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Progress of urban wastewater treatment & black and odorous water body governance in China

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Chinese Research Academy of Environmental Sciences

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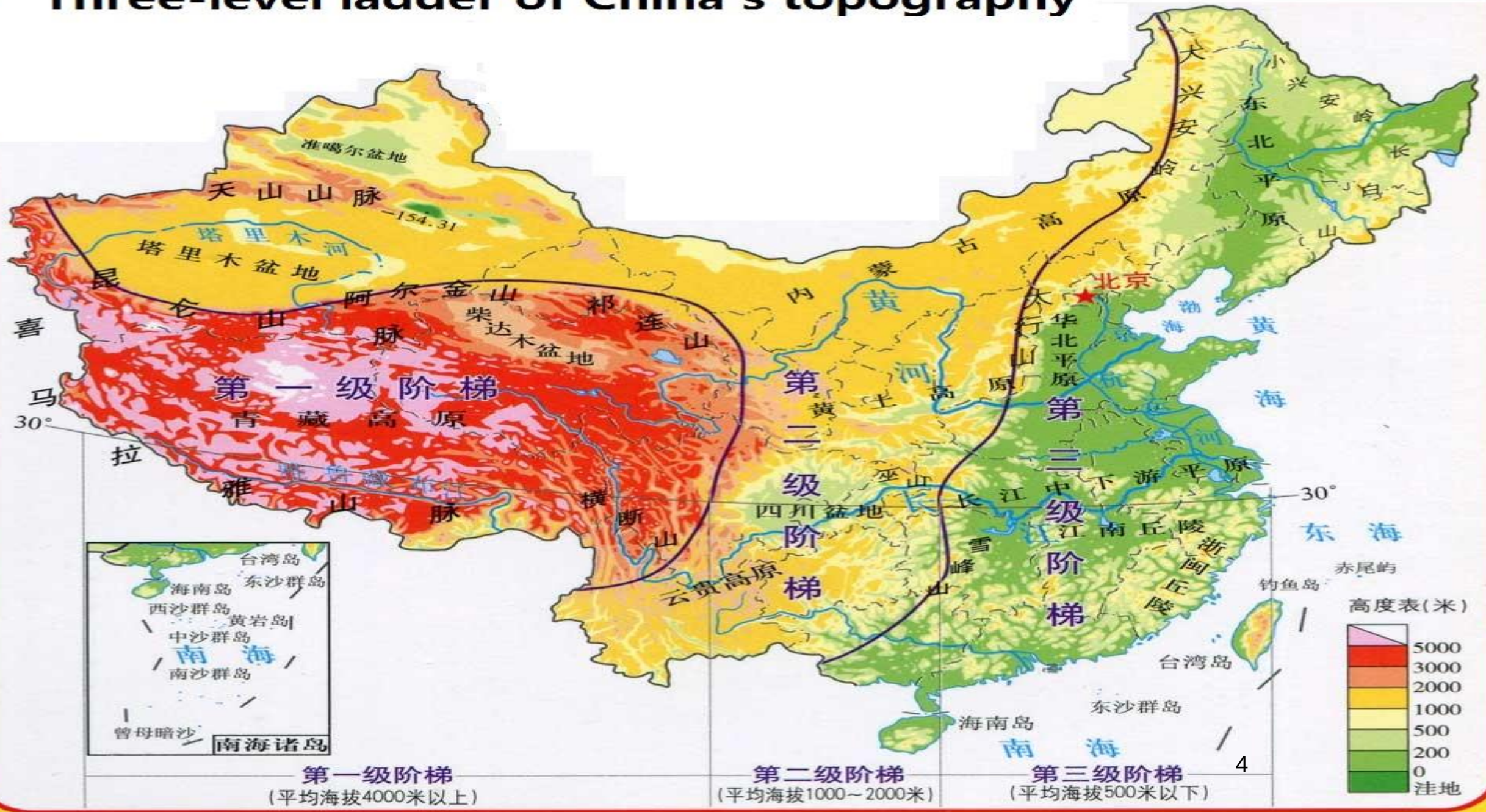
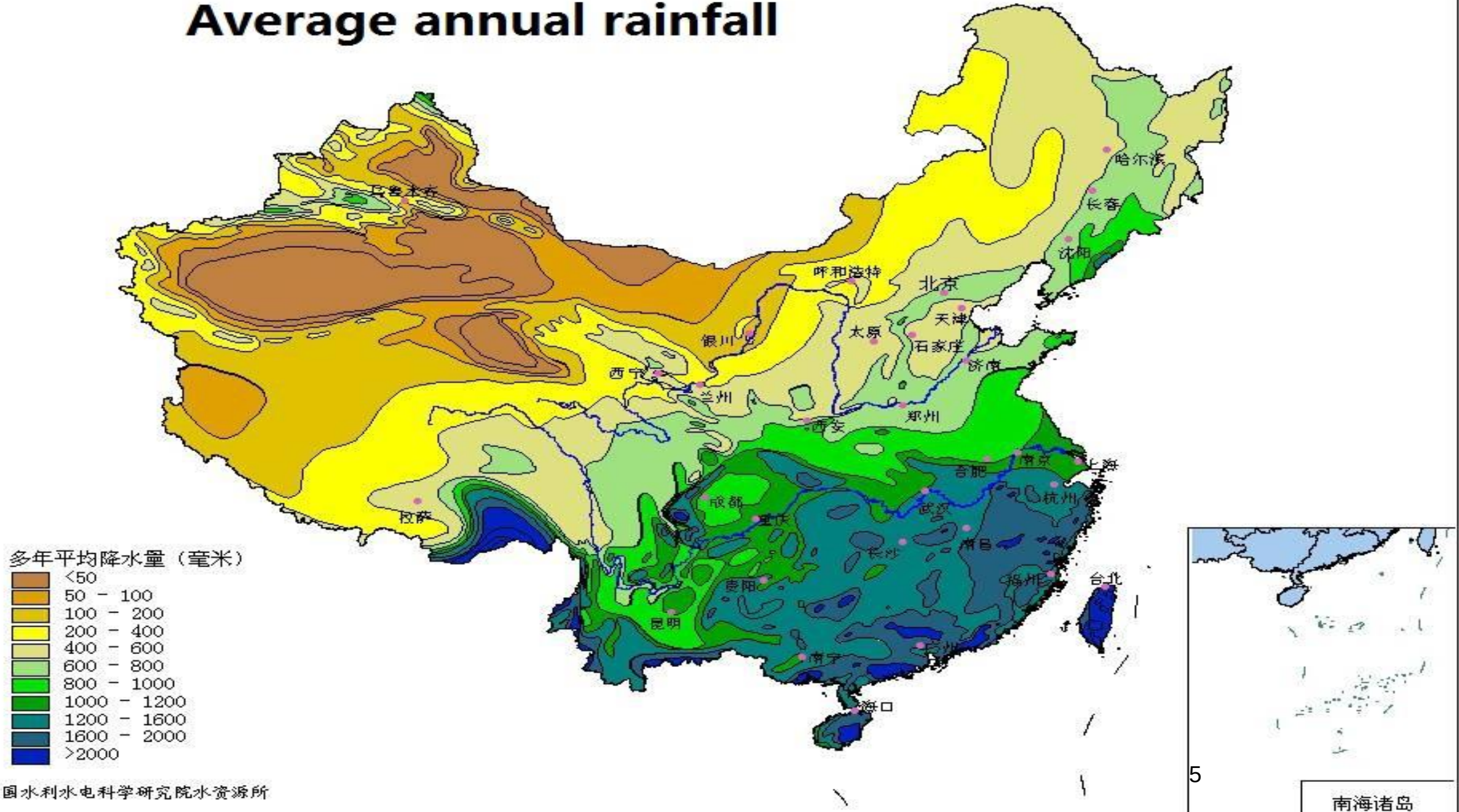
I. Water challenges in China

Three-level ladder of China's topography



Average annual rainfall



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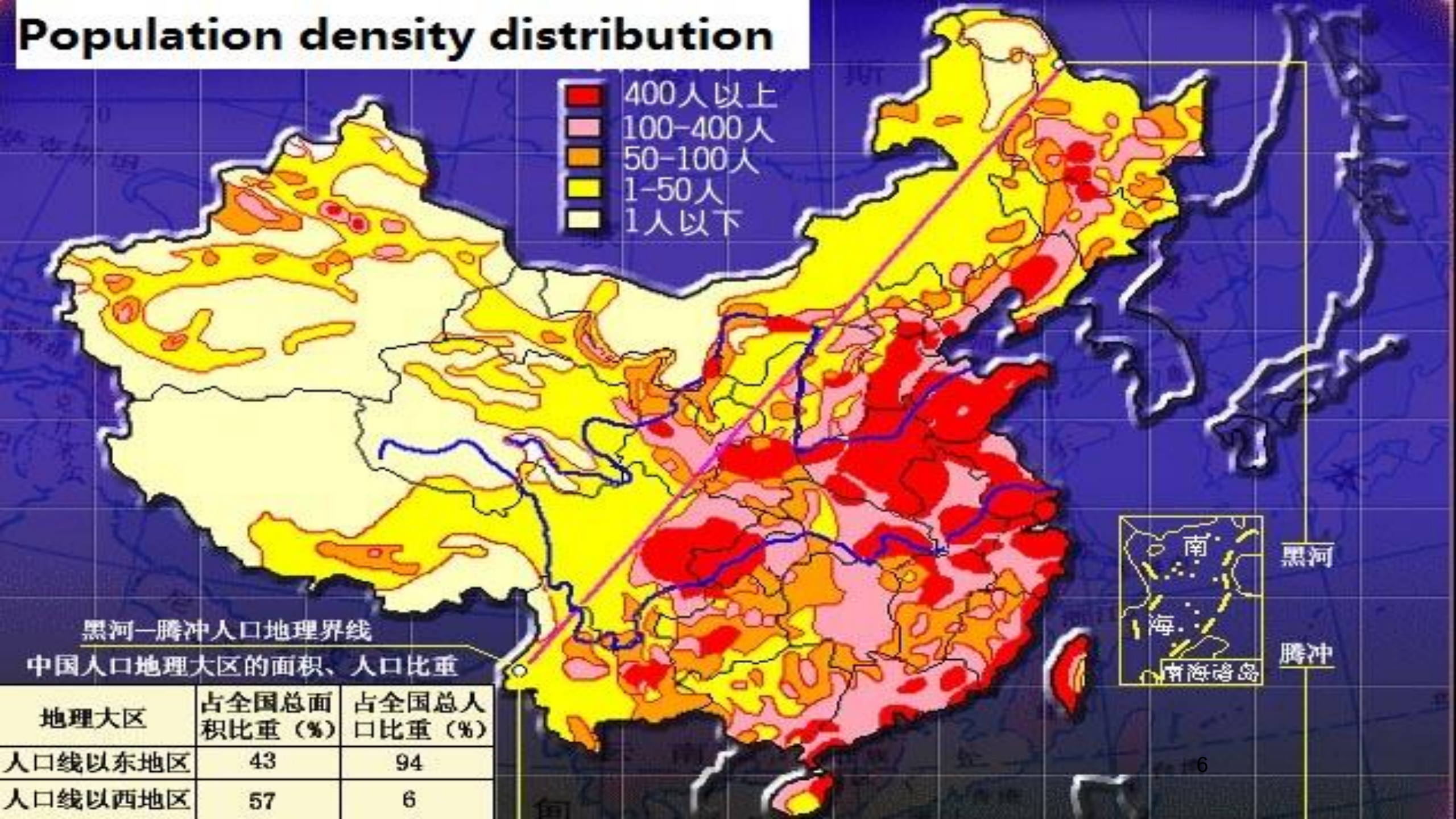
Population density distribution



黑河—腾冲人口地理界线

中国人口地理大区的面积、人口比重

地理大区	占全国总面积比重（%）	占全国总人口比重（%）
人口线以东地区	43	94
人口线以西地区	57	6

Uneven Distribution of Water

Abundance of water in Southern and Western regions

Lack of water in Northern and Eastern regions

Amount of water:

-More during summer

-Less during winter

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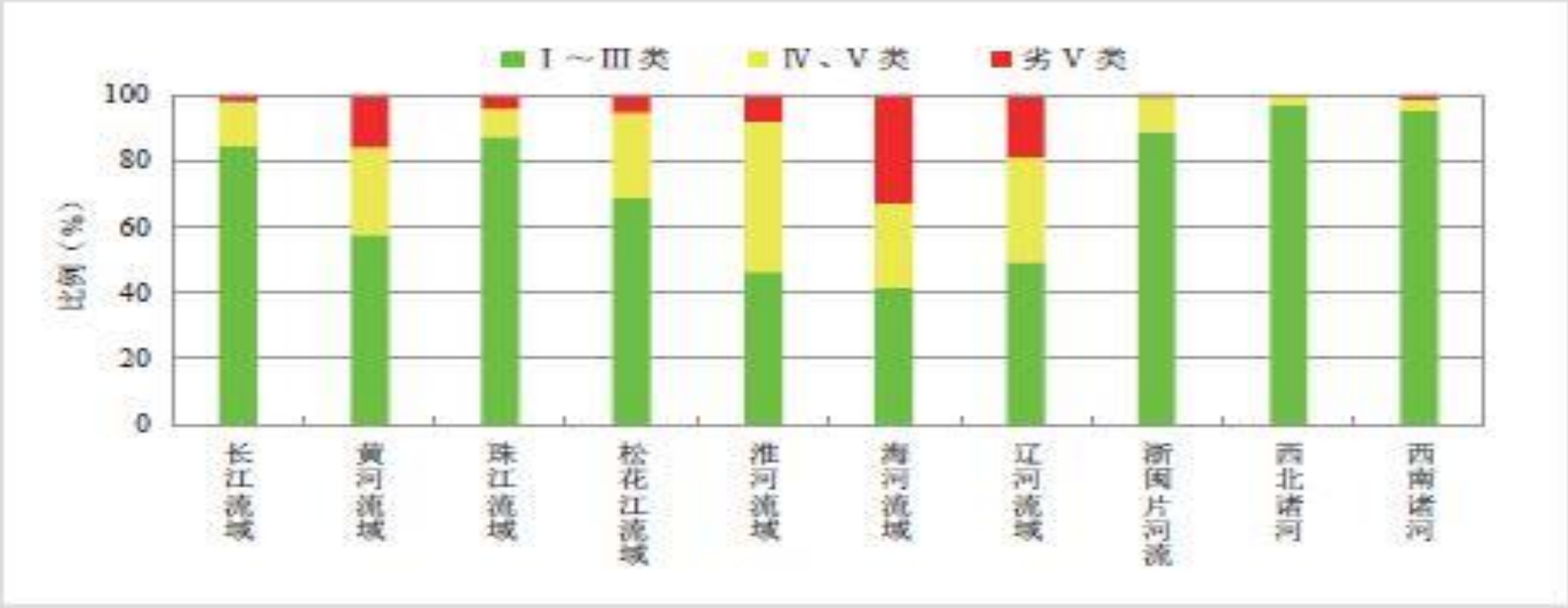
Main Rivers in China

Water quality of the main rivers



2017年七大流域和浙闽片河流、西北诸河、西南诸河水质状况

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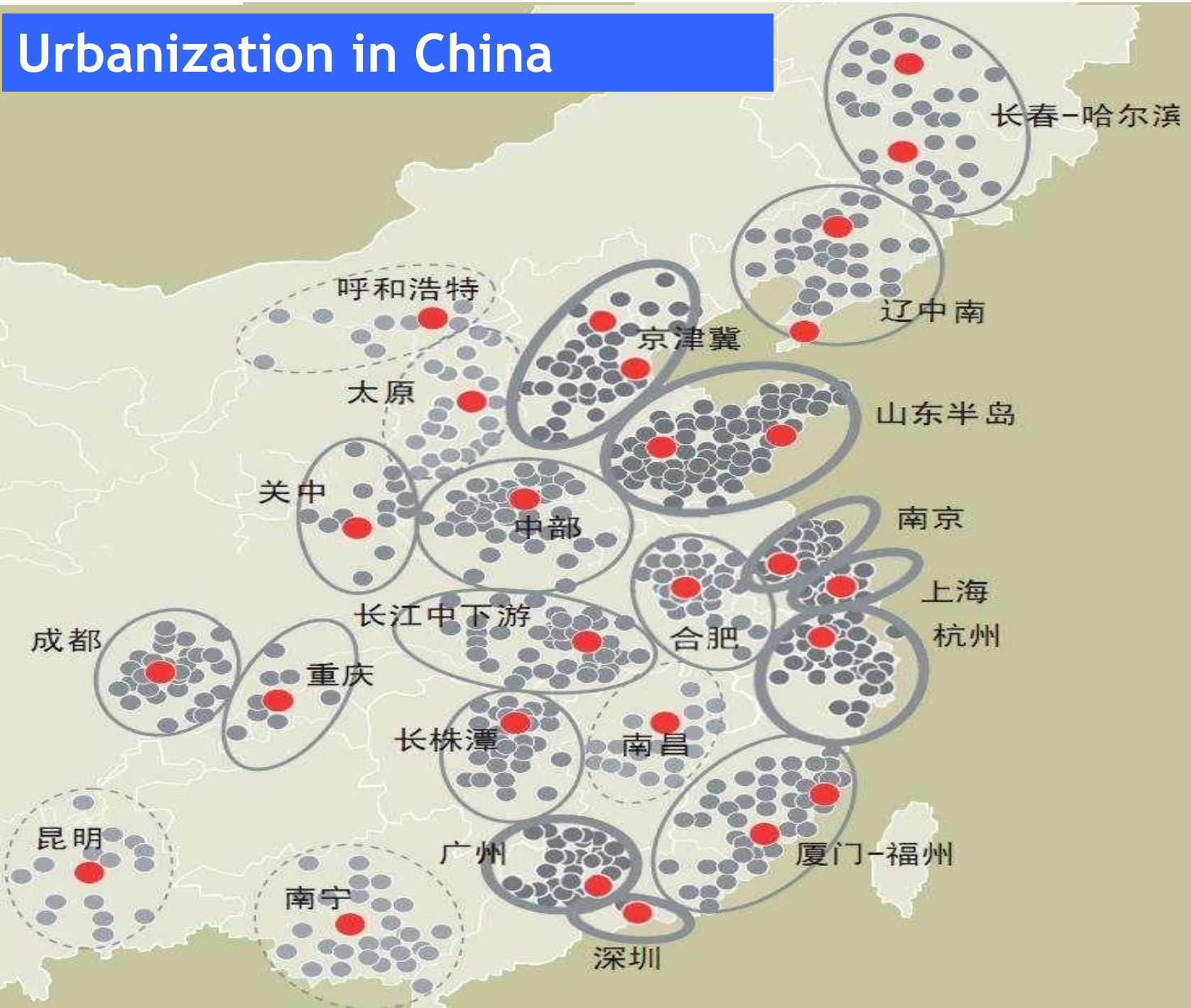
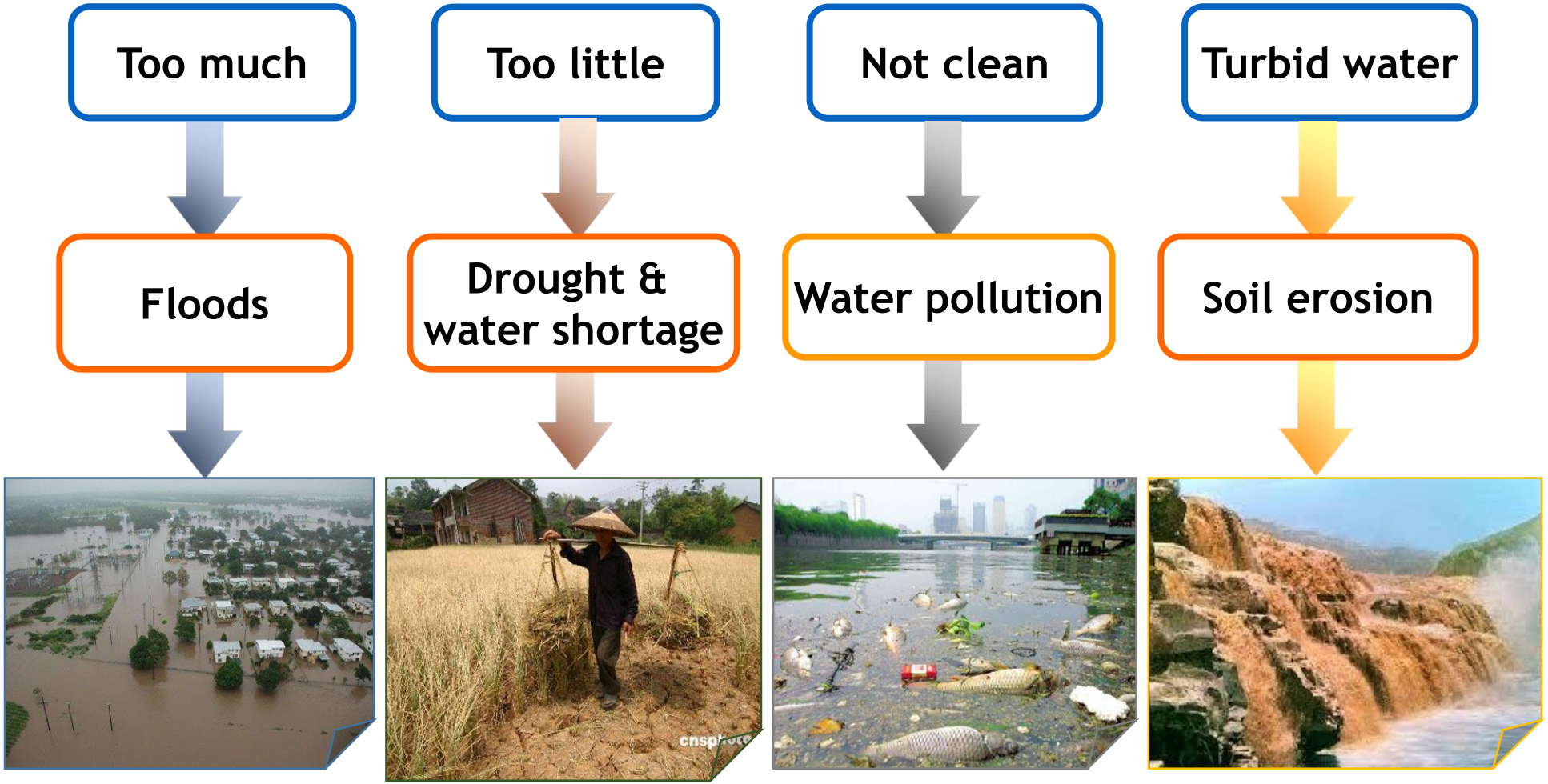
Urbanization in China



城市群名称 城市数量	城市群 GDP	枢纽城市 GDP
大城市群		
京津冀 (37)	10.8%	7.9%
上海 (19)	10.8%	6.2%
山东半岛(67)	9.0%	2.1%
杭州 (38)	6.7%	1.6%
广州 (24)	6.6%	2.6%
南京 (27)	4.8%	1.8%
深圳 (2)	4.3%	2.9%
中城市群		
辽中南 (30)	4.3%	2.4%
厦门-福州 (42)	4.2%	1.4%
长江中下游 (42)	4.0%	1.8%
中部 (40)	3.8%	0.7%
长春-哈尔滨 (36)	3.6%	1.6%
成都 (29)	3.2%	1.6%
合肥 (29)	2.8%	0.8%
长株潭 (28)	2.2%	0.8%
关中 (15)	1.9%	1.2%
重庆 (6)	1.8%	1.5%
小城市群		
南宁 (28)	1.8%	0.3%
南昌 (22)	1.7%	0.6%
太原 (19)	1.4%	0.5%
呼和浩特 (10)	1.3%	0.4%
昆明 (16)	1.1%	0.5%

Water challenges in China



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II. Water management strategy in China

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Strategic Water Management

- 节水优先、空间均衡、系统治理、两手发力
- Prioritize water saving, balance water resources, systematic governance, and two-handed support.

Implementation of new Environmental Protection Law

Law articles increased from 47 to 70:

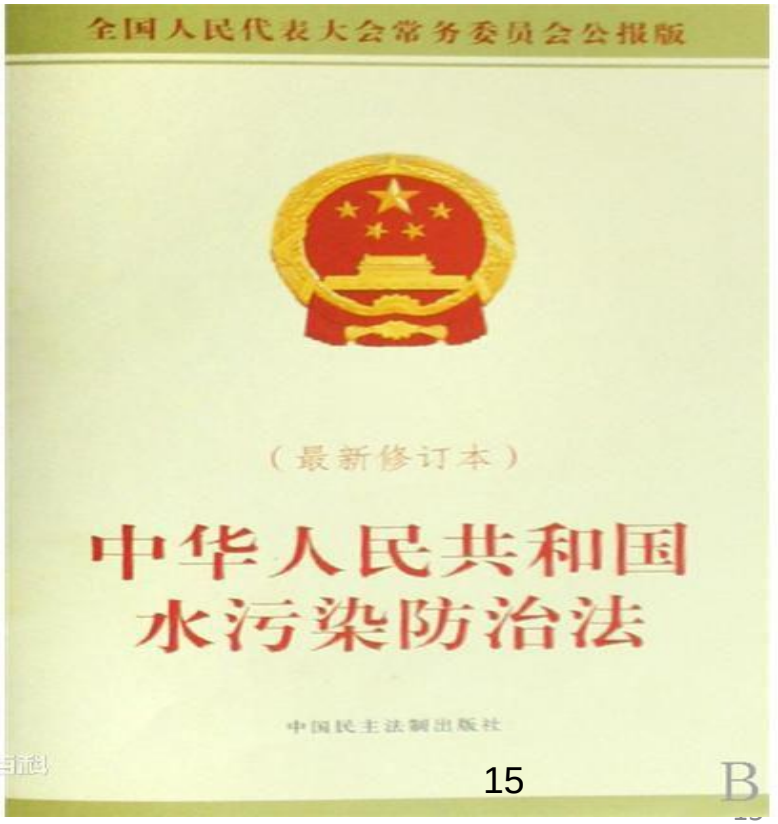
Implemented on Jan. 1st, 2015

- Prioritized environmental protection
- Strengthened punishment for law violation
- Supervision of environmental protection through information disclosure and public involvement.
- Environmental violation lawsuit
- Ecological “red-lines” for stricter protection

Implementation of new Water Pollution Prevention and Control Law

- River governor system
- Prevention of agricultural and rural water pollution
- Total volume control and sewage discharge permit
- Drinking water protection
- Environmental monitoring and supervision

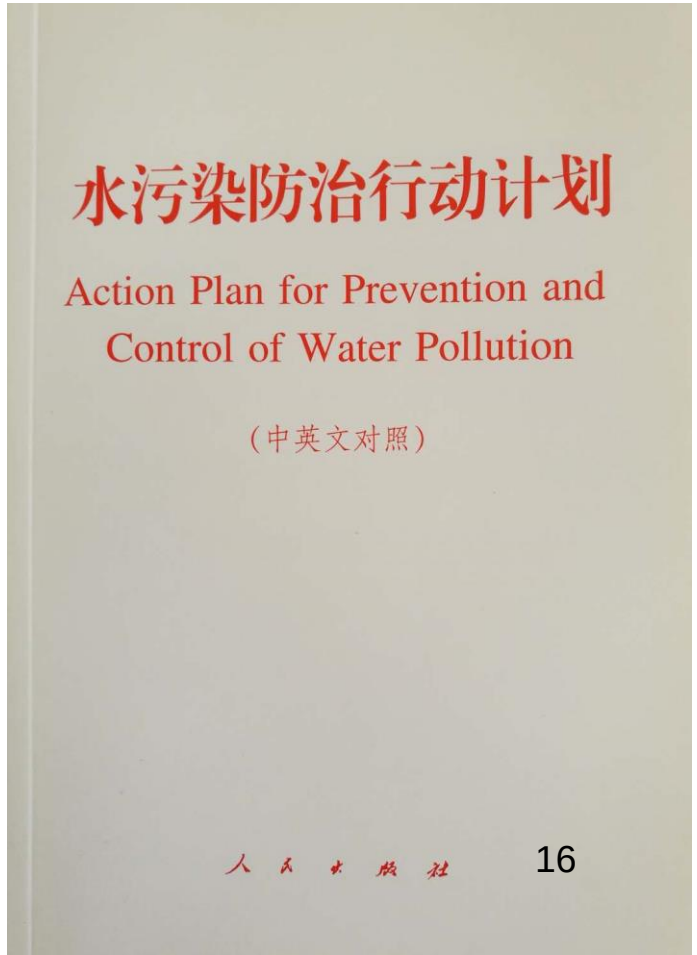
Implemented on Jan. 1, 2018



Implementation of Action Plan for Prevention & control of Water Pollution

- Overall considerations for saving, protecting, developing, governing and sustainably utilizing water resources
- Overall improvement of security levels of water environment, water resources and water ecology

Implemented on Apr. 16, 2015



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1. Overall control of pollutant discharge

(1)Prevention and control of industrial pollution

(2)Strengthened control of urban domestic pollution

- Increased emission standards
- Increased rate of collection and treatment
- ---counties：reaching 85% by 2020

  ---cities：reaching 95% by 2020

(3)Prevention and control of agricultural and rural pollution

(4)Strengthened control over ship and port pollution

2. Promotion of economic transformation and update of economic structure

3. Focus on water resources saving and conservation

4. Strengthening of Scientific Technology support

5. Adding the factor of market influence
6. Strengthening of environmental law enforcement and supervision
7. Effective strengthening of environmental water management
8. Full guarantee of ecological and environmental water safety

…

Treating black-odorous water bodies in cities

…

9. Defining & fulfilling the responsibilities of each party
10. Strengthening of public participation & social supervision

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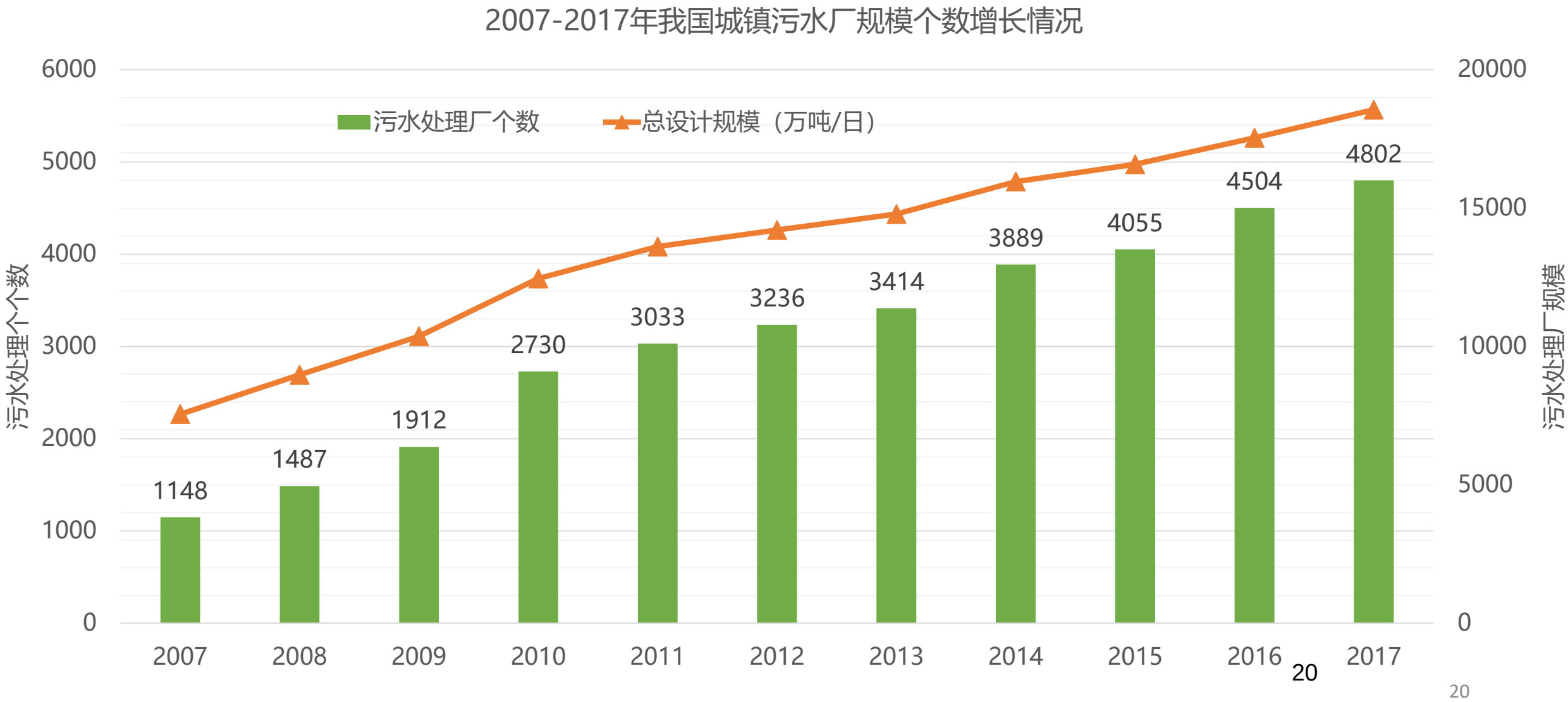
III. Urban wastewater treatment

Growing urban wastewater treatment capacity in China



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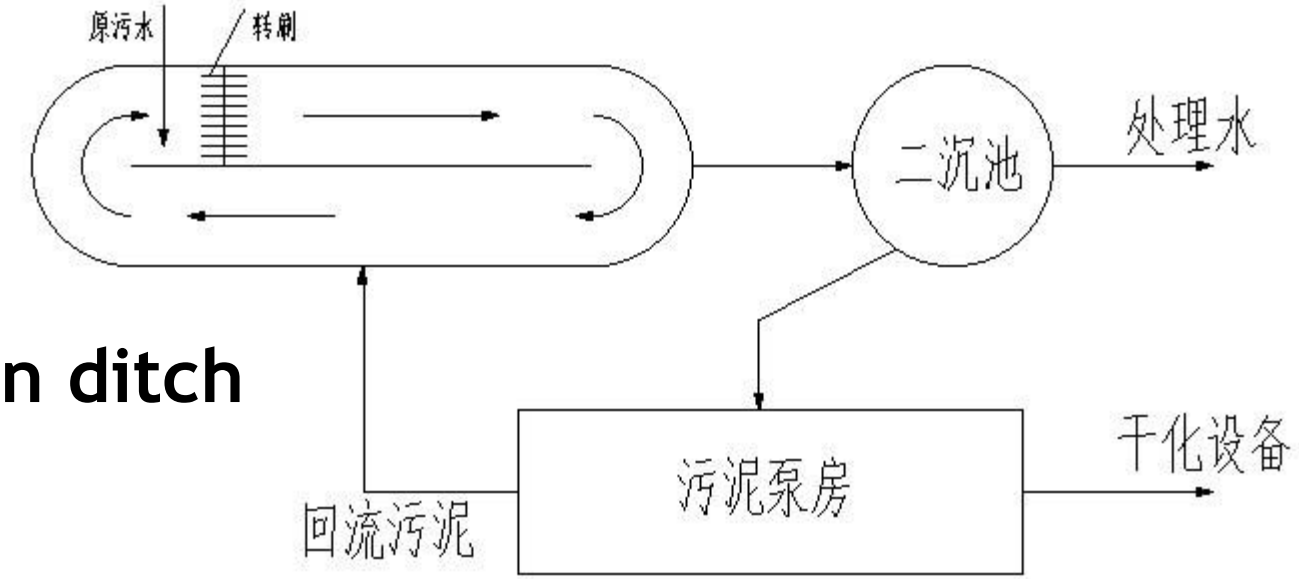
Oxidation ditch process



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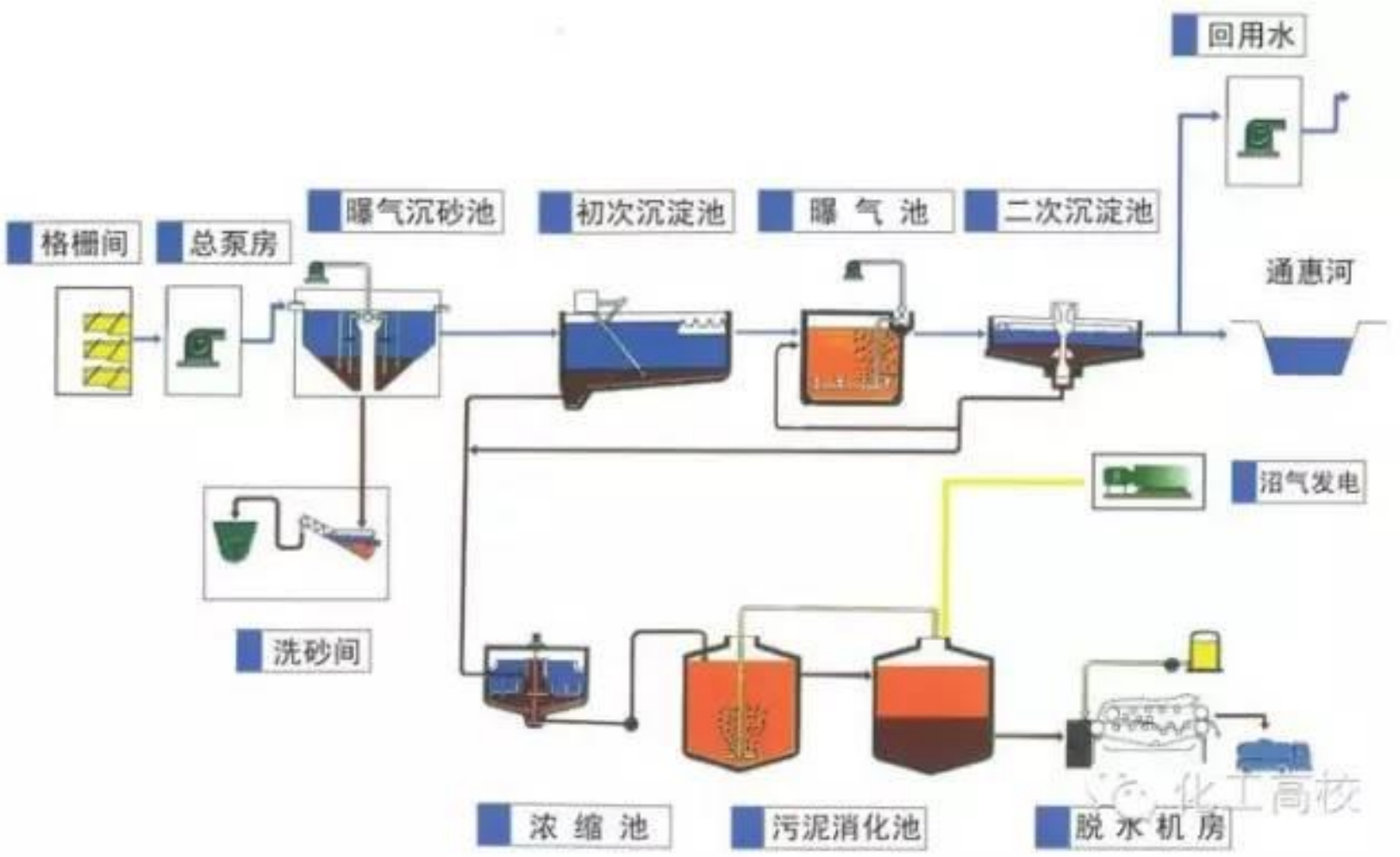
Activated sludge process



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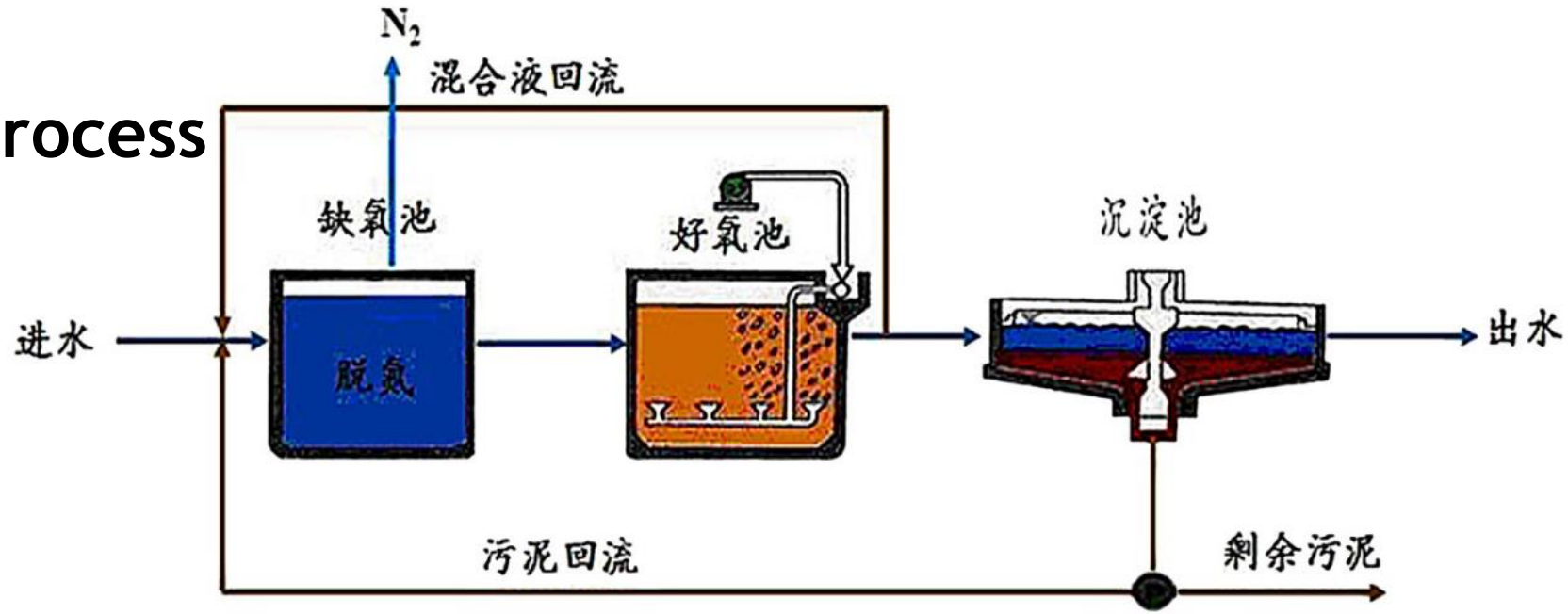
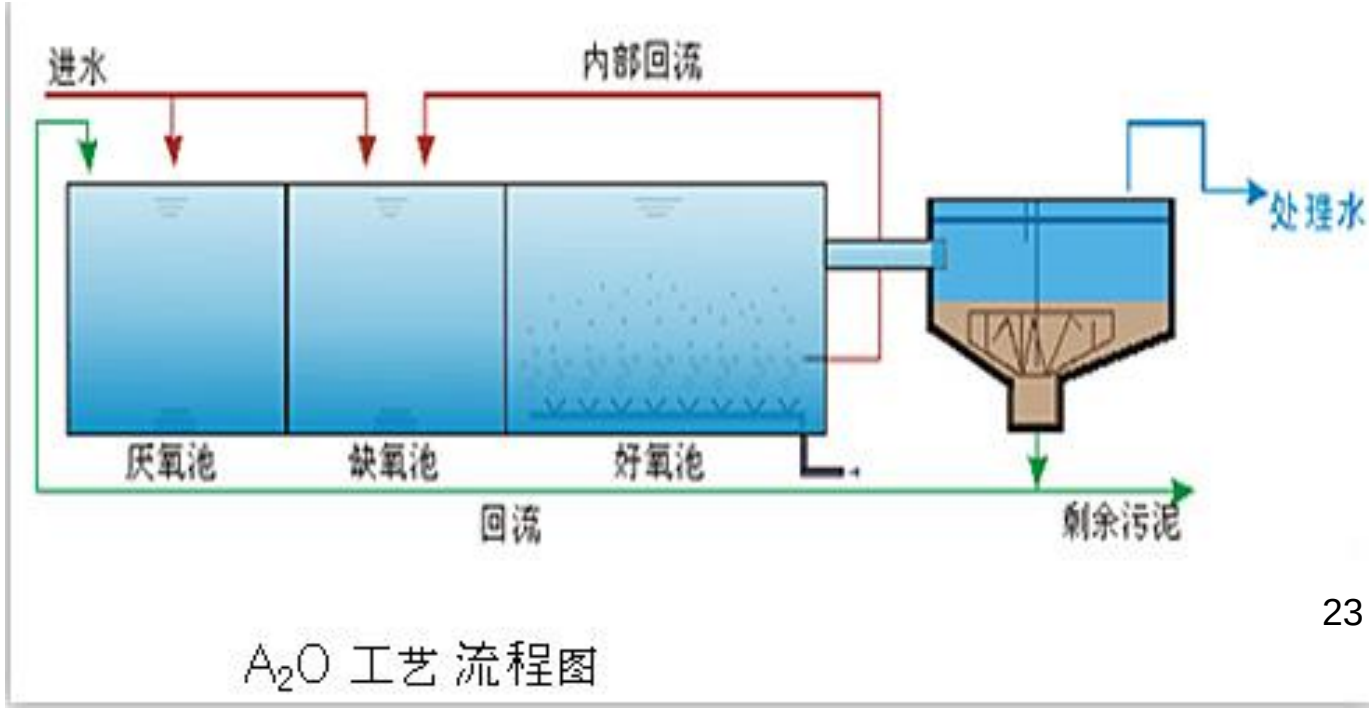
A/O process



A^2O process



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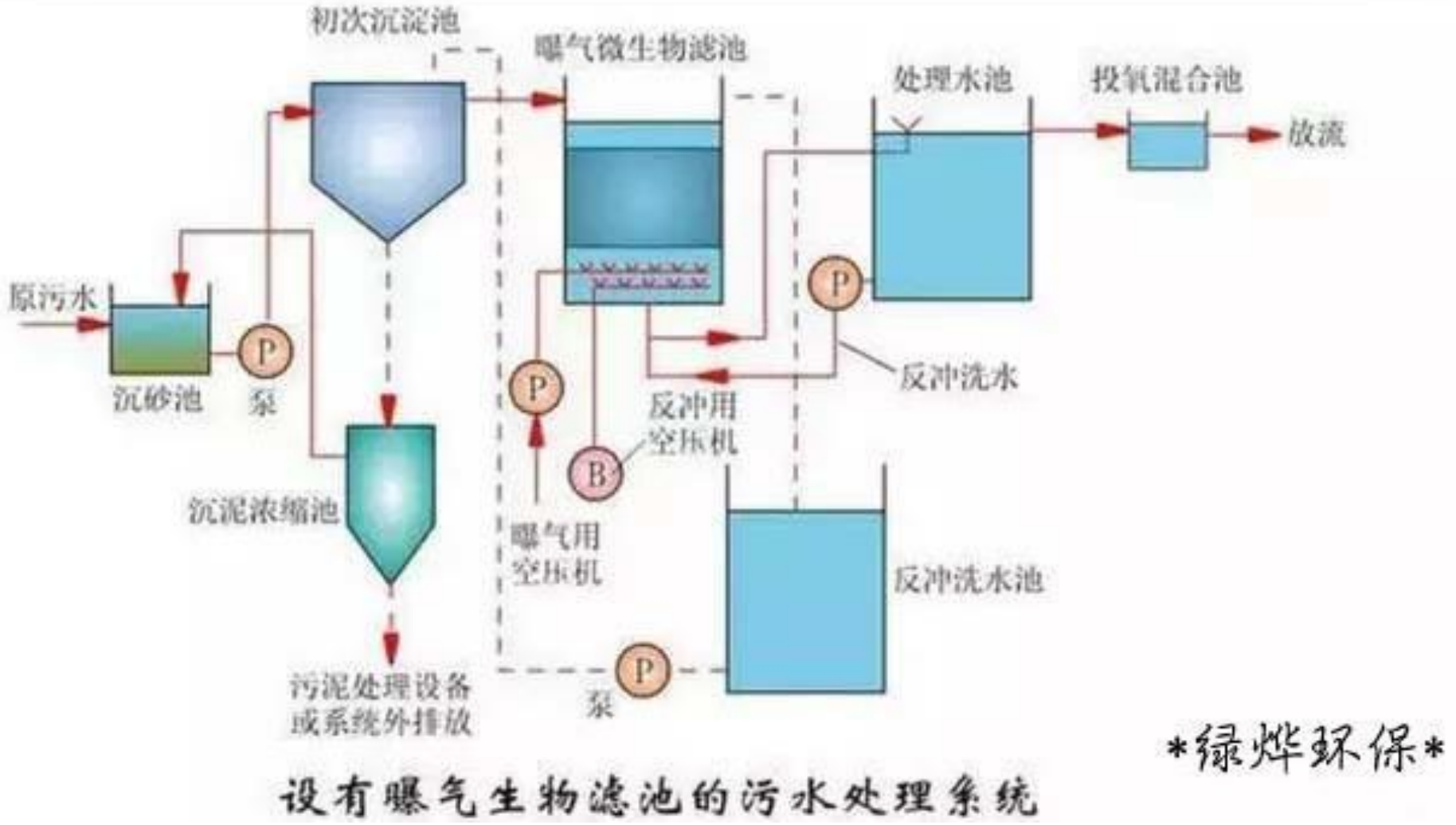
BAF process



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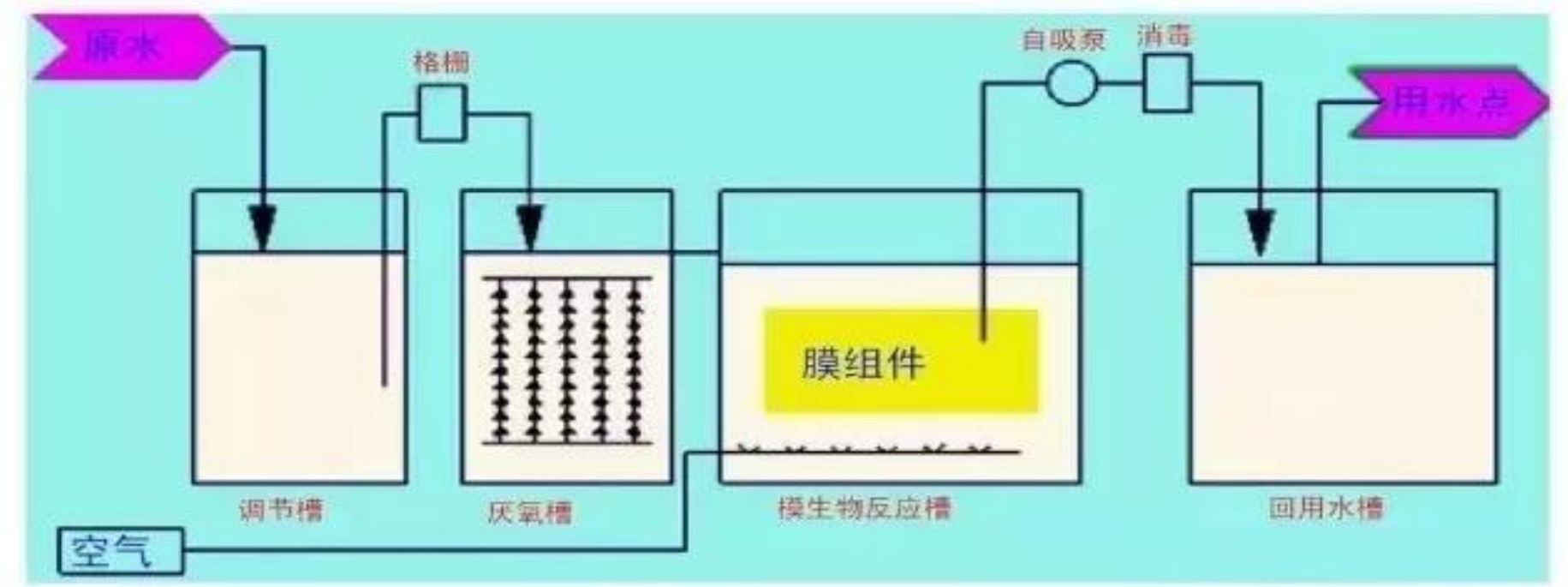
MBR process



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Gap between the discharge standards and the surface water quality standards

Indicator	Surface water quality standards, mg/L					Discharge standards, mg/L		
	I	II	III	IV	V	1st Level A	1st Level B	2nd Level
COD ≤	15	15	20	30	40	50	60	100
BOD_5 ≤	3	3	4	6	10	10	20	30
NH_3-N ≤	0.15	0.5	1.0	1.5	2.0	5	8	25
TP (river) ≤	0.02	0.1	0.2	0.3	0.4	0.5	1.0	3.0
TN (lake) ≤	0.2	0.5	1.0	1.5	2.0	15	20	-
…								
Fecal coliforms (units/L)	200	2000	10000	20000	40000	1000	10000	10000

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Higher treatment efficiency & effluent quality are required

- Even the 1st level A discharge is worse than the lowest surface water quality V (Before 2015, 1st level A, 21%; 1st level B, 44%; 2nd level, 35%);
- The black-odorous water body governance needs more high-quality reclaimed water.

→ **Upgrading of the "old" WWTP**

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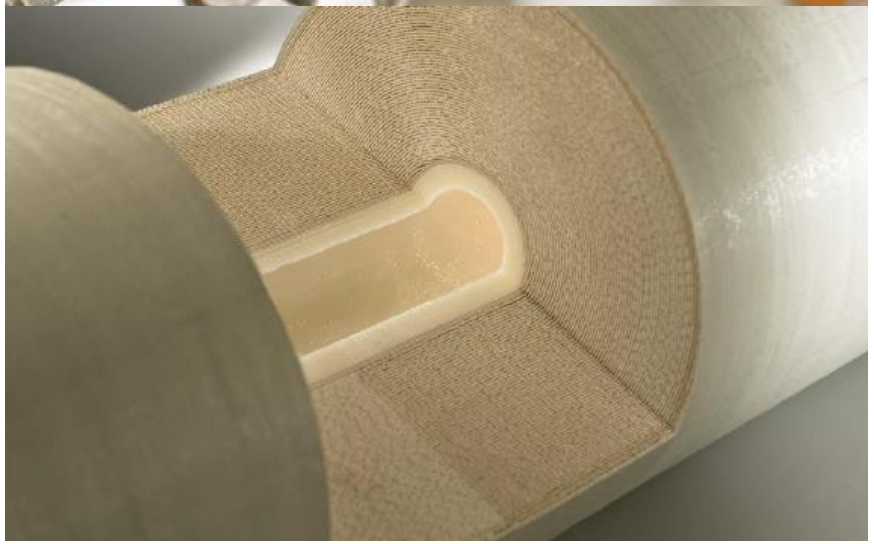
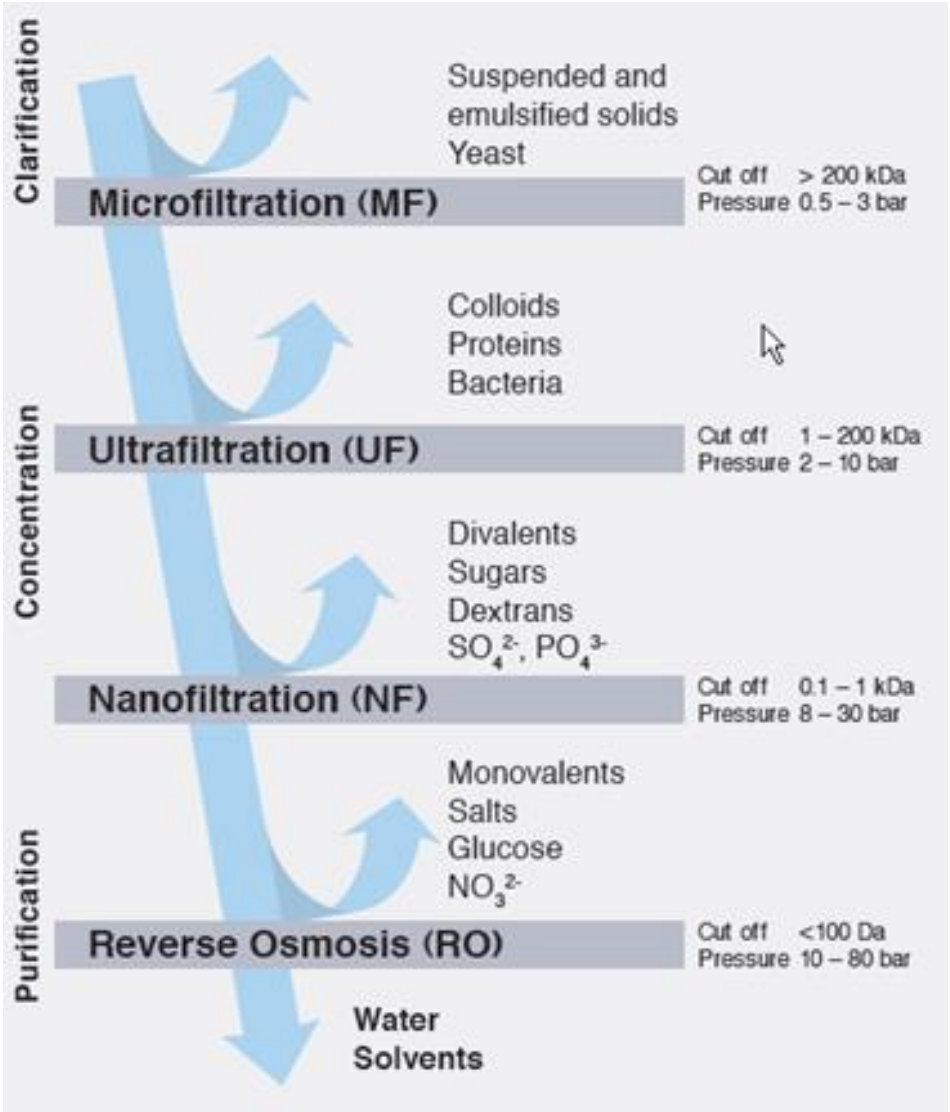
Membrane technology is a choice





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Solution to the problem of “less water” --Reclaimed water (RW)

	Region / country	Process	Operation pressure	Reuse way	Effect
RW	•Beijing •Tianjin •Jinan	•Sand/cloth filtration	–	•Landscape •Toilet flushing •Street spray •Car washing •Greening	Solution to water pollution
		•MBR •UF, MF	0.01~0.1MPa		
High-quality RW	•Beijing-Yizhuang •Erdos •Tianjin-Binhai	•MBR+RO •UF(MF)+RO	1.0~1.5MPa	Industrial reuse	Solution to water shortage
High-quality RW	•Singapore	•UF+RO	1.0~1.5MPa	•Industrial reuse •Drinking water source supplement	Solution to water shortage

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Direction of RW production

- WWTP effluent is a reliable source for high-quality RW production – solution to water shortage
- RO is an acceptable process for RW
- High pressure of the RO is the bottleneck for the large scale RW production – to develop low pressure membrane

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Develop high-quality reclaimed water technology

- Developed ultra-low pressure RO technology, with operating pressure <0.4MPa, desalination rate ≥85%, 42% less than US Dow membrane operating pressure;
- A complete set of technologies with immersion UF-ultralow pressure RO was formed. The cost was <1 yuan/ton water, which was about 55% lower than the traditional RO. The effluent COD is < 10 mg/L and the NH_3-N was < 0.1 mg/L.

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Challenges to face

- Sewage collection pipe network does not match the WWTP;
- Low wastewater concentration due to the pipe network leakage;
- Wastewater treatment of the industrial park;
- Sludge treatment, disposal, and resource utilization.

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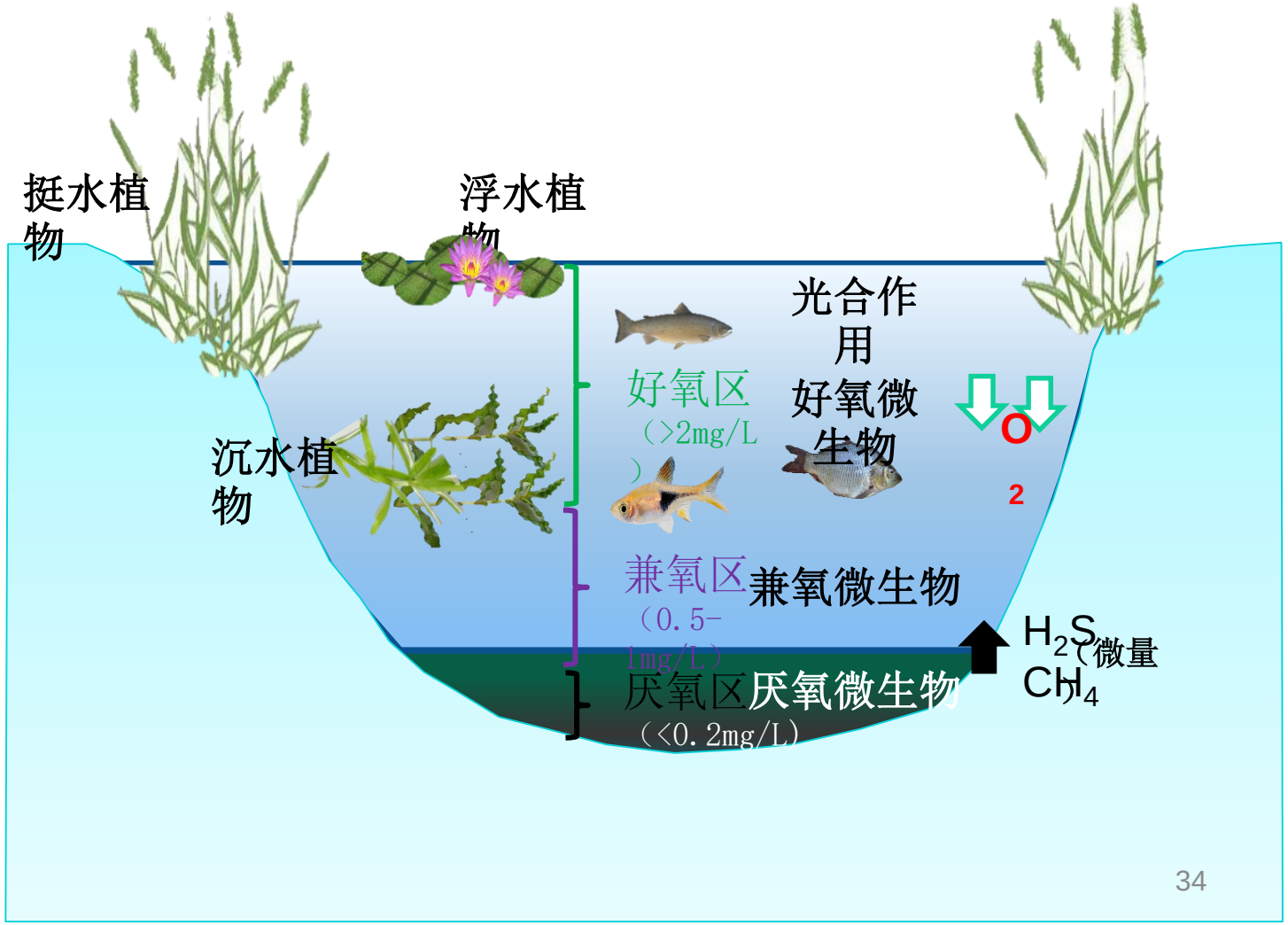
IV. Urban black-odorous water body governance

Healthy water ecosystem



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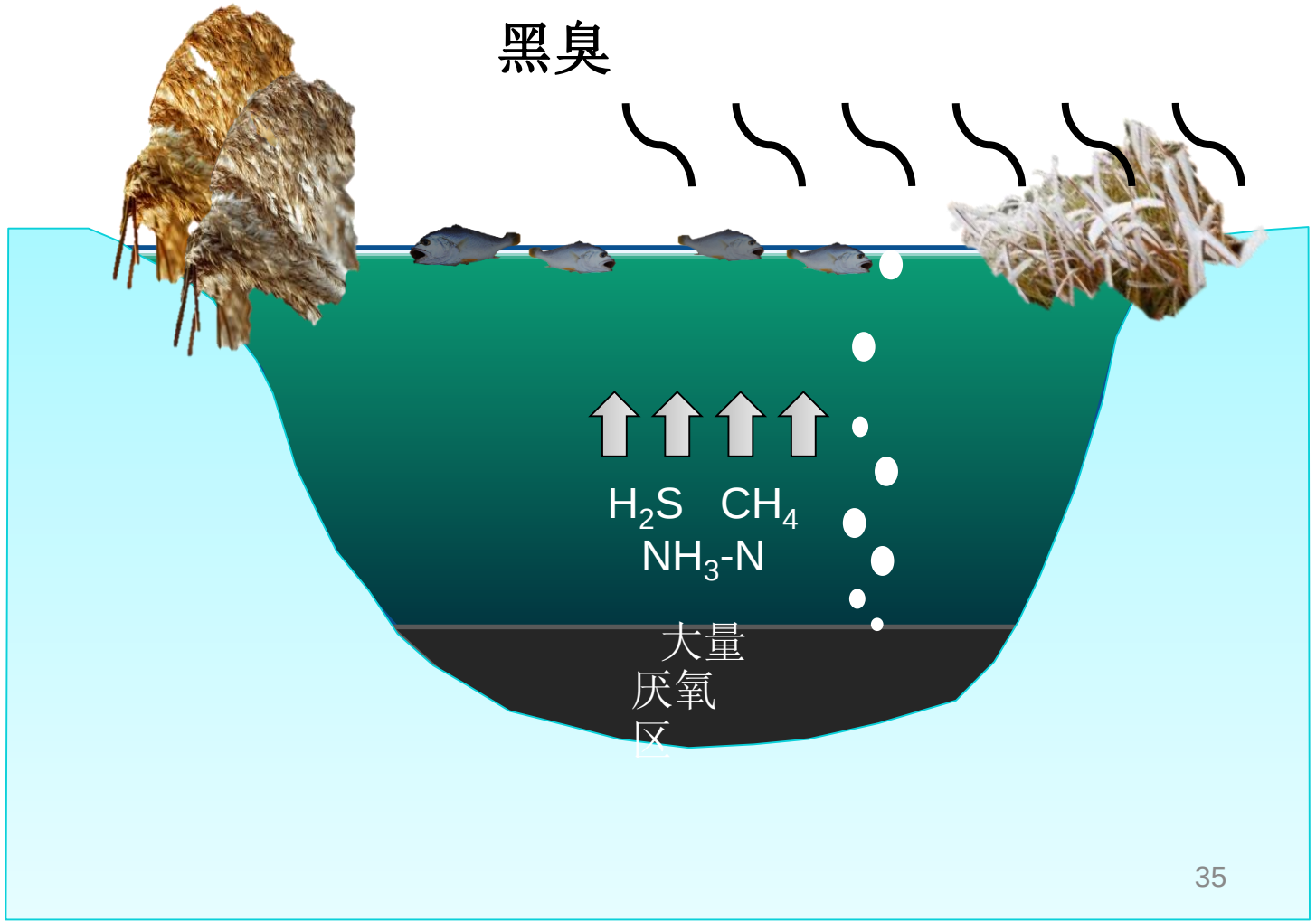
Black-odorous water body

Pollution, ecological damage, water does not flow



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Reason 1: Incomplete pipe network leads to wastewater discharge when it does not rain

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Reason 2: Wrong connection of rainwater pipeline and sewer leads to sewage discharge from rainwater pipe

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Reason 3: Sewage treatment is not up to standard, and self-purification ability of the water bodies is poor

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Reason 4: Serious endogenous pollution

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Black-odorous urban water body governance

- 2100 black-odorous water bodies were found;
- Ministry of Ecology and Environment, Ministry of Housing and Urban Rural Development are pushing forward the governance by supervising the local authorities
- By 2020, the elimination of black-odorous water bodies must reach above 90% in the 334 cities of China.

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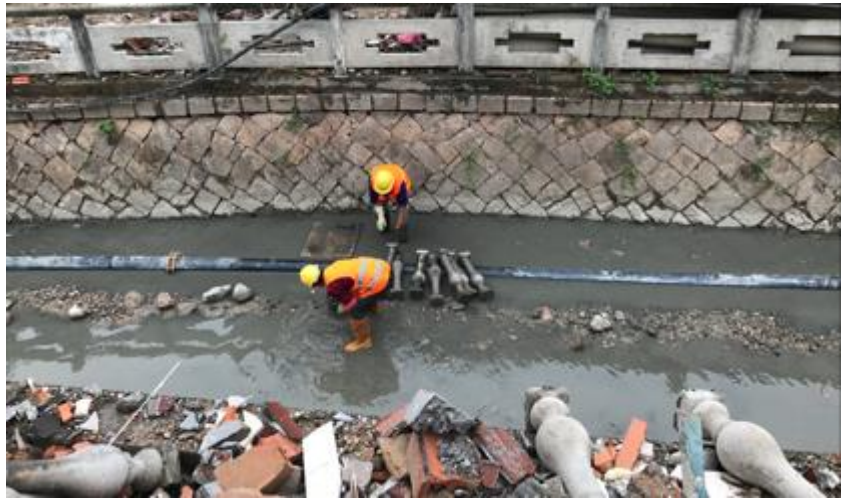
Measure 1: Pipeline construction and endogenous source cleaning



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Measure 2: Pipe network maintenance







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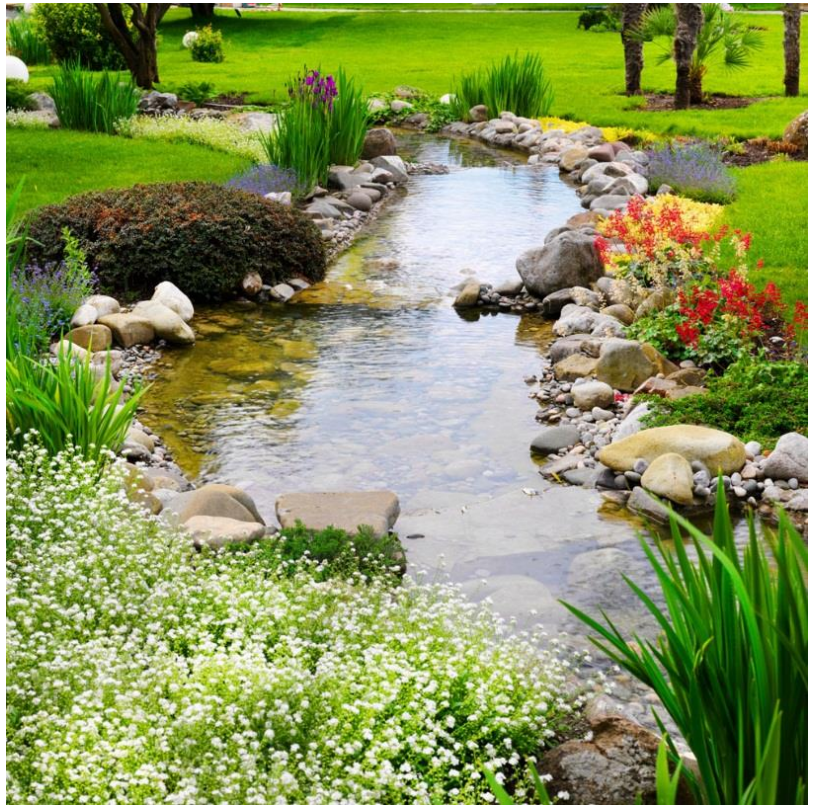
Measure 3: Reclaimed water used as ecological water source



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Measure 4: River aeration, and aquatic plants planting

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Measure 5: Maintain a proper low water level

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Other measures

- River master/governor system
- Maintenance
- Law enforcement
- Public supervision

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Summary

- Urban wastewater treatment and black-odorous water body governance require the joint efforts of government, market, and the public.
- Laws, regulations, price and tax, supervision etc. are all indispensable, among which technology innovation is one of the key promoting factors.

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Thank you!

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