **the EATC of OTP is much less than the others**
- **the UPT's is a little smaller than the VTP's**

Life of Pipeline: 50 years

Life of treatment facilities: 30 years

The equivalent annual total cost (EATC) is the cost per year of owning and operating an asset over its entire lifespan with a giving discount rate.

Conclusion and Proposal

- **The EATCs of UTP, VTP and OTP are respectively 2,816 RMB/household/year, 2,820 RMB/household/year and 2334 RMB/household/year. The EATC of OTP was much lower than the others’.**
 - The construction cost of OTP using the Japanese household Johkasou was significantly lower than others. The high cost of the pipeline construction in existing settlements is unbeneficial for choosing more concentrated sewage patterns.
 - the running and maintenance workload of the facilities using the Japanese household Johkasou technology is comparably low. The building quality of the VTP facilities in China urgently needs to be improved.
- **OTP should be the preferential sewage pattern in current rural wastewater treatment in Changshu and in similar areas of China, and the technology of the Japanese household Johkasou or other technologies with equivalent performance should be adopted in engineering**

Thanks for attention