

# Eutrophication Control and Coordinated Development of Society–Economy–Environment

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# I Current status and trend in China

- Rapid Socio-economic development
- Excessive use of nitrogen and phosphorus
- Eutrophication develops dramatically
  - Most of the lakes have been polluted and encounter the problem of eutrophication, including Taihu lake, Chaohu lake, etc.

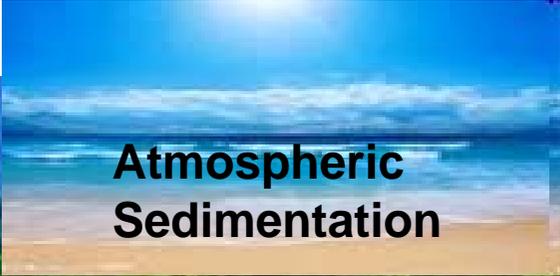
## **II Causes and Challenges**

# Causes

- **Conflict between economic development model and water environmental capacity makes a dramatic increase of environmental pressure on watershed**
  - **Population density**: surpass the international threshold of lake carrying capacity
  - **Urbanization**: rapid development, improper planning, inadequate waste treatment
  - **Land usage**: over-exploitation, soil erosion, excessive usage of chemical fertilizer and pesticide
  - **Economic development model**: extensive model of development, serious pollution



**Water loss and soil Erosin**



**Atmospheric Sedimentation**



**Urbanization**



**Industrial point sources**



**Acaricide**



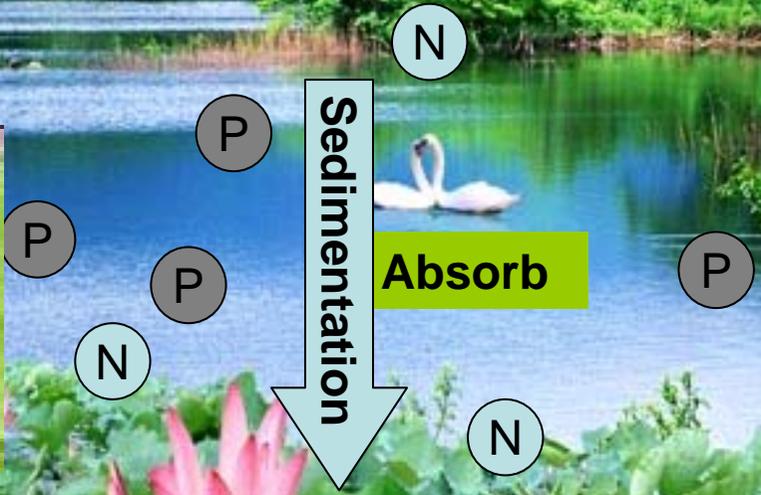
**Waste and Sewage**



**Fertilizer**



**Farming and Fishing**



**Sedimentation**

**Absorb**

**Release**

- The main ways of the agricultural non-point source pollution in China
  - Fertilizer pollution
  - Pesticide contamination
  - livestock and poultry manure
  - Sewage and solid waste

- **Chemical Fertilizer pollution**

- application of chemical fertilizer is close to 400kg/hm<sup>2</sup>, far more than the maximum safe threshold to prevent water pollution set at 225kg/hm<sup>2</sup> of fertilizer use, while the average utilization rate is only about 35%, with 65% going into water and air.

- **Pesticide contamination**

- The use of pesticides reached 230 000 tons (active ingredient), but the utilization of pesticides is less than 30%, more than 70% of the pesticides lost in the environment, seriously affecting agricultural ecological environment.

- **livestock and poultry manure**

- More than 90 percent of the livestock and poultry farms has no sewage treatment system.
- In 2010, the amount of the loss of nitrogen, phosphorus in this way were 3.455 million tons and 419,500 tons, which will exceed the amount of the loss of chemical fertilizers.

- **Sewage and solid waste**

- Vast majority of rural areas do not have solid waste, wastewater treatment facilities.
- Most of the sewage and solid waste discharge into rivers, lakes and other surface water bodies, which will have a serious impact on the quality of the water body.

# Challenges

- **Deficiencies of lake eutrophication management**
  - **Scientific evidence**: research of eutrophication forecasting and project demonstration
  - **Management tools**: standardized eutrophication control systems based on ecological regionalization, goals of management and standards of management
  - **Categorical guidelines**: categorical management strategies and guidelines which reflect regional differences
  - **Technology and evaluation systems**: supporting technology and well-established evaluation system for eutrophication control and nutrient reduction
  - **Policies and funding**: technology and economic policies as well as stable long-term financial program for integrated eutrophication control

# III Strategies

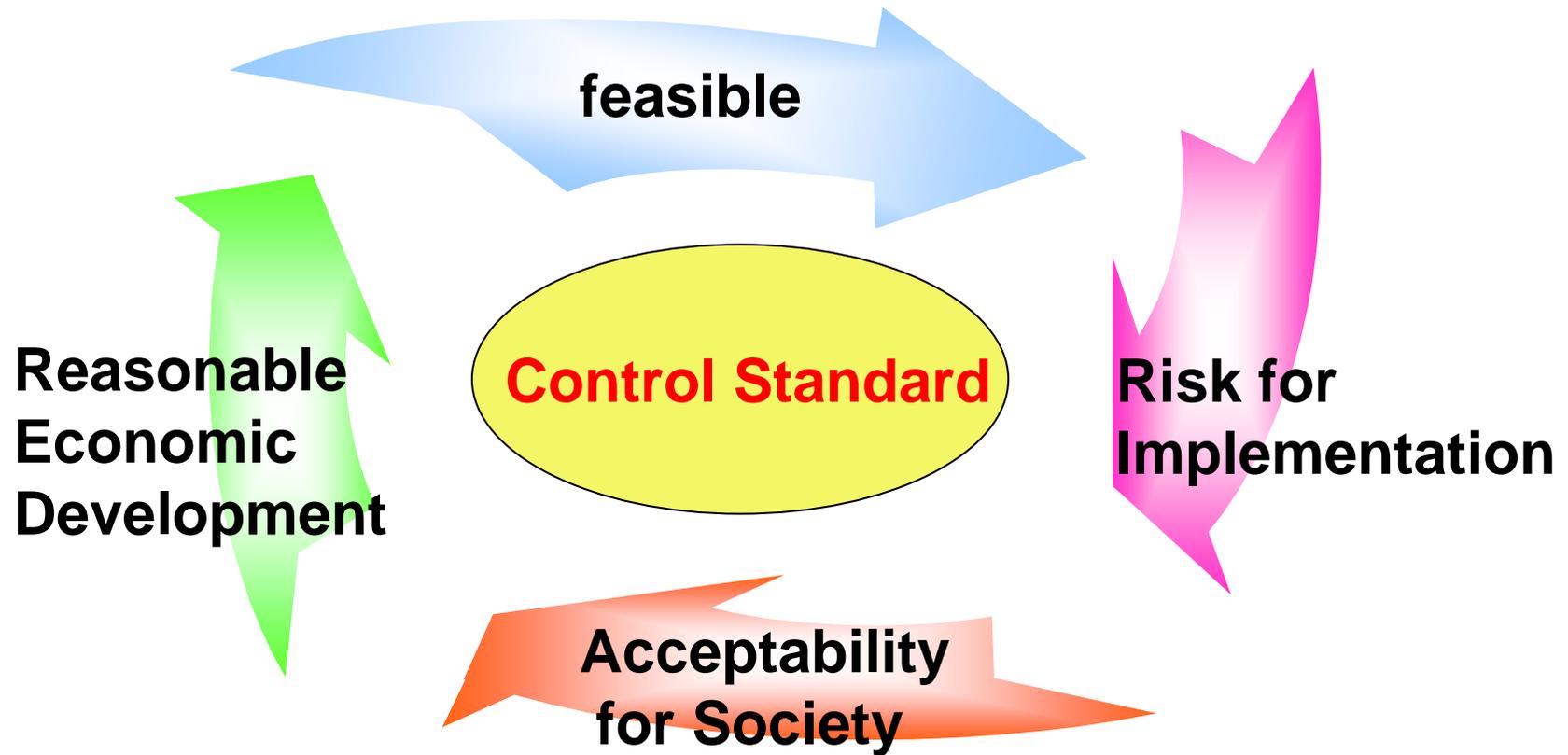
## Principle: Eutrophication Control and Coordinated Development of Society–Economy–Environment

- **To solve the contradiction between development and environment, and align socio-economic development with the water environment carrying capacity.**
  - It is necessary to identify the carrying capacity precisely and propose a corresponding socio-economic development model, to ensure the coordination of eutrophication control and economic development, protect the health of the ecological system and water environmental security

# What are the measures?

- **Combine** technology and management
- **Interact** central and local department
- **Interdisciplinary** research

- **Emphasis on watershed resources, environment and economic development coordination and management, not just the management of river water.**



- **Turn to administration of functions of water environment, including various functions of environmental, ecological, management, protection and restoration**

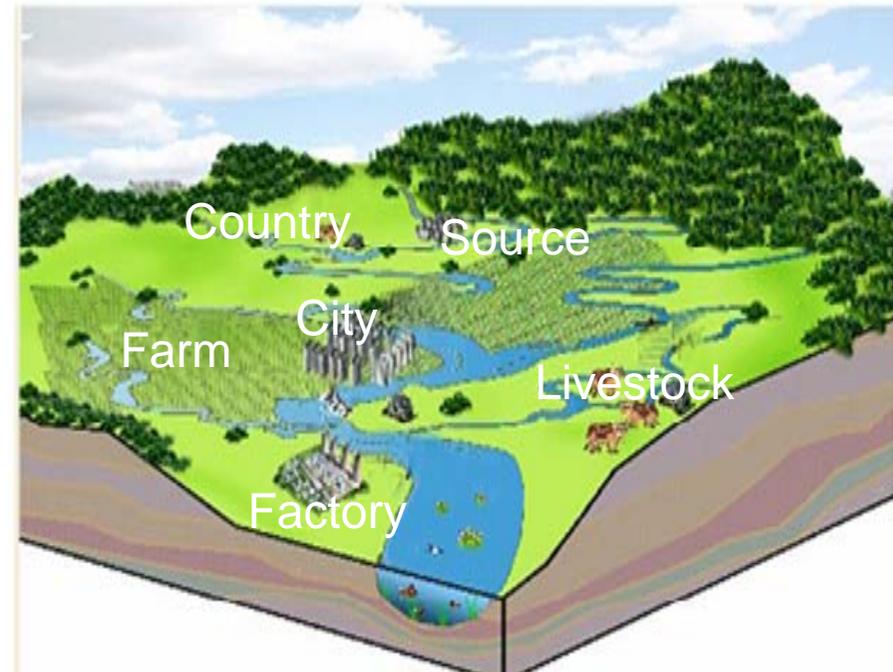
### Major functions of water environment

Function	Comments
Water supply	development and utilization of various ways to use water
Resources	to create economic value as a productive resource
Accommodate	accommodate polluted water
Ecological	aquatic ecosystem water, nourish aquatic life, social environment and landscape water

# Crucial tasks

- **Build lake fresh water production mechanisms to reduce soil erosion, purify water and restore the ecology.**

- Water source protection: plant water conservation forest to reduce soil erosion
- Water body conservancy: lake and river maintenance and pollutant discharge reduction
- Ecological restoration: lakeside wetland



- **Promote the development of reduction strategy and monitoring for excessive nutrient**

- Establish ecological models for lake nutrients nitrogen and phosphorus, develop lake nutrients capacity calculation model
- Construct reduction system for nitrogen and phosphorus, and assess its performance
- Analyze the steps in nutrients reduction and optimization of allocation, implement control plan and long-term operational mechanism in key lake basin (TMDLs)
- Induce lake nutrient control into the national basic strategy of water environmental protection, and implement lake nutrient supply control policy
- Provide a scientific basis and measures for management of lake eutrophication, scientific prevention, effective control and integrated management

- **Make an in-depth survey** and research on residents' consciousness of environmental protection & on corresponding behaviors for public participation.



- **Find an appropriate economic compensation mechanism and make a demonstration.**

**An study on public willingness to pay for water quality control  
(in rural Beijing)**

- Questionnaire consists of 3 parts
  - Environmental awareness and willingness to pay
  - Options related to policies, regulations, technology and others.
  - Personal information: occupation, household per capita net income, age and education degree
- Survey
  - Total 320 copies were distributed, and 302 valid collected
  - Respondents: farmers account for 91.4%, cadres 3%  
Businessman 3.4% and workers 2.2%
  - Male 80.9%, female 19.1%
  - High school graduates 18%, 73% junior high school graduates,  
9% elementary school graduates.

## Correlation between WTP and different variables

Variable name	correlation coefficient	significant
Age	-0.652	**
Occupational	-0.132	Not significant
Number of household members	-0.068	Not significant
Water quality conditions	0.703	*
Total household income	0.79	*
Level of education	0.83	**

## **WTP base : amount of money based on information from socio-economic groups (Yuan/Per capita annual)**

Age	<25	25-35	36-45	46-55	56-65	>65	G
WTP(yuan)	125	113	100	102	83	62	55

Education	elementary school	junior high school	high school
WTP(yuan)	67	102	123

Incoming(y/p.c.a)	<3K	3K-5K	5K-8K	8K-12K	12K-15K	>15K
WTP(yuan)	57	62	87	107	113	122

- public awareness of environmental protection is improving.
- The willingness to pay increases with income.
- The young with higher levels of education are willing to pay more to improve water quality.
- Government plays an important role in water quality improvement.
- Integration of policies, regulations and technology is an effective way to water pollution control.

- **The main problems**

- Economics:

- High cost: 200 yuan/ per soil sample can not be accepted by farmers
    - Shortage of investment in non-point source pollution control

- Institutions:

- Lack of qualified agricultural production and technical standards
    - Lack of dedicated , effective, qualified and longterm system of supervision and economic incentives

- Technical:

- Traditional irrigation methods further exacerbate nonpoint source pollution

- Environmental Consciousness:

- Farmers' nonpoint source pollution prevention awareness is very weak: pesticide pollution and unreasonable application of fertilizer

- **Constitutes the evaluation index system for the water environmental bearing capacity**
- **I Goal:** The sustainable carrying degrees of water environment
  - **II Factors**
    1. The development and utilization degree of resource endowments
      - **index**
        - (1)...
        - (2)....
        - (3)....
    2. Economic and social water consumption level
    3. Environmental capacity and pollution accommodate levels
    4. The level of ecosystem function
    5. Environmental protection and governance level
    6. Environmental institutional and management levels

## ●1 The development and utilization degree of resource endowments

- Per capita water resources (million m<sup>3</sup> person)
- The development and utilization level of surface water (%)
- The development and utilization level of groundwater (%)
- Surface water supply rate (%)
- Per capita water area (ha / person)

## ●2 Economic and social water consumption level

- Water consumption level of per 10000 Yuan GDP (m<sup>3</sup> / 10000 yuan)
- Water consumption level of per Mu agricultural irrigation (m<sup>3</sup> / mu)
- Water consumption level of per capita (L / person d)
- Water consumption level of eco-environmental (%)
- The ratio of inland waters area and aquaculture area (%)
- Gini coefficient

### ●3 Environmental capacity and pollution accommodate levels

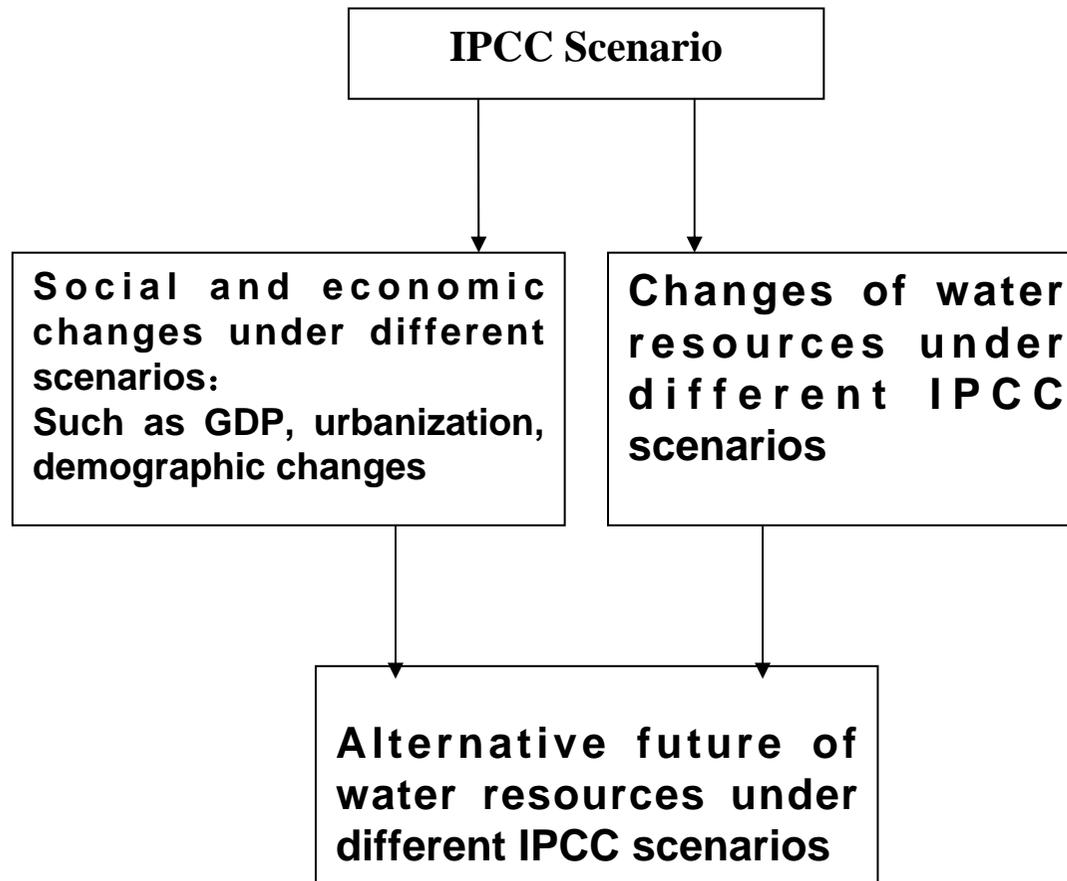
- The COD ratio of planning area with standard concentration
- The per capita a waste water sewage (L / person d)
- The COD emission intensity of per 10000 yuan GDP (kg /10000 yuan)
- The chemical fertilizer application intensity of per Mu cultivated land (kg/hm<sup>2</sup>,)

### ●4 The level of ecosystem function

- Soil erosion rate (%)
- Aquatic diversity index
- Vegetation index
- The proportion of wetland area with land area (%)
- Riparian zone length of per unit area (km/km<sup>2</sup>)Eutrophication level

- **5 Environmental protection and governance level**
  - The rate of urban sewage centralized treatment (%)
  - The percentage of agricultural water-saving irrigation area (%)
  - Agricultural irrigation water coefficient
  - Soil erosion rate (%)
  - Water reuse rate (%) Environmental investment share of GDP (%)
  
- **6 Environmental institutional and management levels**
  - If has Water Environmental Protection Plan
  - The compliance rate of industrial wastewater discharge (%)
  - Water pollution accident frequency (%)
  - letters on reflecting the environmental issues from the public (times / year)
  - the total number of petition (times / year)

- **Based-on scenario analysis, evaluate the effectiveness of relative policy for policy choice.**



# **IV Conclusions**

- China's shallow lakes environment are vulnerable and liable to eutrophication. Pollution poses difficult challenges and high costs of restoration.
- Early awareness of protection and dealing with pollution in time is vital .

- It is important to consider lakes as a whole system when dealing with pollution. It is essential to control the source/s. It is better to combine source control and ecological restoration, governance and management. It is crucial to have accurate and proper concepts.

- Ecological restoration is an essential measure of eutrophication control. Restoration of degraded ecosystems, where mainly natural restoration is preferable.

- Strengthen management is essential
  - Encourage public participation
    - With relatively low incomes of most rural areas of China, incentive economic measures is suitable, such as subsidies for farmers use of farmyard manure, or green pesticide.
  - Improve surveillance
  - Provide scientific forecast
  - Speed up legislation
  - Enhance research, especially interdisciplinary

Thank you for your attention!