



Challenges and practices of decentralized domestic wastewater treatment in China

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24. 09, 2019

North Center for Rural Wastewater Treatment Technology Ministry of Housing and Urban-Rural Development

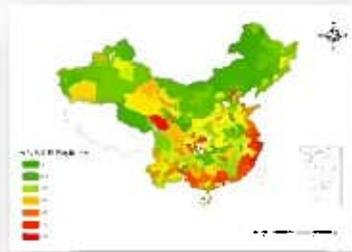


Established in 2008

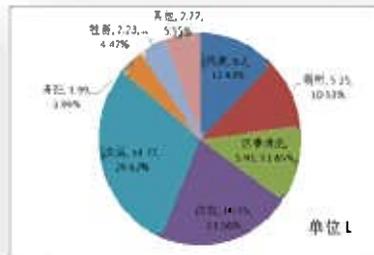
Mission & Goals

To build scientific and technological platforms, gather national scientific and technological forces, serve rural pollution control, and provide technical support for the formulation of relevant policies, regulations and administrative management.

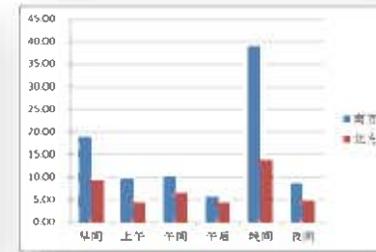
Pollution characteristics



National survey and evaluation of rural sewage



Source and proportion of rural household sewage



Spatial and temporal characteristics of rural sewage

R&D



Oxidation ditch



MBR



Demonstration in Yunnan

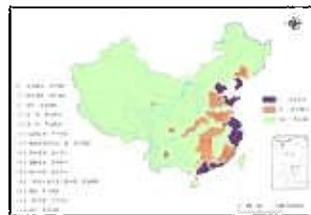


Demonstration in Guangxi



First demonstration county: Changshu

Administrative support



Planning



Technical guidelines



Standard specification



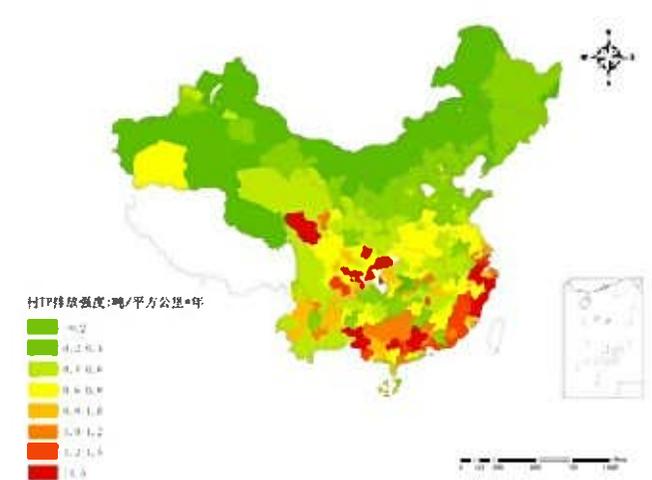
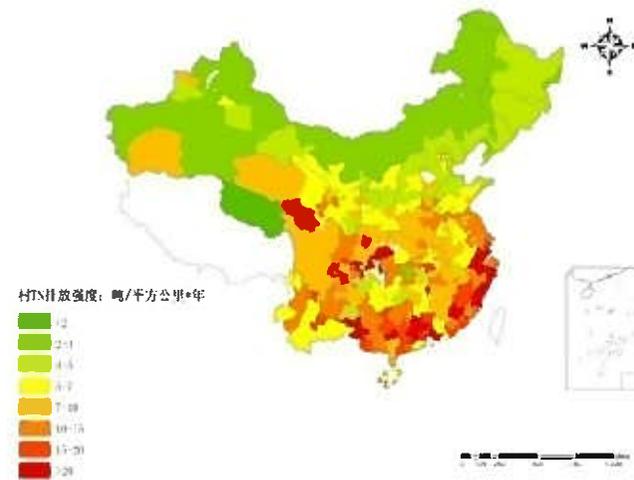
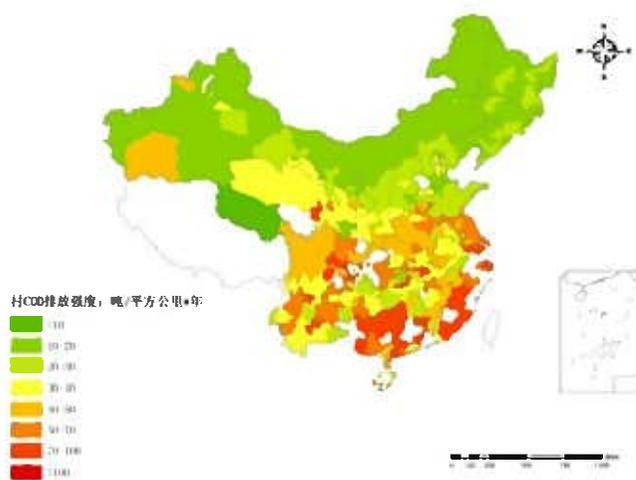


Environmental pressure factors

Contaminant emission intensity: ton/km².year

Average in towns: COD 74.0 , TN 14.8, TP 1.0
Average in villages: COD 52.2, TN 10.4, TP 0.7

- The high intensity is in Southeast China: Shanghai, Jiangsu, Zhejiang, Guangdong, Fujian, Guangxi and Sichuan;
- The intensity in Jingjintang area and northeast China is also high.



1. Current situation of pollution control in rural area

1.1 The inevitable requirement of building a moderately prosperous society in all respects



By the end of 2017, the pollution-free disposal rate of urban household garbage will reach 97%, and only 55% in rural areas ;

Urban residents generally use water flush toilets, while only 36 percent of rural households use water flush toilets

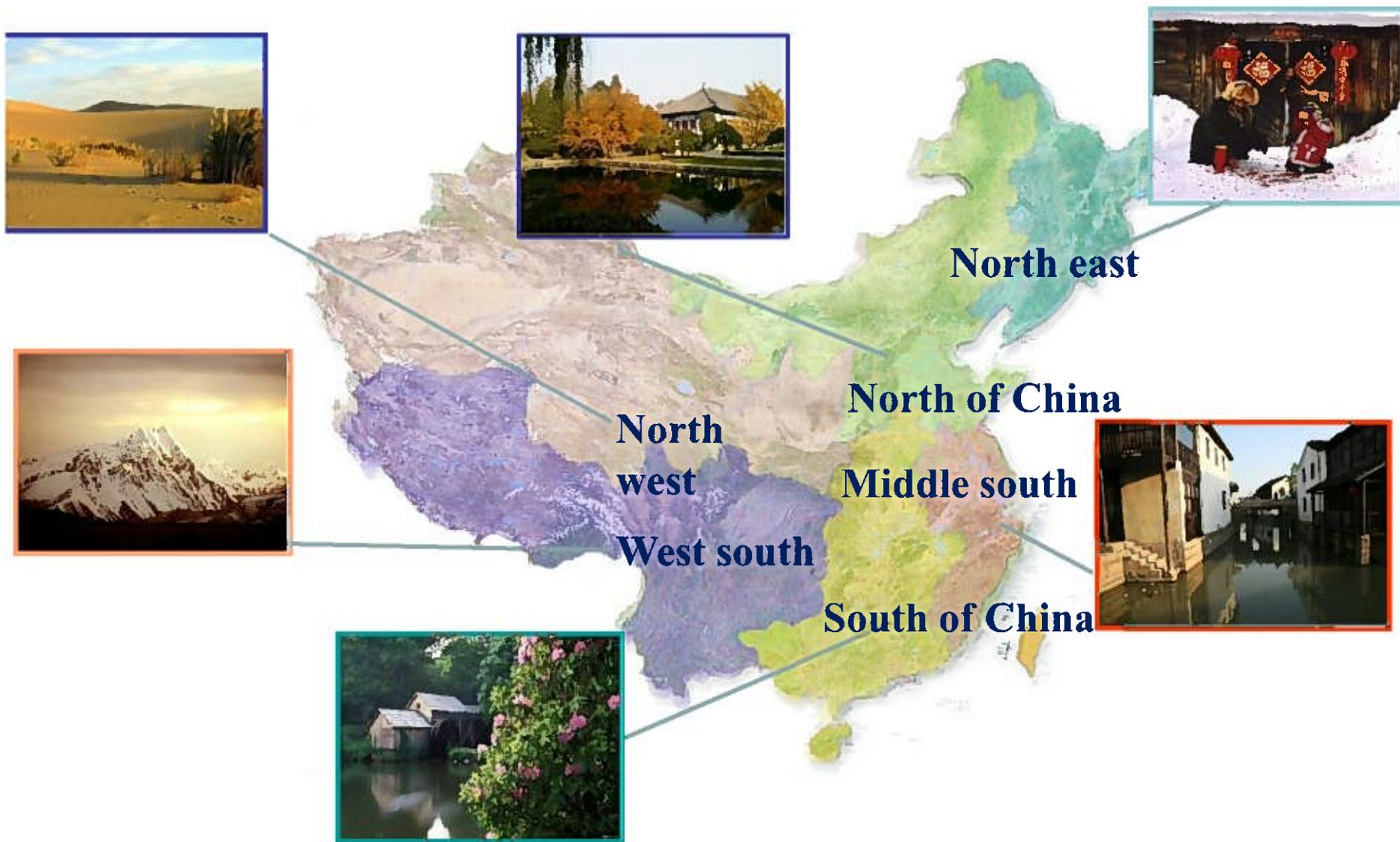
The overall look of the countryside has not fundamentally changed. We must conform to the expectations of farmers for a better life.

1. Current situation of pollution control in rural area



General Secretary Xi proposed to **"launch a toilet revolution"** at a peasant family of Yanbian Prefecture, Jilin Province

1. Current situation of pollution control in rural area



Rural areas

Different climate, geographical features, economic development level, drainage habits.....

1. Current situation of pollution control in rural area

1.2 Needs for decentralized wastewater systems

1. Satisfy the demand of **public health** and **various water quality** goals;
2. **Economic suitability** of processing technologies;
3. **Operation simple and easy routine management.**

1.3 Actions

13th Five-Year Plan: Rural Residential Environment Improvement Actions



- **Integration of urban and rural development**
- **The development of social undertakings in rural areas**
- **Urban public services extend to rural areas**

1.3 Actions

Rural household toilet renovation

Three kinds of patterns

- **Black water treatment is preferred**
- **Health dry toilet**
- **Combination of rural sewage treatment**

2. Case study

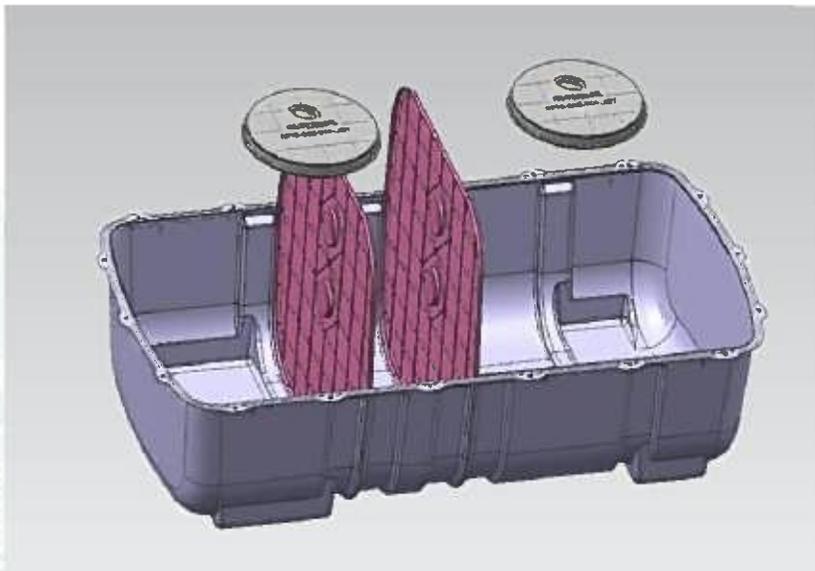
2.1 Experience in Shandong province

Determine governance patterns appropriately

General village



three-squared septic tank



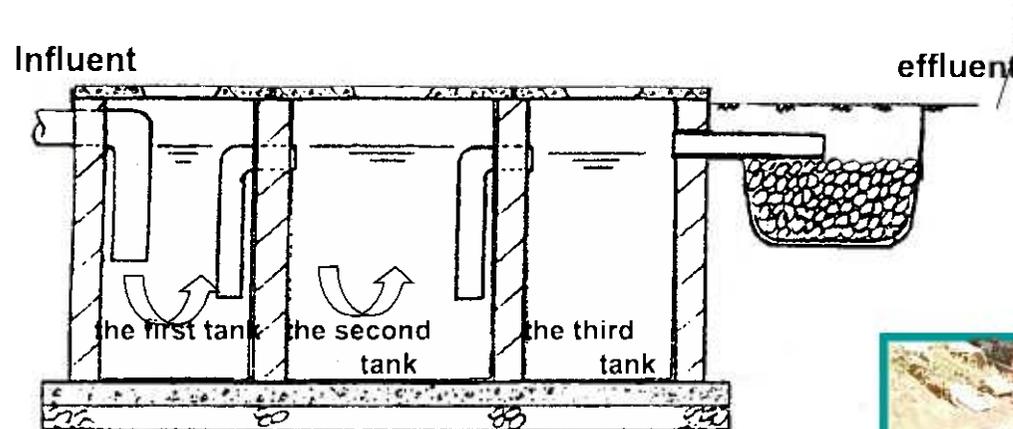
Double urn funnel toilet



Basic principles of septic tanks

Function: the primary treatment structures of suspended matter, organic matter and pathogenic microorganisms in fecal sewage or other domestic sewage are removed by precipitation and anaerobic microbial fermentation.

Removal rate: after 12-24h precipitation, 50% to 60% of suspended matter is removed, and the precipitate is decomposed by anaerobic fermentation for more than 3 months, and becomes stable mature sludge.



Structure



We will actively explore and innovate to provide policies, funds and technical guarantee for the sewage treatment of rural toilets

To explore the operation system of toilet

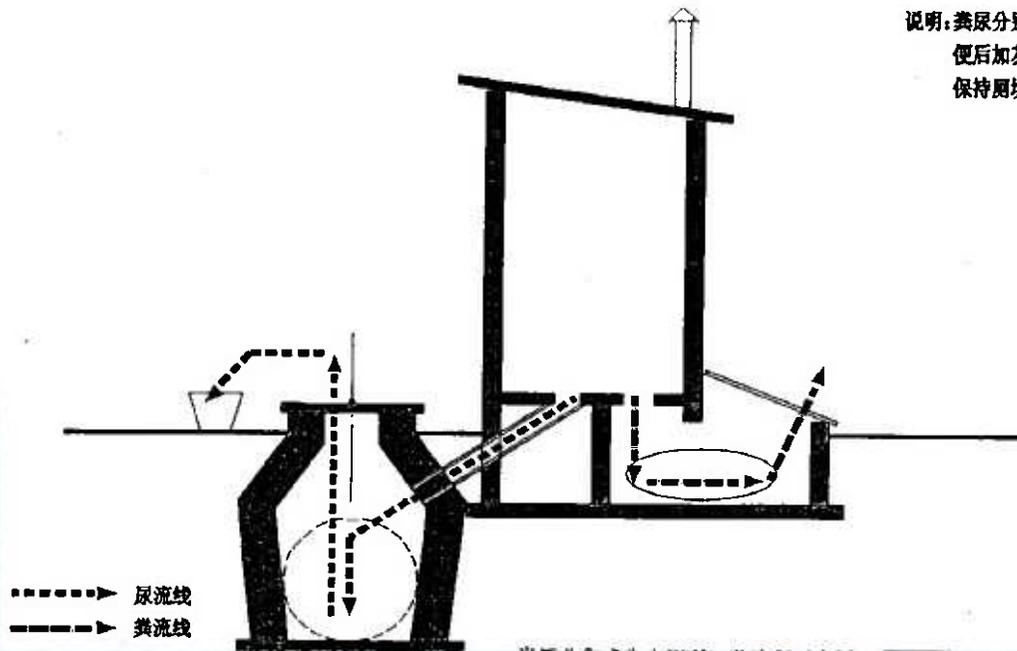


2.1 Experience in Shandong province villages in a mountainous area or in

a water-deficient area

Fecal urine collection toilet

说明：粪尿分别收集
便后加灰
保持厕坑干燥



composition

Store tank of the urinal

Fecal and urine diverter

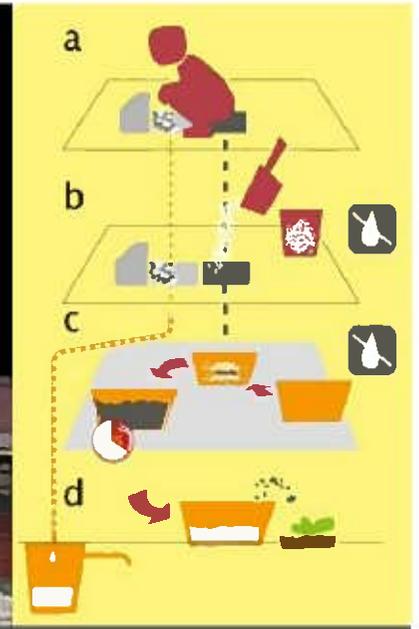
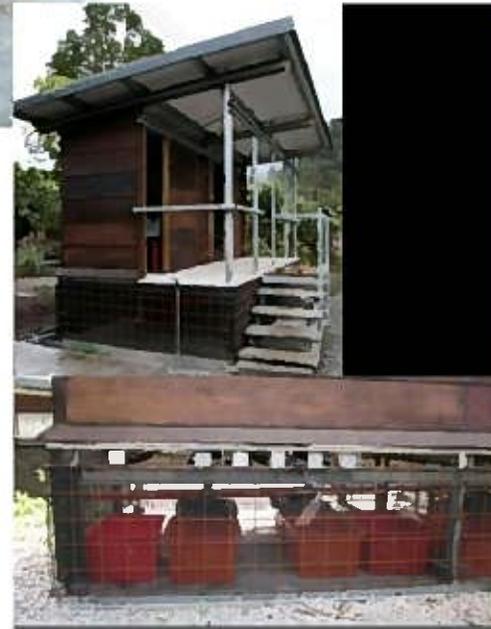


Ecological toilet

Separation of fecal and urine



尿糞分離廁所
Urine & Faeces
separate



粪分所 尿集所



使用手册

Hi, 我是大便

水分
70%
20%
健康的便便

植物残渣、细菌、碳水化合物、无机盐、脂肪

干燥后的便便

Hi, 我是小便

我身体里有好多不喜欢人喜欢的分子和细菌，它们会排进尿液的。

苍蝇喜欢我

平均一次大便重量 0.2 千克

平均每次大便一次需要用水 3-5 千克

我有便秘，不要强行去逼它，可以冲水。

粪 fen

尿 niao

Hi, 我是小便

95% 水

4% 尿素、无机盐、维生素、色素

(夏季6-7天, 冬季15-10天)

静置发酵.....之

兑水稀释

我们的厕所

盖板

灰土桶

纸篓

厕纸头进纸篓

大便冲水要分开

用土盖好讲卫生

粪坑盖好的时候

2.1 Experience in Shandong province

villages covered by a town sewerage network

New rural community

Villages in key drinking water sources protection areas

➤ **Flush toilet**



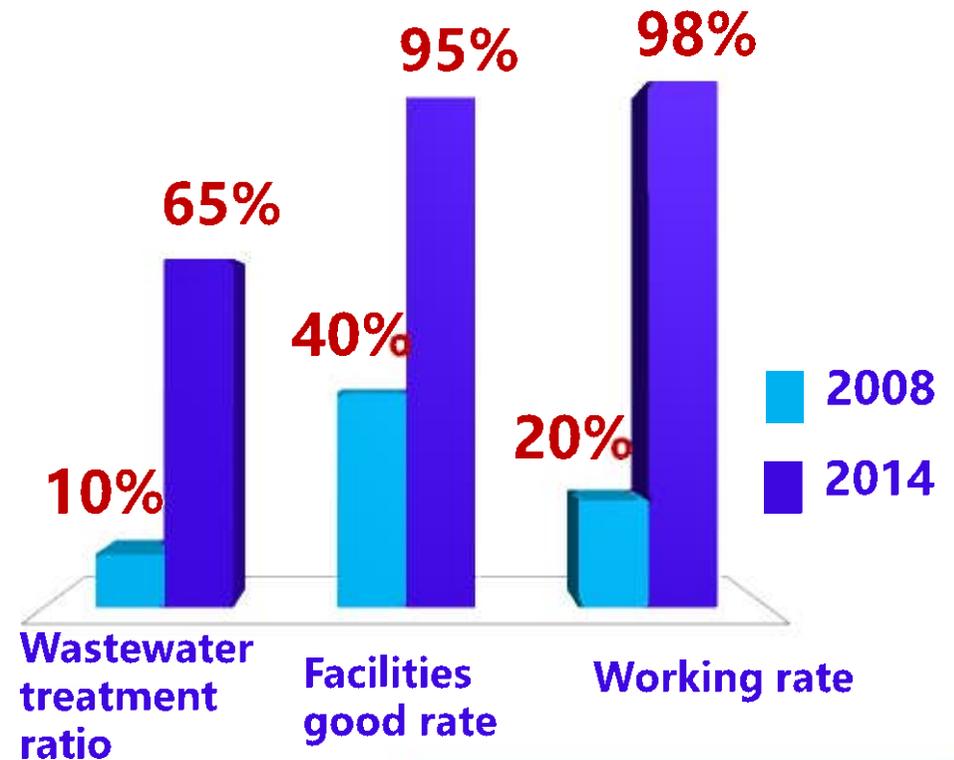
2.2 Experience in Changshu



Demonstration of one hundred counties

Unified

- **Planning**
- **Construction**
- **Management**
- **Operation**



Changshu model

Regional
integrated
propulsion

Government
purchase
service

Unified
operation of
the company

2.2 Experience in Changshu

unified planning



29 WWTPs before 2008

County as an unit

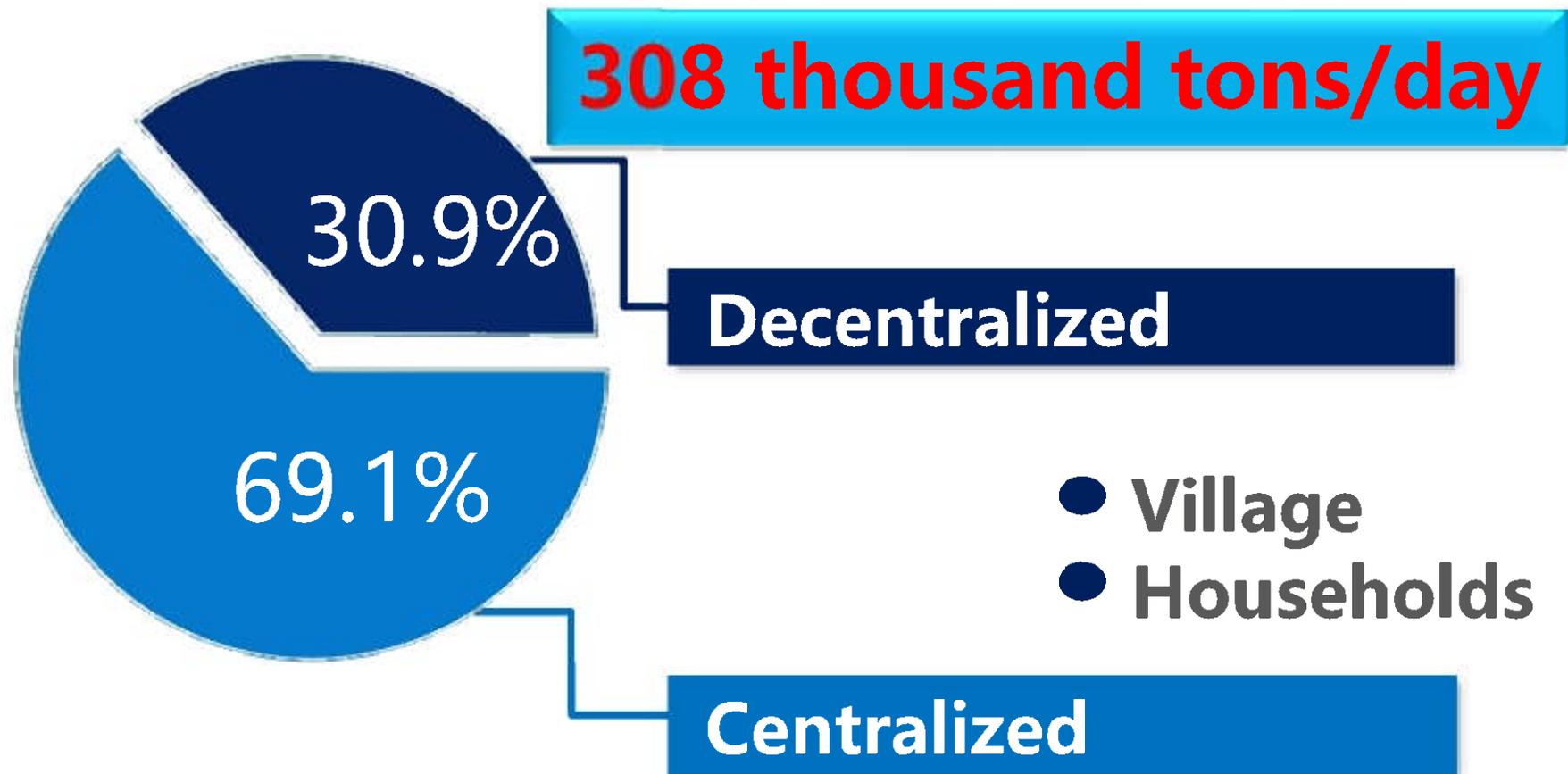


11 WWTPs after 2012

Since 2008, local governments have broken administrative boundaries, drawn up special plans for the treatment of domestic sewage, removed, upgraded and built high-standard centralized sewage treatment plants, and rationally laid out decentralized sewage treatment facilities in rural areas.

2.2 Experience in Changshu

unified planning

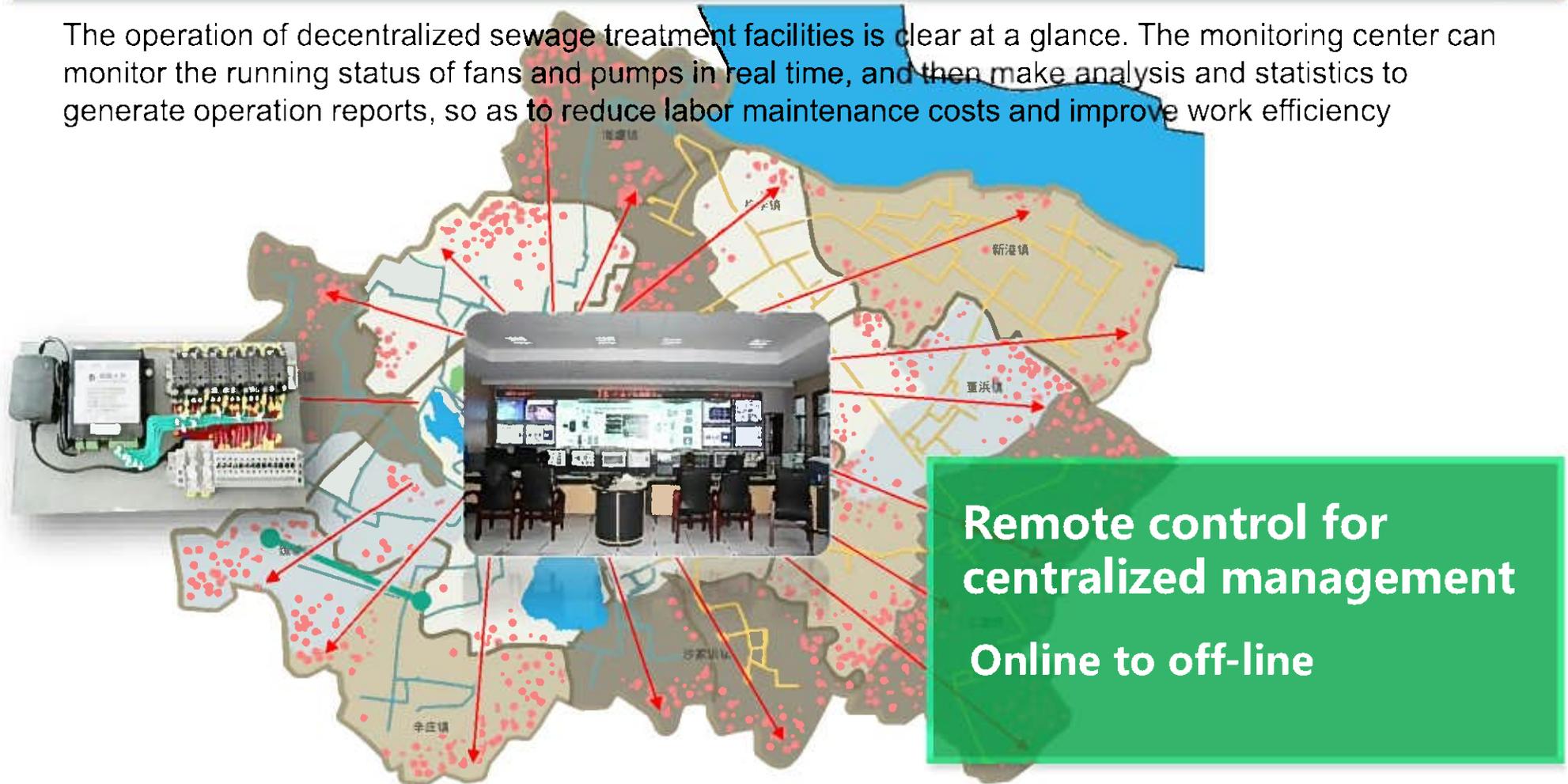


About 70% of the households in Changshu have their sewage treated in the urban pipe network. Other farmers choose three decentralized treatment modes, namely relatively centralized, village group treatment and household treatment, according to the classification of village shape and scale.

2.2 Experience in Changshu

Information-based monitoring platform of rural sewage treatment

The operation of decentralized sewage treatment facilities is clear at a glance. The monitoring center can monitor the running status of fans and pumps in real time, and then make analysis and statistics to generate operation reports, so as to reduce labor maintenance costs and improve work efficiency



Centralized management for decentralized facilities

Management

- **Funding**
- **Appropriate system design and selection process**
- **Operator training**

Promotion Plan

—**Funding**

• **PPP (Public-Private-Partnership)**

- **The main body of construction and operation management : Enterprises**
- **Local government is mainly to buy services included in the annual budget**

Wastewater in different regions

Domestic water use (L/P. day)

Types of village	Northeast	North south	North	West north	West south	South
Good economic, bath ,flush toilet ,wash mashine	80-135	90~200	100~145	75~140	80-160	100~180
Good economic, bath and kitchen	40-90	80~100	40~80	50~90	60-120	60~120
Normal economic ,simple toilet	40-70	60~90	30~50	30~60	40-80	50~80
No flush toilet	20-40	40~70	20~40	20~35	20-50	40~60

Characters of wastewater (mg/L)

	pH	SS	COD	BOD ₅	NH ₄ ⁺ -N	TP
West south	6.5~8.5	100-300	100-400	50-300	3-50	1.0-6.0
Northeast	6.5-8.0	150-200	200-450	200-300	20-90	2.0-6.5
North south	6.5~8.5	100~200	70~300	150~450	20~50	1.5~6.0
North	6.5~8.0	100~200	200~450	200~300	20~90	2.0~6.5
West north	6.5~8.0	150~200	150~400	100~150	20~50	2.0~6.0
South	6.5~8.5	100~200	100~300	60~150	20~80	2.0~7.0

Technical guide for rural domestic wastewater treatment in different regions



Northeast: septic tanks, anaerobic biofilter, bio-contact oxidation tank, land treatment, constructed wetlands, lagoon



North China : septic tanks, sewage digesters, aeration tank, sequencing batch bio-reactor, oxidation ditch, biological contact oxidation , constructed wetlands, land treatment



Northwest : septic tank, anaerobic digesters, anaerobic biofilter, constructed wetlands, land treatment



Southwest: septic tanks, wetland, land treatment, anaerobic technology, bio-contact oxidation tank, oxidation ditch, anaerobic biofilter

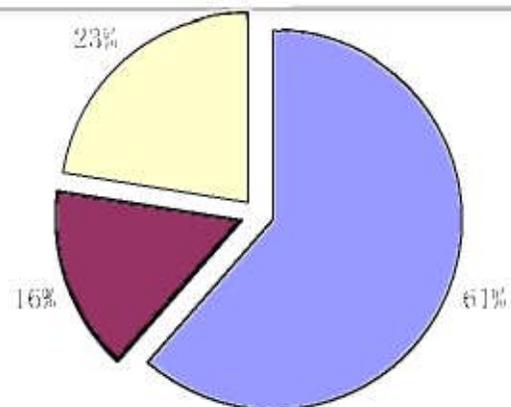


Middle south: septic tanks bio-contact oxidation, oxidation ditch, constructed wetland, lagoon, floating islands could be applied for sewage treatment.

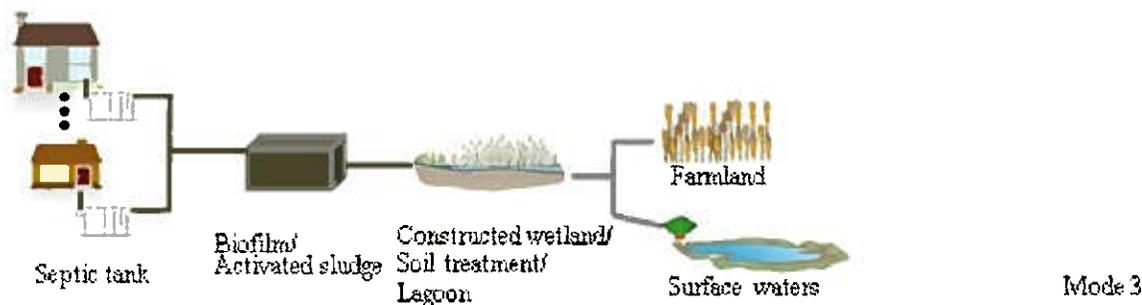
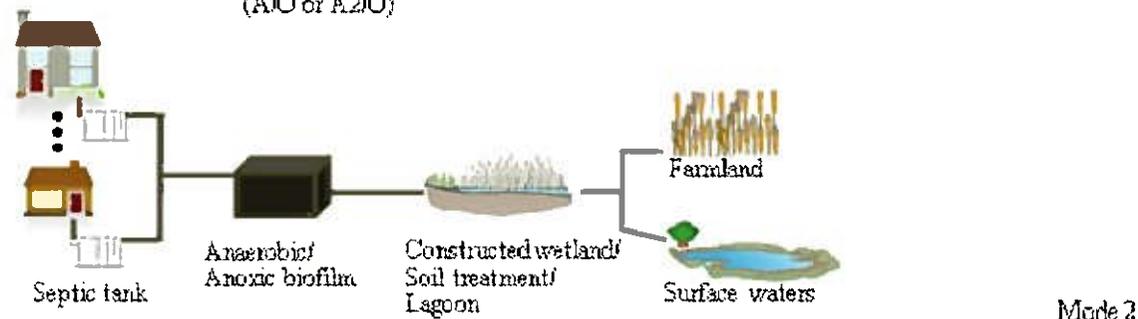
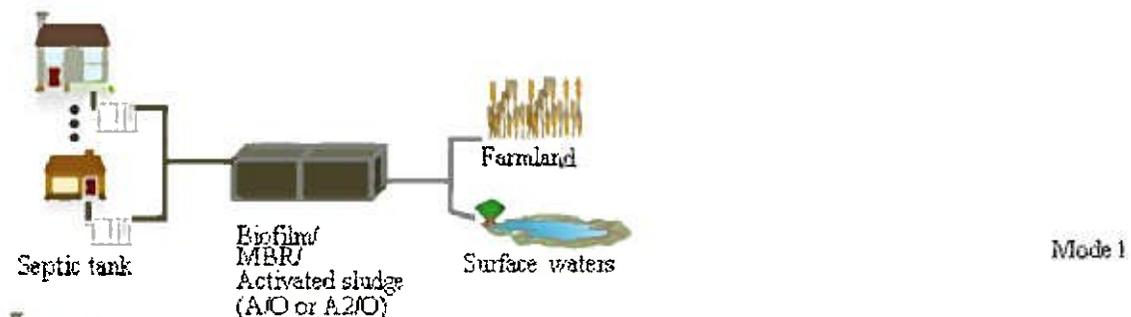


southeast: septic tank, anaerobic biofilter, anaerobic digesters; biological contact oxidation tank, oxidation ditch, constructed wetlands, ecological filter.

Typical modules in China

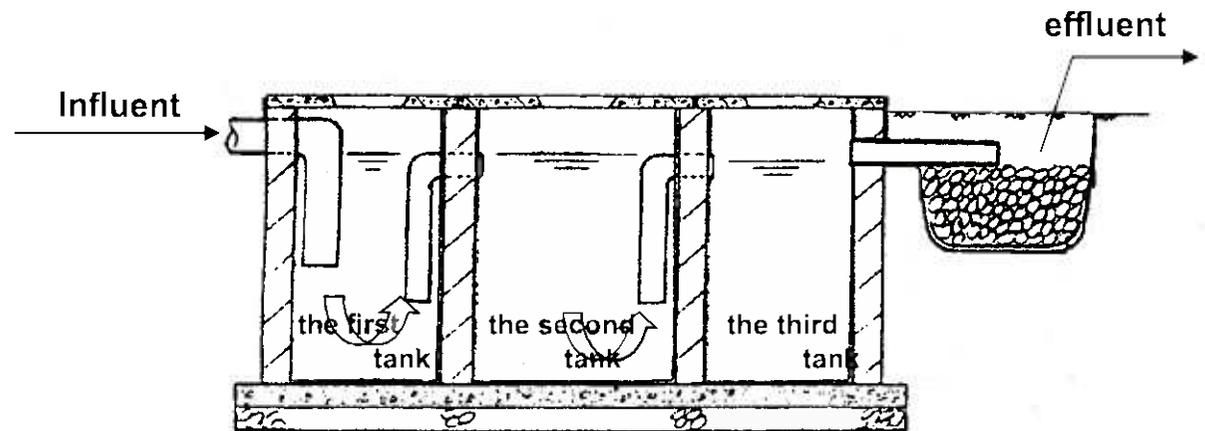


- 模式1: 生物处理
- 模式2: 厌氧生物+生态处理
- 模式3: 好氧生物+生态处理



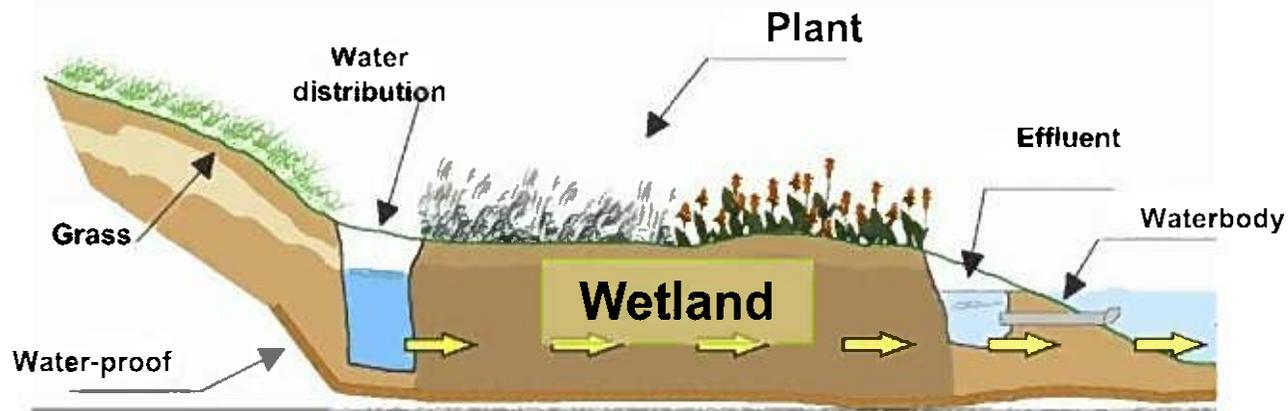
Septic tank

- Inexpensive
- Simple to maintain



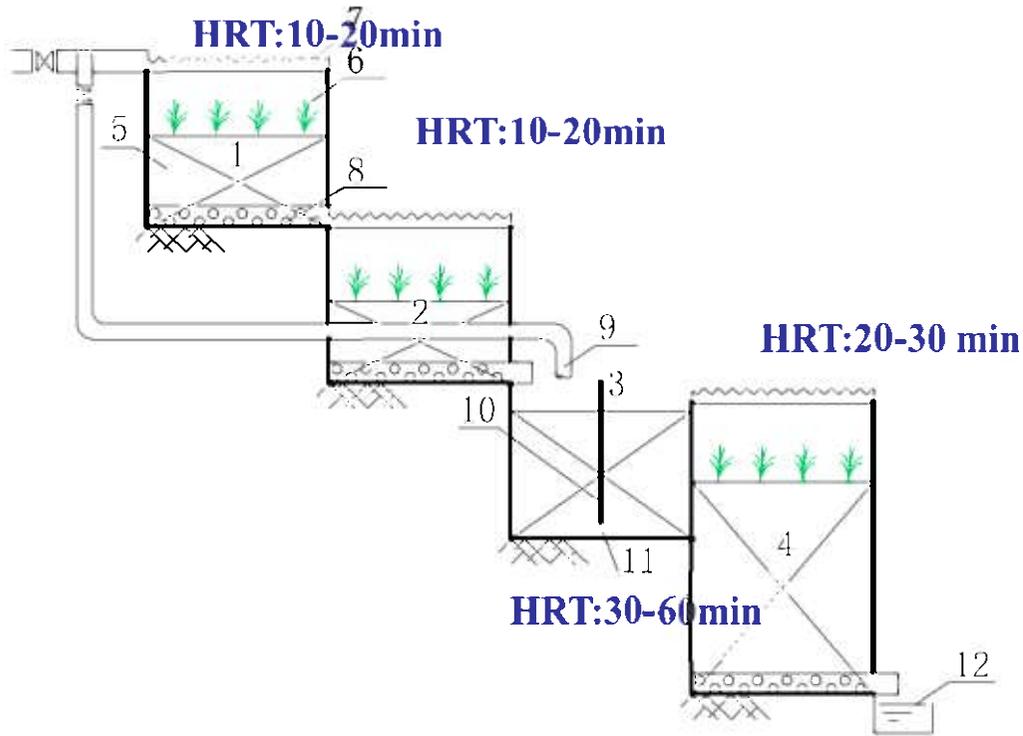
- Sludge may cause an odor problem
- Not effective in removing nitrate and phosphorus and pathogenic organics
- Potential pollution source of groundwater

Constructed wetland



- **constructed cost**
- **flexible land use**
- **Low removal rate**
- **Management**

Case study: anaerobic tank+ ladder eco-filter

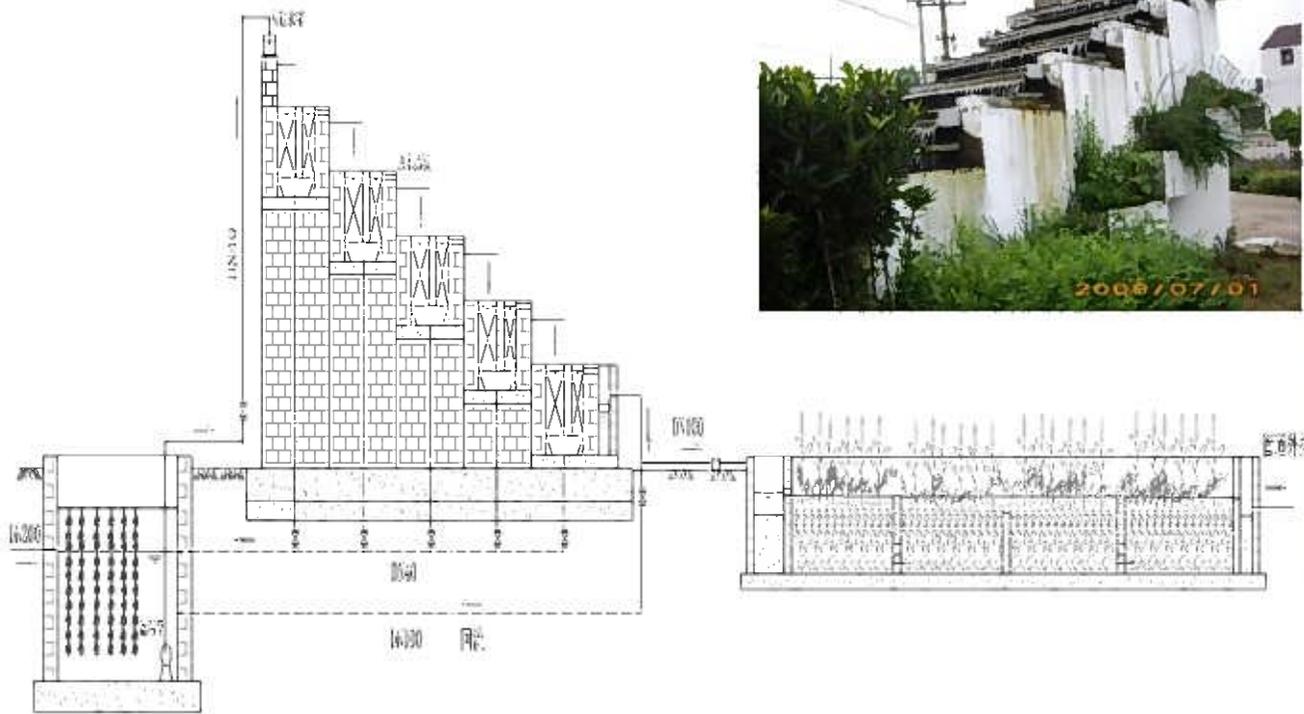


- Energy save
- Amonium and phosprous removal
- Odor

Unit: mg/L

item	COD	BOD ₅	NH ₄ ⁺ -N	TN	TP	SS
Influent	400	150	25	40	4	200
Effluent	60	20	8	20	1	20

Case study: Anaerobic+ drop aeration + constructed wetland



Anaerobic tank

Oxic

Constructed wetland



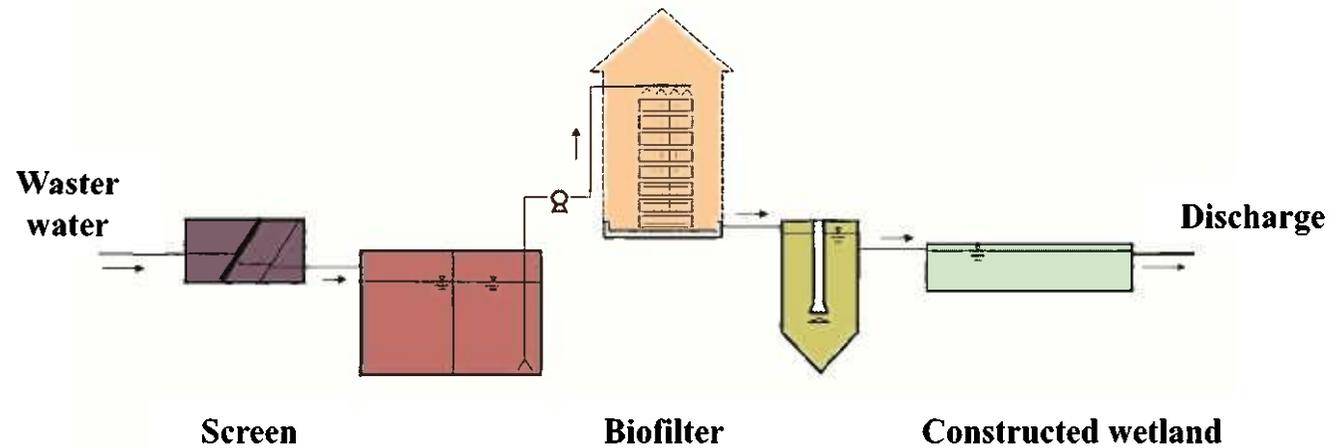
Case study: Bio-rotation + vegetable tank

3~10t/d, COD concentration is 100~100mg/L



- **Suitable in south area**
- **Vegetable management complex**

Case study: Cluster system



- **Cluster system**
- **High quality of effluent**



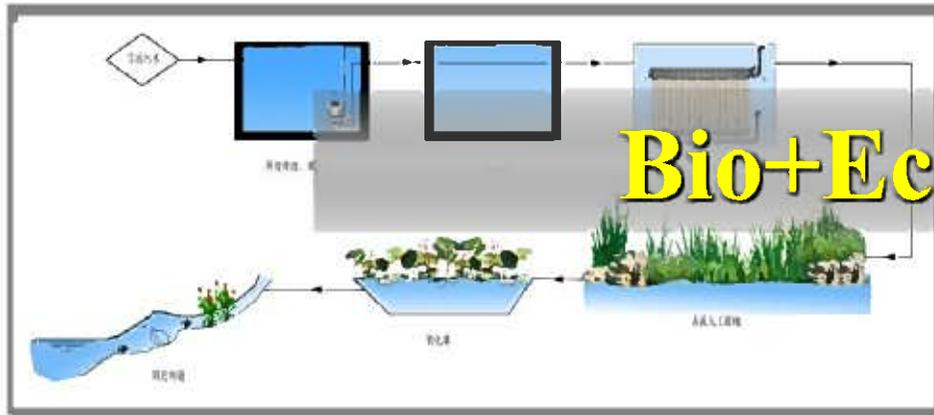
Decentralized wastewater systems

For COD removal



Aeration process

For nitrogen removal



Bio+Eco Treatment



Ecological toilet

Separation of fecal and urine



Technical Specification of wastewater treatment facilities for village (CJJ/T163-2011)



Main contents

How to choose the suitable technology for rural area?

1 General provisions

2 Terms and symbols

3 General requirement

4 Treatment technologies

- Anaerobic biofilm tank
- Biological contact oxidation tank
- Biological aeration filter
- Oxidation ditch
- Rotating biological contactor
- Activated-sludge process
- Ecological treatment of wastewater
- Chemical phosphorus removal
- Disinfection

5 Wastewater treatment facilities in village

6 Wastewater treatment station in village

- Wastewater treatment station for COD removal
- Wastewater treatment station for nitrogen removal
- Wastewater treatment station for nitrogen and phosphorus removal

7 Construction and acceptance of engineering quality

Main contents

Discharged standard:

- Discharge
- Reuse

Items	Grade IA	Grade IB	Grade II
COD	50	60	100
T-N	15	20	-
NH ₄ -N	5(8)	8(15)	25(30)
T-P	0.5	1	3

Unit: mg/L

3.0.3 污水的排放要求直接关系到污水处理程度和技术选择，因此，农村生活污水的排放要求需根据国家和地方的排放要求因地制宜地确定，以保证污染物消减目标的实现和降低成本。在没有排放要求的农村地区，针对地区的特征，建议按表 1 参考不同的排水去向的排放要求。

表 1 村庄污水排放执行的相关参照标准

排水用途	直接排放		灌溉用水		渔业用水	景观环境用水
	污水综合排放标准 GB8978-1996	城镇污水处理厂污染物排放标准 GB18918-2002	农田灌溉水质标准 GB5084-2005	城市污水再生利用农田灌溉用水水质 GB 20922-2007	渔业水质标准 GB11607-89	城市污水再生利用景观环境用水水质 GB/T18921-2002
参考标准						

Thanks for your attention!

