# Applying the RE-AIM framework to evaluate the Ecological & Environmental Zoning-based Regulation (EZR) in China

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**Dan Xie,** Zishu Wang, Yang Yang, Yi Liu

*Center for Strategic Environmental Assessment, Tsinghua University*

*Beijing, China*

xied2022@gmail.com

# Outline

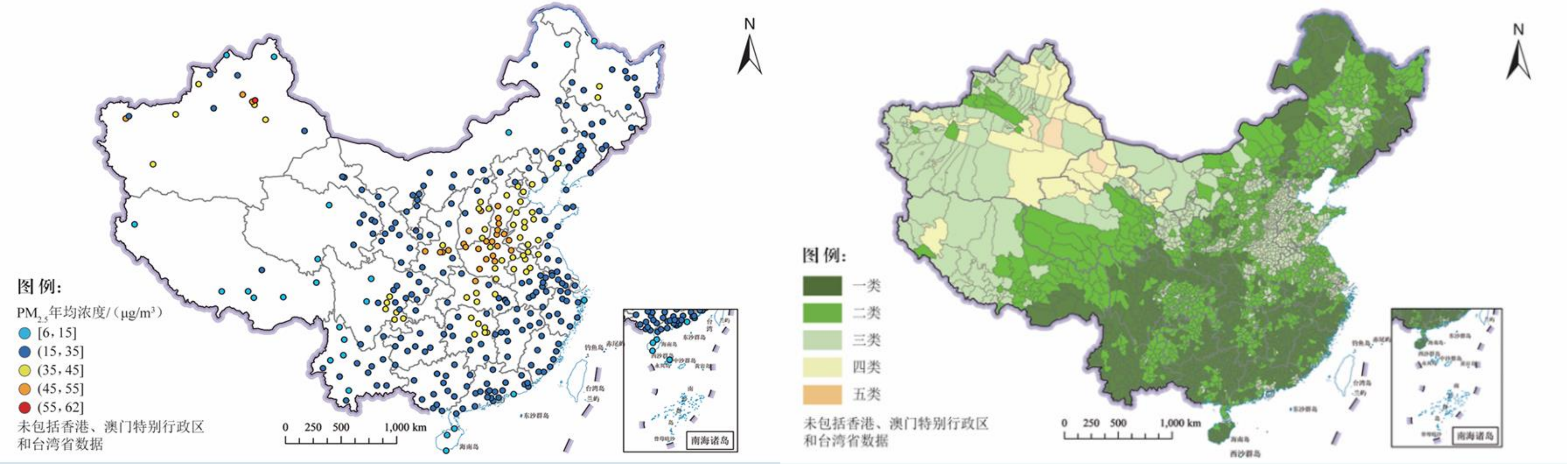
01 **Background**

02 **Purpose and scope**

03 **Results and discussion**

# Background

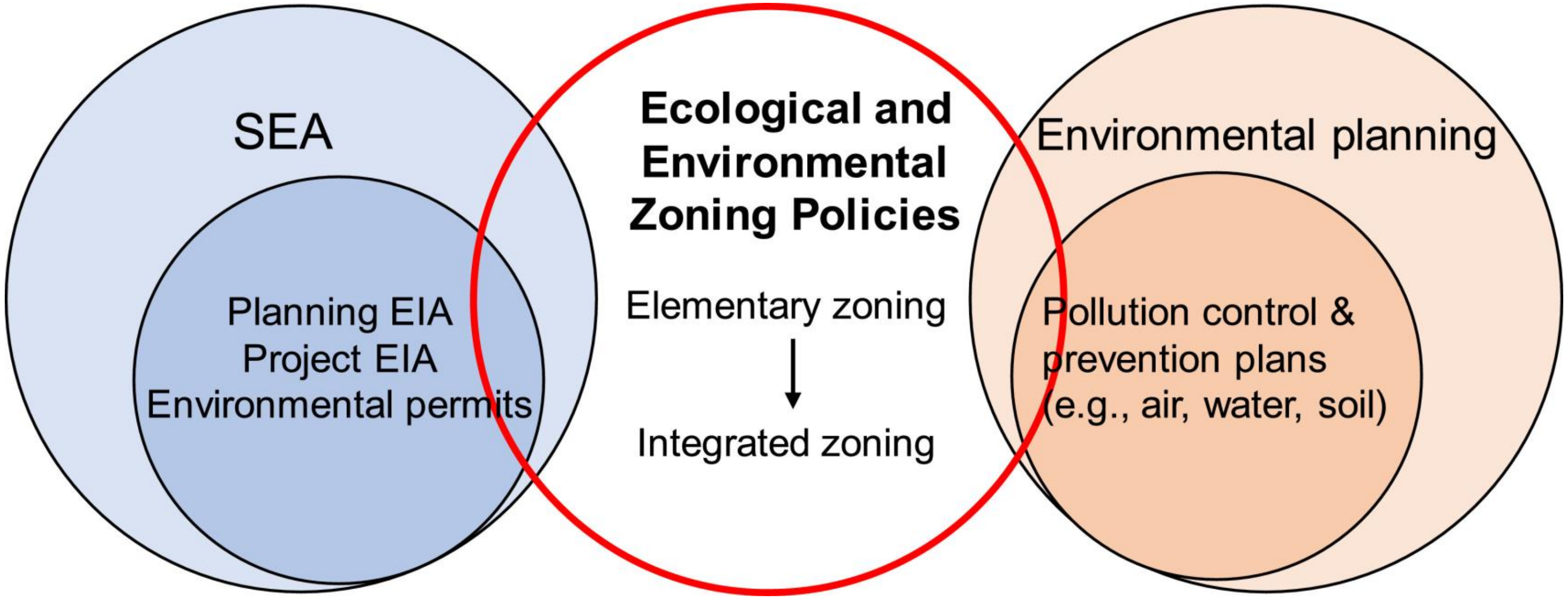
- Ecological degradation, environmental pollution, and resource overexploitation have been considered as critical constraints and challenges for sustainable development in China.




Annual average concentration of $PM_{2.5}$ (left) and Ecological quality (right) in China (2022)

# Background

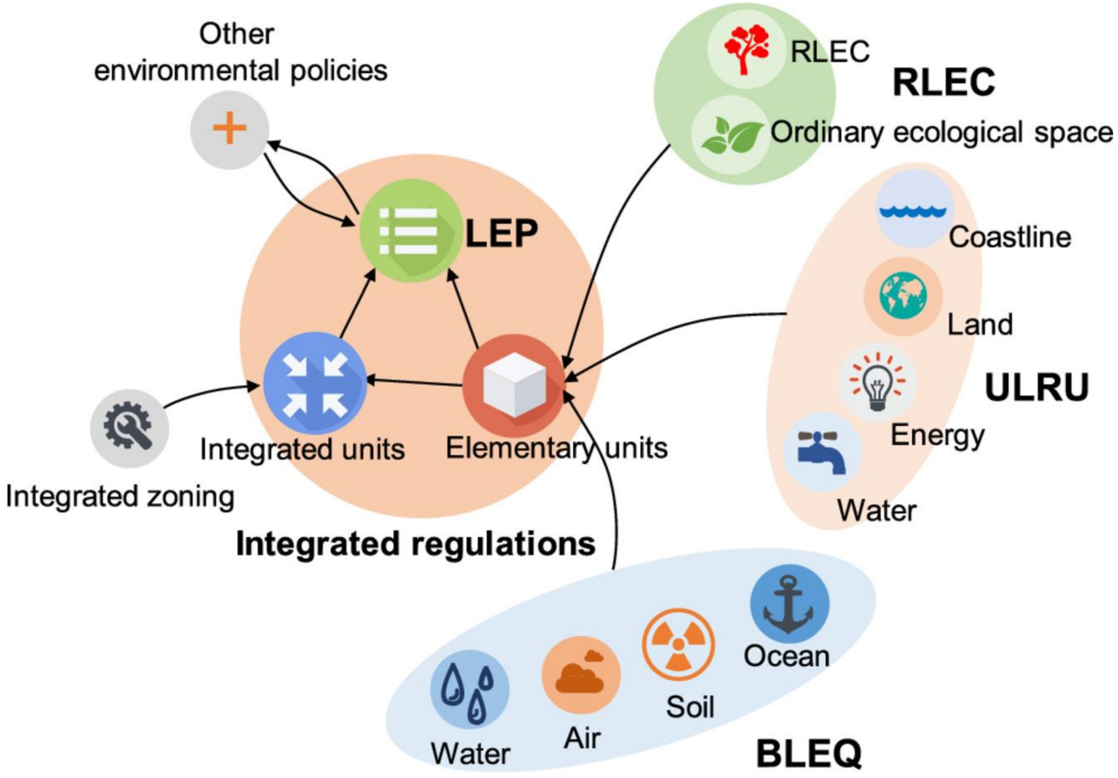
- Environmental initiatives: environmental protection planning, Strategic Environmental Assessment (SEA), and environmental function zoning (both elementary and integrated).




Environmental regulations in China *(Wang Z, et al. RCR, 2020)*

# Background

- Ecological & Environmental Zoning-based Regulation (**EZR**)
  - Harmonizing environmental protection with human activities within specific geographic regions
  - **Integrated Management**: Coordinating goals of ecology, environment and resources
    - Ecology
    - Environment: Water, air, soil, ocean …
    - Resource: Water, energy, land, coast…

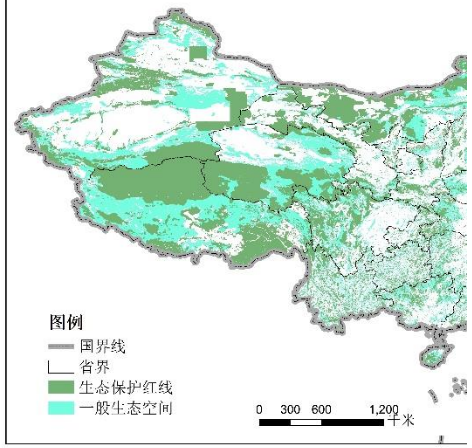



Conceptual framework of EZR *(Wang Z, et al. RCR, 2020)*

# Background

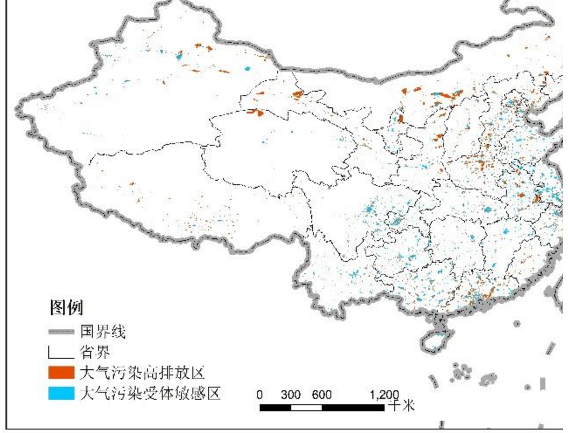
- Ecological & Environmental Zoning-based Regulation (**EZR**)
  - 2024: EZR becomes a national regulation
  - Territorial Zoning: Dividing regions into zones based on environmental characteristics and human activities.

**5.16 million km²**



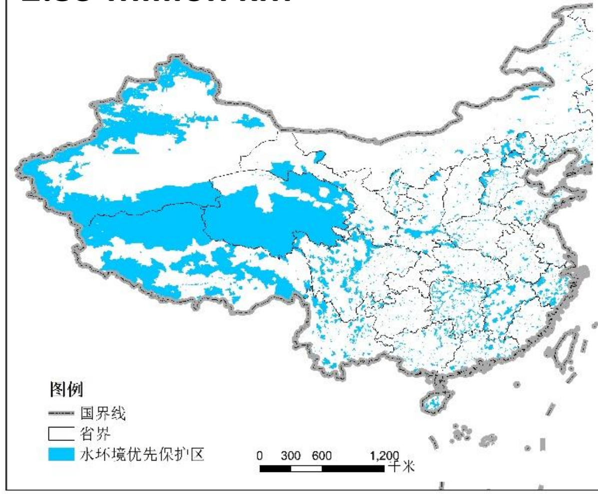

**Key Protection Area for Ecology**

**Heavily Emission Area 1.7 million km²**



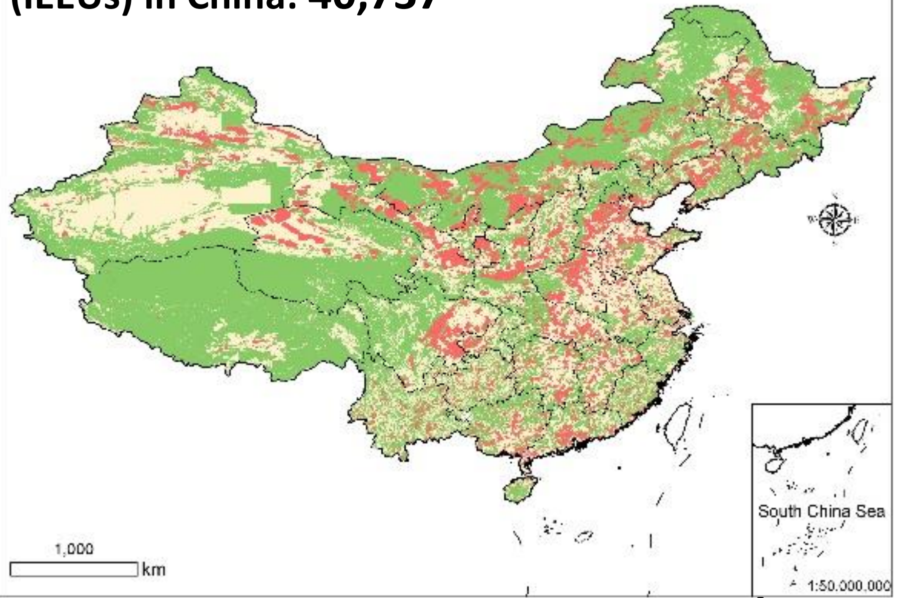

**Critical Regulatory Area for Air**

**2.39 million km²**




**Key Protection Area for Water**

**The integrated Ecological & Environmental units (IEEUs) in China: 40,737**




| Types | Amounts | Area proportions |
|---|---|---|
| Protection in-Priority Units **(IEEU-P)** | 16,834 | 55.5% |
| Critical Regulatory Units (**IEEU-C**) | 17,271 | 14.5% |
| Ordinary Restriction Units (**IEEU-O**) | 6,632 | 30.0% |

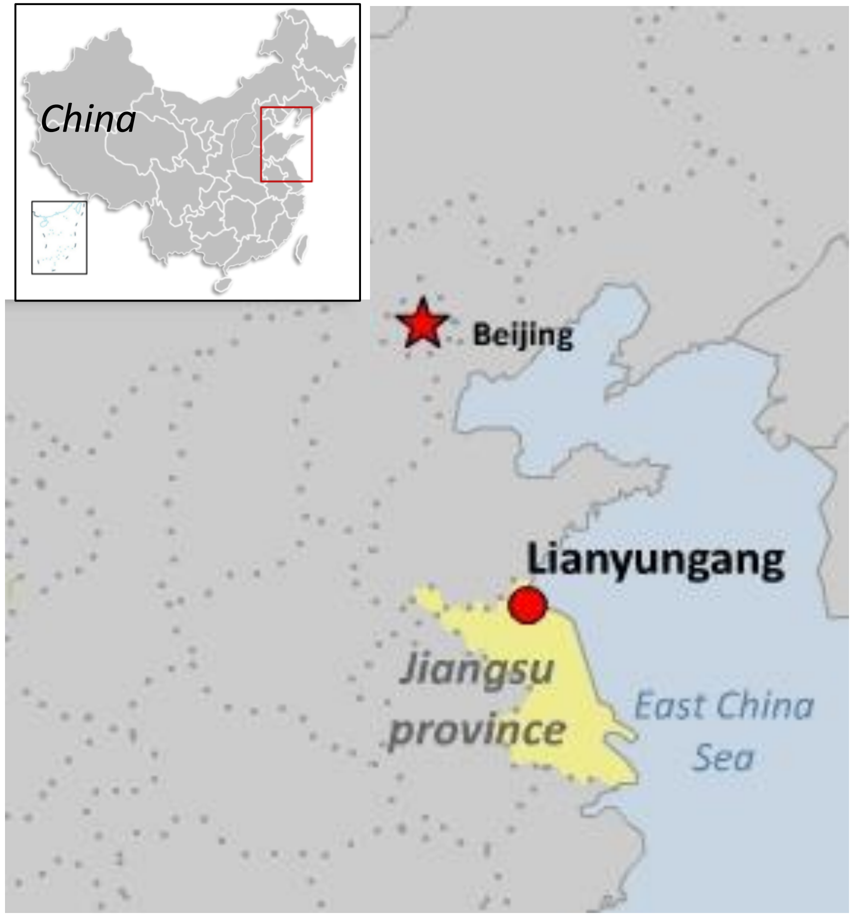
# Background

- Policy evaluation has played key roles in all stages of policy making
  - Ex-ante evaluation: focuses on the potential impacts, risks and prospective benefits
  - In-process evaluation: tracks policy implementation and supervision, follow-up insufficiencies
  - Ex-post evaluation: focuses on the effectiveness, outcomes, and new policy measurements
- Data-driven and evidence-based policy evaluation approaches are two notable trends


Policy making process in EU

# Purpose and Scope of the Evaluation

- **In-process evaluation**: Assess the actual performance of the EZR policy compared to initial expectations **in Lianyungang**, employing the RE-AIM evaluation framework.
  - Identify implementation highlights and insufficiencies
  - 2018-2020/2021

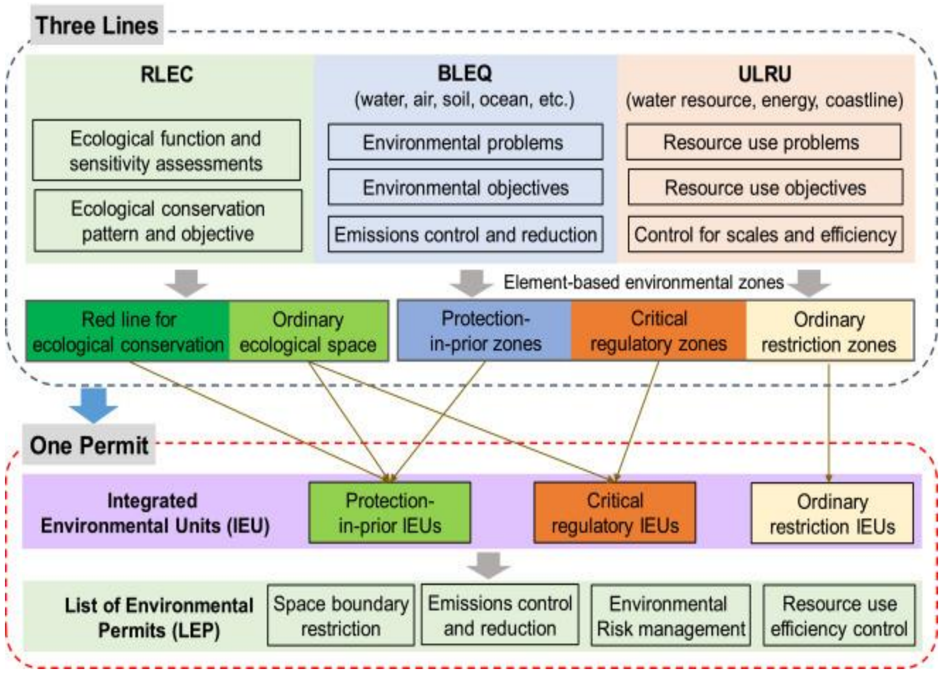



Location of Lianyungang

- First pilot city to carry out the EZR policy
- Land area is 7,627 $km^2$, and sea area is 7,516 $km^2$
- In 2020, GDP per capita exceeded US$10,000, and population is about 4.6 million

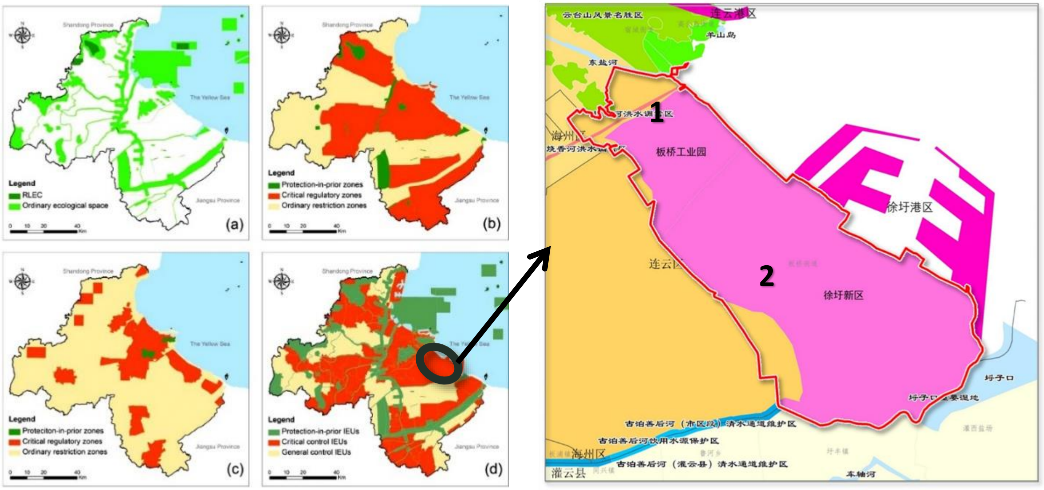
# The EZR policy in Lianyungang

- Key regulation tools: a series of ecological and environmental **protection objectives (2020, 2025, 2030)**, a set of **regulatory units** (both elementary and integrated), and **a list of environmental permits (LEP).**




Intervention Logic of EZR *(Wang Z, et al. RCR, 2020)*

**298 IEEUs** with an average area of 25 km$^2$ were designated based on the element-based regulatory zones, including 79 IEEU-C with an average area of 55 km$^2$ and 187 IEEU-P.

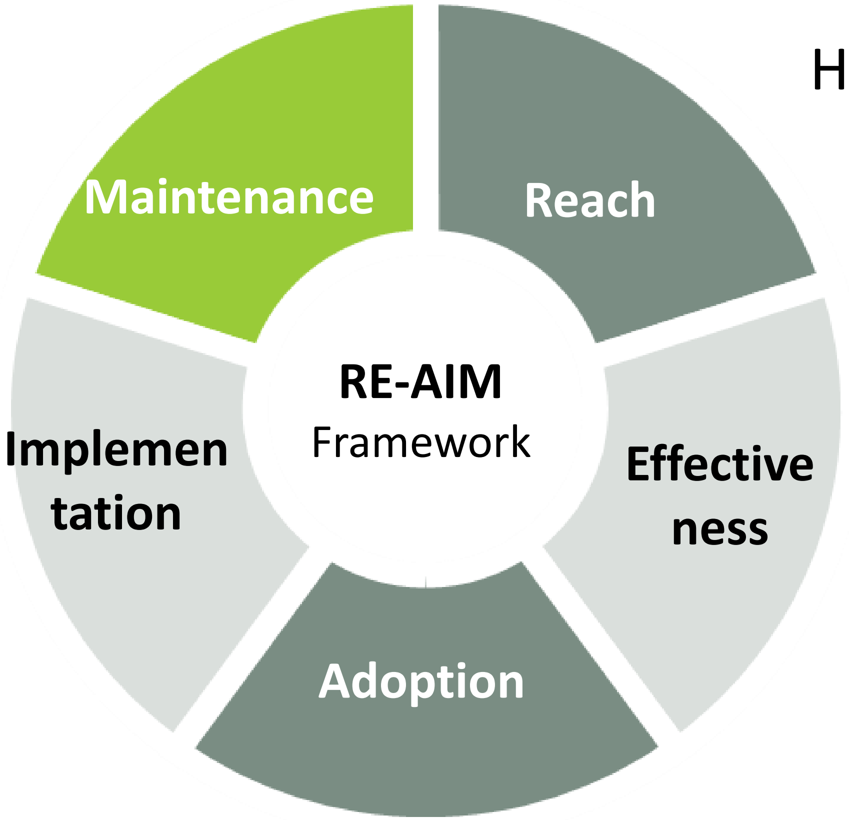



1. Build **ecological isolation zones**
2. Strictly control sewage discharged industrial projects. Strengthen **agricultural non-point source and breeding** control

# Evaluation framework

Have efforts been made to keep the interventions work over the long term?

Have the goals reached?




Have the interventions delivered properly?

Are the interventions effective?

Have organizational support been developed to deliver the interventions?

# Methodology

- 5 evaluation questions, 14 sub-questions, and 30 indicators.
- Data collection: Documentary review, Statistical data analysis, Public and targeted consultation.

**Evaluation Matrix**

**Reach**

1-1. Have the **ecological** goals achieved?
1-2. Have the **environmental** goals achieved?
1-3. Have the **resource goals** achieved?

**Effectiveness**

2-1. Improvement of ecological protection
2-2. Improvement of air quality
2-3. Improvement of water quality
2-4. Improvement of marine environment

**Adoption**

3-1. Applied in economic and social development
3-2. Applied in environmental protection

**Implementation**

4-1. Release of TLOP policies
4-2. Information management platform
4-3. Dynamically updates and adjustments

**Maintenance**

5-1. Construction of management system
5-2. Construction of supporting system

# Results: Reach

- Comparative analysis: Compare whether the actual ecological environment quality data in 2020 meets the target goals set by the EZR plan.
- Goals for 2020 have been accomplished, but some of the goals in 2025 need to be adjusted.

**Ecology**

- Terrestrial ecological space protected areas: 23.18%
- The areas and functions of the ecological protection red line will not be reduced

**Water**

- Proportion of surface water quality (> III): 66.7%
- Eliminate inferior five-category water bodies
- Pollutant decreased compared with 2015: COD 13.5%, $NH_3$-N 13.4%, TN 11.21%、TP 11.33%

**Air**

- Annual average concentration of $PM_{2.5}$: 37 μg/m$^3$
- Air quality excellent rate: 81.1%
- Air Pollutants (SO2, NOx, VOCs ) decreased more than 20% compared with 2015

**Soil**

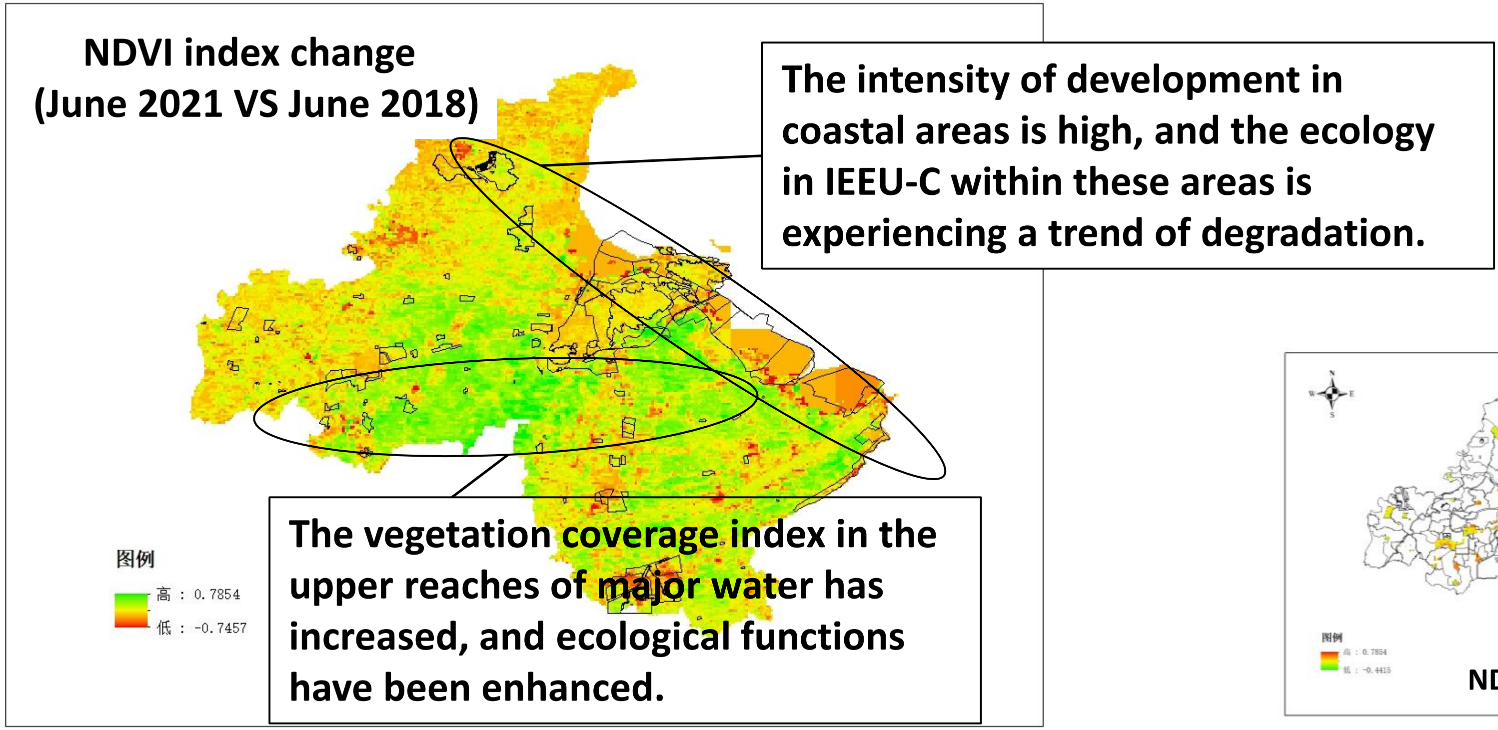
- The safe utilization rate of contaminated farmland: 95%
- Compliance rate of soil construction land monitoring points: 100%

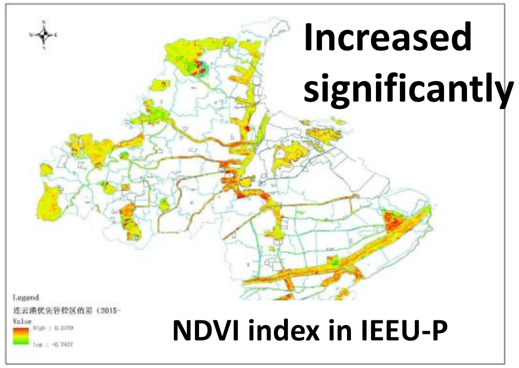
**Resource**

- Total water consumption: 2.65 billion m$^3$
- Increase in total energy consumption: 1.08 million ton of standard coal

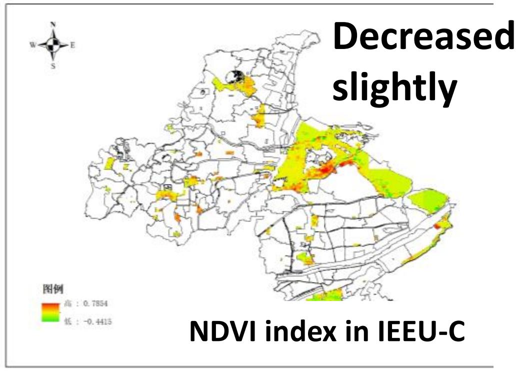
# Results: Effectiveness

- Spatial analysis: Analyze the degree of change in representative indicators in different IEEUs.
- Ecology: NDVI index in IEEU-P and IEEU-O has increased (30%-44%).

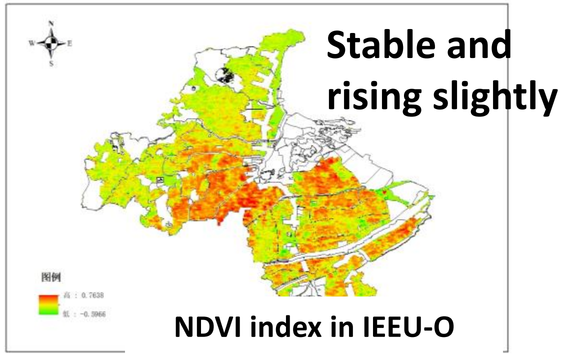


NDVI index in IEEU-P



NDVI index in IEEU-C

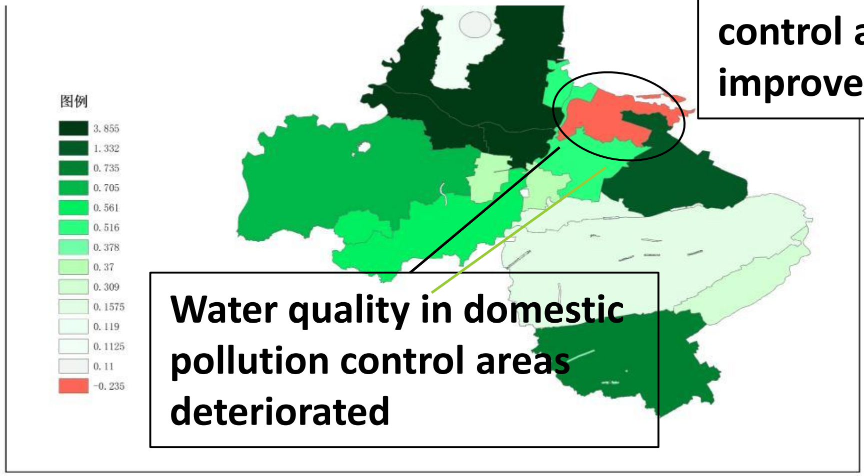


NDVI index in IEEU-O

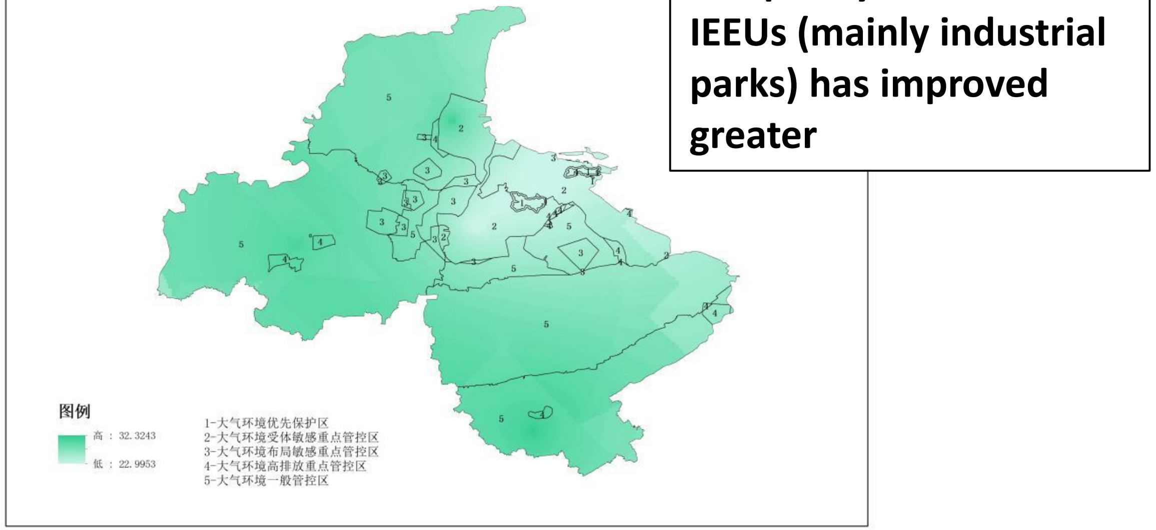
# Results: Effectiveness

- Spatial analysis in water/ air related IEEUs.
- Water (Ammonia nitrogen, total phosphorus), air (Fine particulate matter and $SO_2$): Water quality and air quality improved greater in IEEU-C.

**Annual average concentration of Ammonia Nitrogen change (2021 VS 2018)**

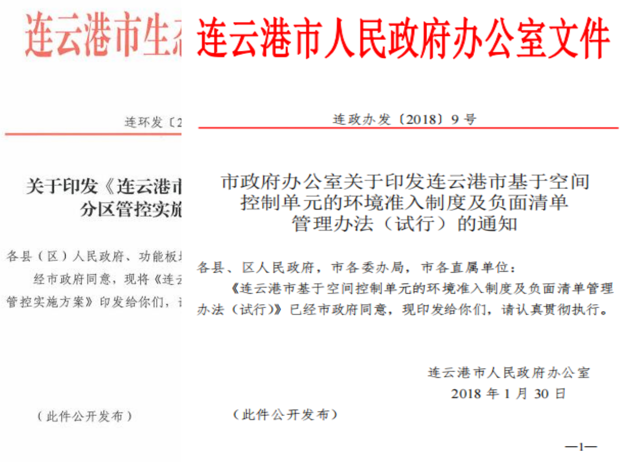



**Annual average concentration of PM2.5 change (2021 VS 2018)**



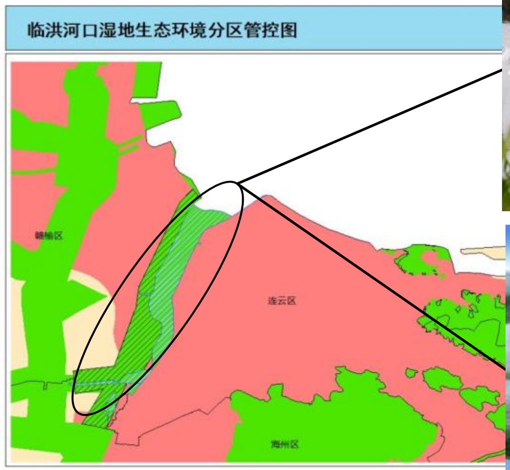
# Results: Adoption, Implementation, Maintenance

- Documentary review and interviews: How the EZR plan were adopted and used.
  - Adoption in plans, projects, EIA, and environmental governance
  - Implementation: EZR related policies, Information management platform, updates
  - Maintenance: Institutional linkage, supervision system, reward and punishment mechanism; Technical team, financial funds




EZR related policies


EZR Information management platform



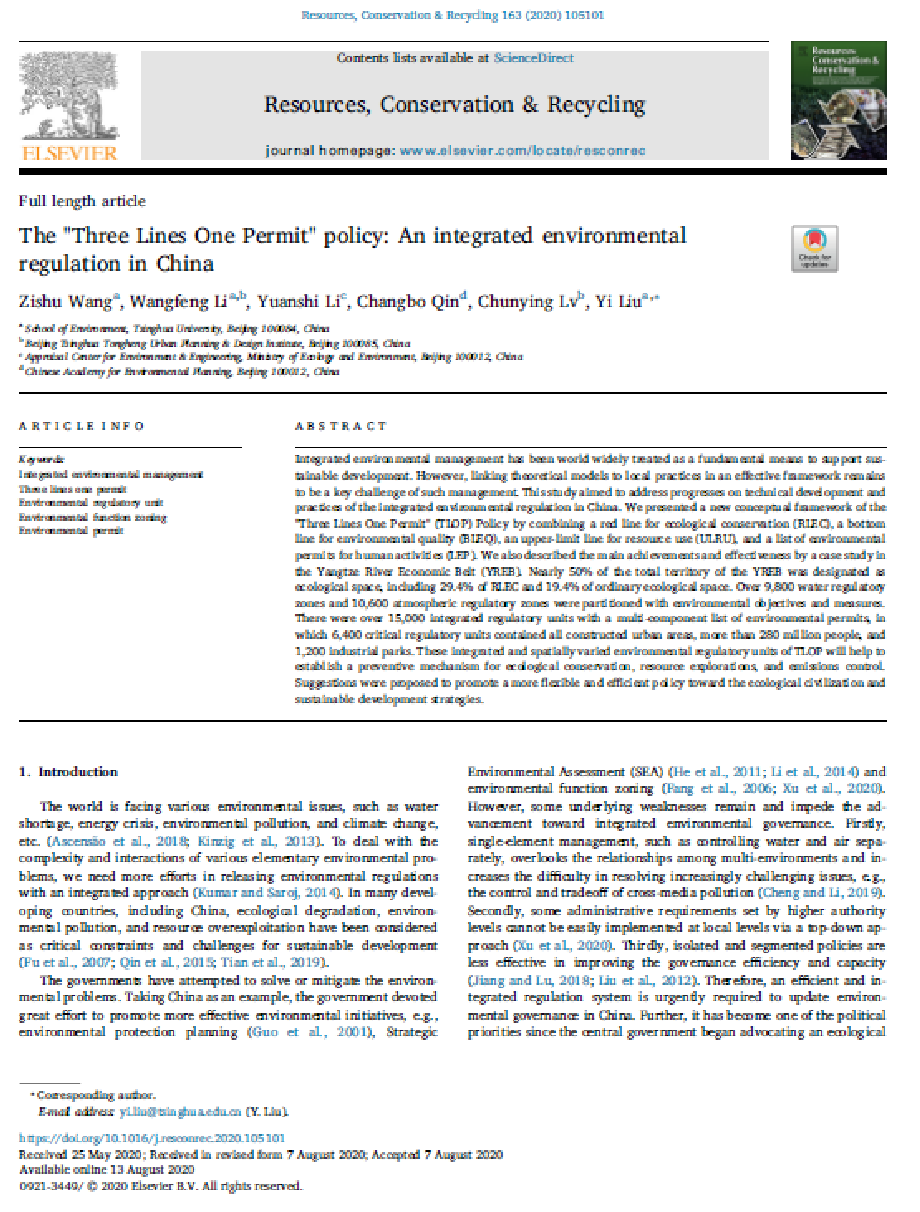

EZR adoption case

# Conclusions and Suggestions

- The EZR policy in Lianyungang is delivering the goods. **The ecological environment quality has been improved significantly across the IEEUs , with spatially differentiated effects**. The implementation and the application are strong. A long-term guarantee mechanism has been initially established.
- EZR policy need to be adjusted according to the latest requirements. It is necessary to strengthen cooperation between different departments and expand the application areas of EZR information management platforms.
- The RE-AIM framework serves as a valuable tool for evaluating policy effectiveness and identifying shortcomings, with a specific focus on enhancing policy implementation. It can offer enhanced support for government agencies in refining their policies.

# Published work

- **Wang, Z., Li, W., Li, Y., Qin, C., Lv, C., & Liu, Y. (2020). The" Three Lines One Permit" policy: an integrated environmental regulation in China. *Resources, Conservation and Recycling*, 163, 105101.**
- Wang, Z., Xie, D., Yang, Y., & Liu, Y. (2024). A process-based evaluation framework for environmental impacts of policy making. *Environmental Impact Assessment Review*, 104, 107351.
- Wang, Z., Wang, C., & Liu, Y. (2023). Evaluation for the nexus of industrial water-energy-pollution: performance indexes, scale effect, and policy implications. *Environmental Science & Policy*, 144, 88-98.



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Full length article

## The "Three Lines One Permit" policy: An integrated environmental regulation in China

Zishu Wang[a], Wangfeng Li[a,b], Yuanshi Li[c], Changbo Qin[d], Chunying Lv[b], Yi Liu[a,*]

[a] School of Environment, Tsinghua University, Beijing 100084, China
[b] Beijing Tsinghua Tongheng Urban Planning & Design Institute, Beijing 100085, China
[c] Appraisal Center for Environment & Engineering, Ministry of Ecology and Environment, Beijing 100012, China
[d] Chinese Academy for Environmental Planning, Beijing 100012, China

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ABSTRACT

Integrated environmental management has been world widely treated as a fundamental means to support sustainable development. However, linking theoretical models to local practices in an effective framework remains to be a key challenge of such management. This study aimed to address progresses on technical development and practices of the integrated environmental regulation in China. We presented a new conceptual framework of the "Three Lines One Permit" (TLOP) Policy by combining a red line for ecological conservation (RLEC), a bottom line for environmental quality (BLEQ), an upper-limit line for resource use (ULRU), and a list of environmental permits for human activities (LEP). We also described the main achievements and effectiveness by a case study in the Yangtze River Economic Belt (YREB). Nearly 50% of the total territory of the YREB was designated as ecological space, including 29.4% of RLEC and 19.4% of ordinary ecological space. Over 9,800 water regulatory zones and 10,600 atmospheric regulatory zones were partitioned with environmental objectives and measures. There were over 15,000 integrated regulatory units with a multi-component list of environmental permits, in which 6,400 critical regulatory units contained all constructed urban areas, more than 280 million people, and 1,200 industrial parks. These integrated and spatially varied environmental regulatory units of TLOP will help to establish a preventive mechanism for ecological conservation, resource explorations, and emissions control. Suggestions were proposed to promote a more flexible and efficient policy toward the ecological civilization and sustainable development strategies.

### 1. Introduction

The world is facing various environmental issues, such as water shortage, energy crisis, environmental pollution, and climate change, etc. (Ascensão et al., 2018; Kinzig et al., 2013). To deal with the complexity and interactions of various elementary environmental problems, we need more efforts in releasing environmental regulations with an integrated approach (Kumar and Saroj, 2014). In many developing countries, including China, ecological degradation, environmental pollution, and resource overexploitation have been considered as critical constraints and challenges for sustainable development (Fu et al., 2007; Qin et al., 2015; Tian et al., 2019).

The governments have attempted to solve or mitigate the environmental problems. Taking China as an example, the government devoted great effort to promote more effective environmental initiatives, e.g., environmental protection planning (Guo et al., 2001), Strategic Environmental Assessment (SEA) (He et al., 2011; Li et al., 2014) and environmental function zoning (Fang et al., 2006; Xu et al., 2020). However, some underlying weaknesses remain and impede the advancement toward integrated environmental governance. Firstly, single-element management, such as controlling water and air separately, overlooks the relationships among multi-environments and increases the difficulty in resolving increasingly challenging issues, e.g., the control and tradeoff of cross-media pollution (Cheng and Li, 2019). Secondly, some administrative requirements set by higher authority levels cannot be easily implemented at local levels via a top-down approach (Xu et al., 2020). Thirdly, isolated and segmented policies are less effective in improving the governance efficiency and capacity (Jiang and Lu, 2018; Liu et al., 2012). Therefore, an efficient and integrated regulation system is urgently required to update environmental governance in China. Further, it has become one of the political priorities since the central government began advocating an ecological

* Corresponding author.
E-mail address: yi.liu@tsinghua.edu.cn (Y. Liu).

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**Dan Xie,** Zishu Wang, Yang Yang, Yi Liu

*Center for Strategic Environmental Assessment, Tsinghua University*

*China*

xied2022@gmail.com


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