

ORIGINAL ARTICLE

Ecosystem service value evaluation method for
local-oriented rural water ecological governance:
A case study on Shuiku Village in ShanghaiNannan Dong^{1*}, Luca Maria Francesco Fabris², Yongnan Wang³, and Xinyue Chen⁴¹Department of Landscape Studies, Tongji University, Shanghai, China²Department of Architecture and Urban Studies, Politecnico di Milano, Milano, Italy³Department of Landscape Studies, Tongji University, Shanghai, China⁴Faculty of Environmental Science, Wageningen University and Research, Wageningen, Netherlands(This article belongs to the *Special Issue: Reshaping Rural China*)

Abstract

Ecosystem service assessments play a crucial role in highlighting the importance of ecosystems in human life and guiding regional planning processes. This study examines the significance of rural ecosystems and their diverse ecological services, ranging from agricultural productivity to water purification and esthetic value. At present, the ecological restoration of rural riparian zones in China mainly relies on engineering standards as reference guidelines, lacking responses to surrounding land use patterns (including diverse ecological functional requirements) at the planning and design level. This paper proposes 17 assessment indicators for ecosystem services based on a case analysis of Shuiku Village in Shanghai. Through the evaluation of the supply-demand relationship of ecosystem services in the water network rural riparian zone, the paper suggests feasible restoration approaches based on a comprehensive evaluation of the ecological status to address the diverse needs of rural water ecosystems. The result indicated that using an ecosystem services evaluation framework can provide more precise analysis at a small scale.

Keywords: Rural landscape; Water; Ecological restoration***Corresponding author:**Nannan Dong
(dongnannan@tongji.edu.cn)

Citation: Dong, N., Fabris, L. M. F., Wang, Y., & Chen, X. (2023). Ecosystem service value evaluation method for local-oriented rural water ecological governance: A case study on Shuiku Village in Shanghai. *Journal of Chinese Architecture and Urbanism*, 5(3):1055.
<https://doi.org/10.36922/jcau.1055>

Received: June 7, 2023**Accepted:** August 2, 2023**Published Online:** August 22, 2023**Copyright:** © 2023 Author(s).

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non-Commercial 4.0 International (CC BY-NC 4.0), which permits all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher's Note: AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Ecosystem service evaluation is used to highlight the significance of ecosystems in human life, allowing people to demonstrate their importance to society. Regional planners consider these assessments valuable tools in their planning processes. Various assessment methods, including biophysical, social, and economic approaches (Ervin *et al.*, 2014), can be employed, which form the foundation for mapping ecosystem services, enabling their incorporation into decision-making processes related to spatial planning, nature conservation, land management, and utilization of natural resources. The rural ecosystem holds a distinctive significance as an integral part of the overall ecosystem. It offers a wide array of essential ecological services to both urban and rural residents. These services encompass the provision of agricultural products, conservation of biodiversity, facilitation of nutrient cycling, regulation of climate and gas levels, safeguarding and

purification of water sources, and control of pollutants, as well as esthetic value and recreational opportunities (Ge *et al.*, 2023). In addition, water is the foundation of ecosystem services and a fundamental factor affecting ecosystem evolution (Martin-Ortega, *et al.*, 2015). However, rural areas are vulnerable to the impact of climate change and other environmental threats, for example, declining soil and water quality, and decreasing biodiversity (European Environment Agency, 2020). According to the research, one of the main threats in rural areas is industrial livestock production, which leads to severe water pollution (Kupiec *et al.*, 2022). A study investigated the chemical properties of Orla River in Poland and found a positive correlation between livestock building areas and chemical parameters in the river (Kupiec *et al.*, 2022). A study conducted in Córrego da Olaria Basin in Brazil similarly indicated that the water quality of the river was correlated with land use (Simedo *et al.*, 2018). Therefore, it is important to pay attention to the fragile river ecosystem and to provide local-based ecological restoration approaches. In recent years, several studies have employed the ecosystem services approach to assess restoration in riparian areas (Castellano *et al.*, 2022). Furthermore, a pilot study on Shanghai's Baoshan District specifically analyzed the provision of ES in the area. The findings indicated that the implementation of an ecological network plan led to an overall increase in the supply of ecosystem services (Zepp *et al.*, 2021).

Domestic research on rural characteristics in China primarily focuses on the evaluation and development of rurality, utilizing both social and managerial perspectives (Cui *et al.*, 2021). The rural revitalization effort that began in the 1980s, is still the largest-scale endeavor to promote rural governance and restore rural socio-economic vitality. An important task in these efforts is the governance of the ecological environment. While efforts have been made to enhance rural infrastructure and strive toward the goal of creating a beautiful countryside, the ecological protection of rural areas has often been overlooked in the implementation process. In the southern part of China, the water environment in rural areas is currently facing several problems. The increasing population and economic activities have resulted in water pollution, habitat loss, and deterioration of water quality. Industrial discharges, agricultural runoff, and inadequate sewage treatment systems have contributed to high levels of pollutants in the water, affecting both aquatic ecosystems and public health (Qian, 2022). More than 80% of underground water is unsafe for drinking or bathing in China (Buckley & Paio, 2016). In addition, excessive extraction of water resources and improper water management practices has led to water scarcity issues, particularly during the dry seasons. Eutrophication and algae bloom are the main problems

facing the rivers in rural areas (Qian, 2022). At present, the existing approach used to ecologically restore water network in the rural riverbank areas in China mainly relies on a single water body or land cover type, as the basis. In the process from planning to design, there is less emphasis on the relationship between the riverbank boundary and the adjacent land uses, making it difficult to carry out tailored ecological restoration work based on the diverse needs of different land uses (Fu & Liu, 2019).

By presenting a case study, this paper proposes relevant assessment indicators for ecosystem services through the evaluation of the land use types and the supply-demand relationship of ES. A holistic and detailed understanding of the restoration needs can be obtained through a comprehensive evaluation of the ecological status and functions of rural water ecosystems.

2. Data and methods

The river network in Shanghai is well-developed and performs various functions, with different types of rivers providing different ecosystem services. This study focuses on Shanghai city in the Jiangnan region of China, where the water environment holds immense significance for the rural landscapes. The ecological service capacity of rural rivers is important, not only for the green infrastructure of the countryside, but also for the ecological space of the metropolitan area. In the rural landscape planning of Shuiku Village in Shanghai, we started with a supply and demand trade-offs model of ecosystem services and provided a reference for decision-making based on the wide extent of participation. Through innovative mapping techniques, we precisely formulated resilient landscape tasks under the goals of water environment improvement, biodiversity enhancement, and sociocultural reconstruction, providing a spatial and temporal interface for an integrated and collaborative ecological restoration workflow.

2.1. Shuiku village

Shuiku Village, located in Caojing Town, Jinshan District, Shanghai, is one of the typical representatives of Shanghai's water villages, as shown in Figure 1. The village was formed by sediment carried by the Yangtze River, which was later reclaimed by hand to create an island-like landscape. The village boasts 39 rivers, covering a total length of 28.91 km, with a water area ratio of about 40%. However, the density of the river network is high, mostly in the form of cutoff hills, which hampers water system circulation and leads to insufficient hydrodynamic power. Until 2019, Shuiku Village's primary industry was agriculture and farming. However, farmland surface source pollution and uncontrolled fish and shrimp farming resulted in water pollution and weak biodiversity as the processed water

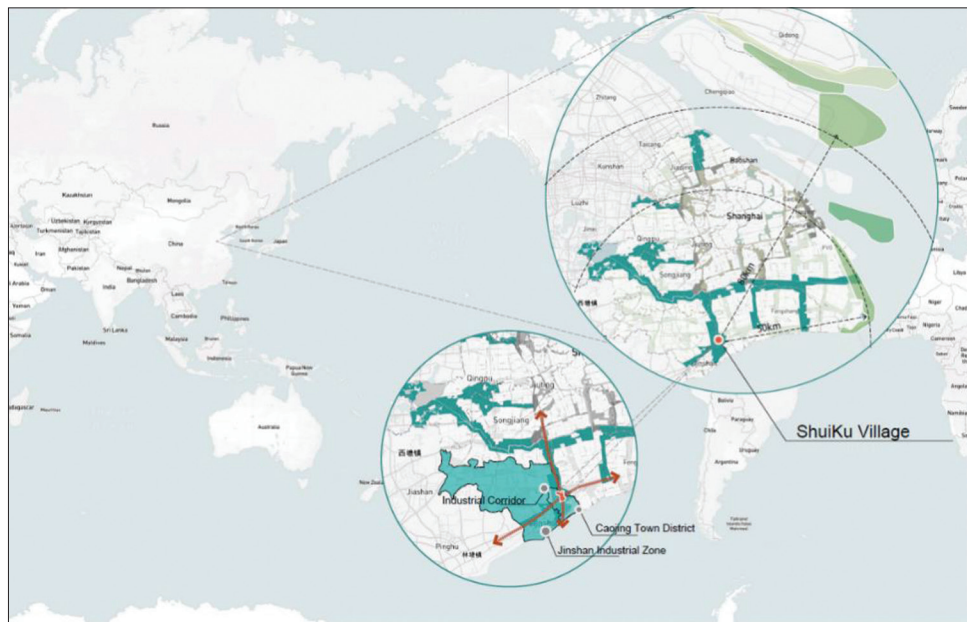


Figure 1. The geolocation of ShuiKu Village. Source: Map by the authors

was discharged directly into the river. Based on the survey, the average nitrogen concentration is 1.41 mg/L and the average phosphorus concentration is 0.17 mg/L, which exceeded the water quality standards.

2.2. Evaluation indicators of river channels

The study took ShuiKu Village in Shanghai as an example and surveyed 114 sample plots of seven types of riparian zones within the village. Based on the statistical results of the current land use types in rural areas in Shanghai, the study divided the land use types adjacent to rural riparian zones into seven categories (Figure 2): Residential area boundary riparian zone (R1), industrial land boundary riparian zone (R2), agricultural land boundary riparian zone (R3), pond boundary riparian zone (R4), commercial land boundary riparian zone (R5), ecological land boundary riparian zone (R6), and green space boundary riparian zone (R7).

In this study, the spatial composition elements of riparian zones were divided into three parts: vegetation structure, vegetation community hierarchy, and artificial facilities. Based on the results of field investigations, the basic parameter range of spatial characteristics of current rural riparian zones was summarized, providing a local reference for discussing the ecological performance of rural riparian zones in Shanghai (Table 1).

Based on the equivalent factor evaluation method, the study reviewed the literature and summarized the evaluation indicators (Table 2) for assessing the supply and demand of ecosystem services in riparian zones. On the support services level, the focus is primarily on

the vegetation diversity of riparian zones in the water network rural areas (Graf *et al.*, 2019), which reflects the richness and stability of habitat provided by the vegetation community. In terms of regulatory services, existing studies have explored the purification and regulation functions of riparian zones in tackling agricultural non-point source pollution. This includes the deposition and purification of surface runoff particulate matter (Zhang *et al.*, 2007; Yu *et al.*, 2021; Zhao *et al.*, 2022) and the purification of water in the soil (Yang *et al.*, 2019; Liang *et al.*, 2022; Wang, 2022). In addition, the regulation of microclimates in riparian zones as a typical scene in rural areas has been investigated (Garner *et al.*, 2015). On the level of cultural services, existing research mainly focuses on the cultural services provided by rural rivers, including discussions on the cultural services of riparian zones in the water network rural areas (Liu *et al.*, 2021). This encompasses showcasing the characteristic features of the water network in rural areas, supporting water-related recreational activities, and exhibiting the historical and cultural significance of rural areas through scientific and educational services (Wang *et al.*, 2021). Table 2 summarizes the spatial indicators for evaluating the eight dimensions of the ecosystem services method above.

To evaluate the supply efficiency of different types of riparian zones, the study adopted the indicator of ecosystem service supply-demand ratio (ESDR) to reflect the degree of supply-demand match. ESDR is used to reflect the balance between the actual supply of ecosystem services in a specific area and human demand, which can be either

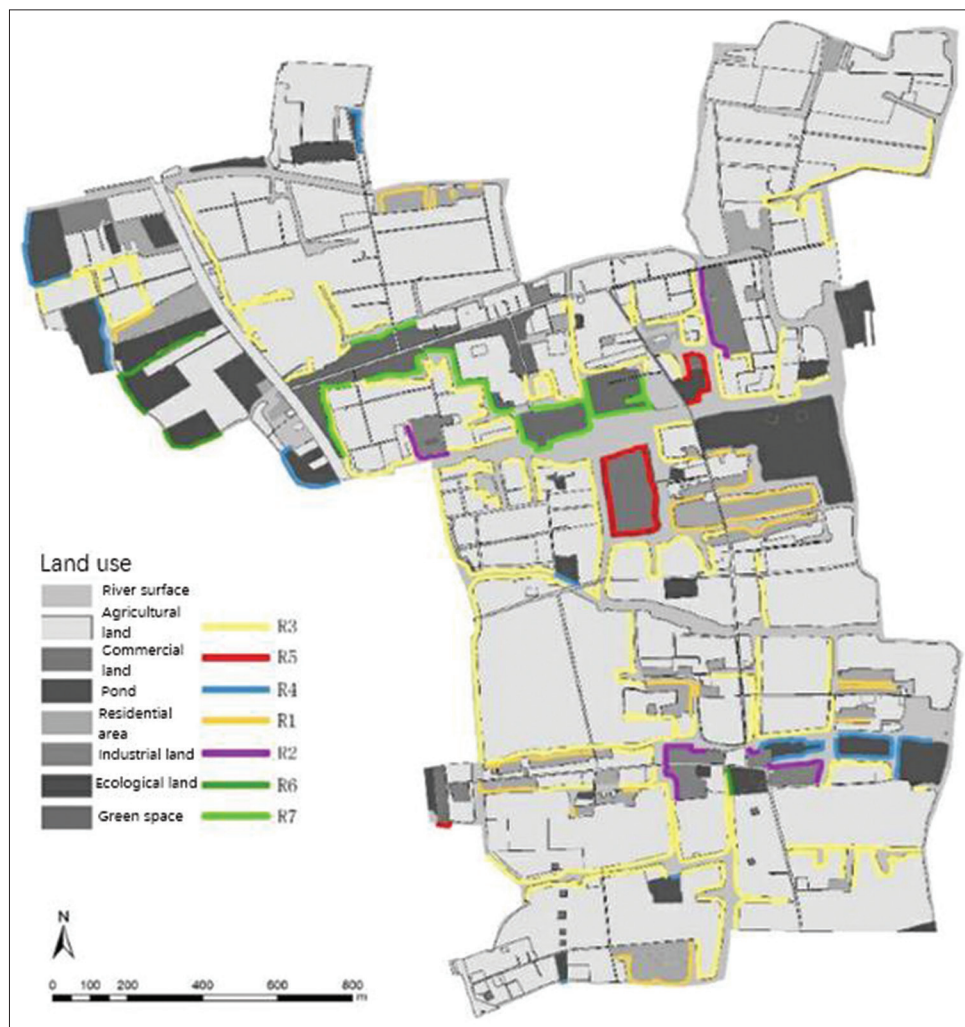


Figure 2. Riparian zone types in reservoir villages based on land use patterns. Source: Drawing by the authors

complete match, surplus, or deficit, and these states are collectively referred to as the matching characteristics of the ecosystem (Bai *et al.*, 2017).

Based on the results of the supply-demand match, a supply-demand match-supply level distribution model was introduced to evaluate the supply efficiency of riparian ecosystem services, by calculating the degree of supply-demand match and the supply level of the riparian zone (Jiang & Liang, 2022). The supply-demand match-supply level distribution model uses the absolute value of the supply-demand ratio $|ESDR|$ as the horizontal coordinate and the supply level of the riparian zone as the vertical coordinate, using the critical values of the degree of supply-demand match and the supply level of the riparian zone to divide the four quadrants (Figure 3). Quadrant I represents the area of efficient supply-demand match, where the supply level of ecosystem services is high and the match

degree is high, resulting in high supply efficiency. Quadrant II represents the area of supply surplus, where the supply level of ecosystem services is high, but the supply-demand difference is significant, resulting in supply surplus. Quadrant III represents the area of inefficient supply-demand match, where both the supply and demand levels of ecosystem services are low, resulting in a high degree of supply-demand match but an overall inefficient state. Quadrant IV represents the area of weak supply, where the supply level of ecosystem services is low, but the demand level is high, resulting in a significant supply-demand difference and insufficient supply.

3. Results




According to the evaluation results in Figure 4, the ranking of ecosystem service supply levels in the residential area boundary riverbank zone (LU1) from high to low is as follows: Provision of village landscape value service (5.00)

Table 1. Summary of revetment characteristics in riparian zones adjacent to different types of land use boundaries

Land use type	Revetment type	Characteristics of riparian zone	Typical scenarios
R1 – Residential area boundary riparian zone	Soft revetment	The slope length is 2 – 3 m, with natural slope bank and a gradient of 10° – 45°. The vegetation is dominated by trees and ground cover, with some areas used for vegetable cultivation	 <p>(Shuiku Village)</p>
	Hard revetment	Width is 1 – 2 m; there is a waterfront platform or a stepped entrance to the water forming a dock; there are planting ponds with trees	 <p>(Shuiku Village)</p>
R2 – Industrial land boundary riparian zone	Soft revetment	Slope length of 3 – 5 m; in the form of natural sloping banks with a gradient between 30° and 45°; dominated by a combination of trees and ground cover vegetation	 <p>(Shuiku Village)</p>
R3 – Agricultural land boundary riparian zone	Soft revetment	The slope length ranges from 2 – 4 m, with a regular shape of human-made reinforced slope. The slope degree ranges from 30° – 45°, and the vegetation is mainly ground cover plants with sign of vegetable planting	 <p>(Shuiku Village)</p>
R4 – Pond boundary riparian zone	Soft revetment	Slope length is mainly 2 – 3 m; the slope surface is artificially modified and has a regular form; the vegetation on the revetment surface is relatively scarce, mainly consisting of bare soil or incomplete coverage by ground cover plants	 <p>(Lianhu Village)</p>
R5 – Commercial land boundary riparian zone	Soft revetment	The slope length is 3 – 5 m; the slope surface is regular with a slope of 30° – 45°; the vegetation is dominated by lawns with decorative shrubs planted	 <p>(Shuiku Village)</p>

(Contd...)

Table 1. (Continued)

Land use type	Revetment type	Characteristics of riparian zone	Typical scenarios
	Hard revetment	Width of 2 – 5 m; a waterfront platform or stepped entrance to the water forms a dock; some have planting pools with shrubs or trees	 <p>(Shantang Village)</p>
R6 – Ecological land boundary riparian zone	Soft revetment	The slope length is about 3 – 5 m, and some exceed 5 m. The slope surface is natural with a slope of 30° – 45°, dominated by a combination of trees and ground cover plants	 <p>(Beiguan Village)</p>
R7 – Green space boundary riparian zone	Soft revetment	Slope length ranges from 3 – 5 m, with a natural slope surface and a gradient between 30° and 45°. The vegetation consists mainly of trees and understory plants	 <p>(Shantang Village)</p>

Source: Tabulation by the authors

Table 2. Hierarchical table of ecological service evaluation indicators for water network-type rural riverbanks

Service type level	Service dimension	Primary indicator	Secondary indicator	Value
Crop production	Crop/Agricultural product output (AP)	Nursery economic output (A_1)	Fruit and vegetable output	5
			By-product output	3
			No output	1
Supporting service	Biodiversity enhancement (BD)	Tree species (T_s)	>5 species	5
			3 – 5 species	3
			1 – 3 species	1
		Shrub species (S_s)	>5 species	5
			3 – 5 species	3
			1 – 3 species	1
		Herb species (G_s)	>5 species	5
			3 – 5 species	3
			1 – 3 species	1

(Contd...)

Table 2. (Continued)

Service type level	Service dimension	Primary indicator	Secondary indicator	Value
Regulating service	Runoff regulation (FM)	Revetment slope (R_s)	10° – 30°	5
			30° – 45°	3
			>45°	1
		Revetment width (R_w)	>5 m	5
			2 – 5 m	3
			1 – 2 m	1
		Plant buffer width (P_w)	>5 m	5
			2 – 5 m	3
			1 – 2 m	1
	Microclimate regulation (EM)	Tree coverage (T_c)	≥ree	5
			30% ≤ T_c < 80%	3
			<30%	1
		Plant spatial structure (P_s)	Tree-shrub-grass	5
			Tree-grass	4
			Shrub-grass	3
			Herb	2
			Bare soil	1
	Water purification (WU)	Plant cover width (P_w)	>5 m	5
			2 – 5 m	3
			1 – 2 m	1
		Revetment foundation structure (I_s)	Ecological zone/natural revetment	5
			Stone/pile revetment	3
			Concrete or other rigid revetment	1
		Wet plant width (W_p)	>5 m	5
			2 – 5 m	3
			1 – 2 m	1
Cultural service	Village landscape value (VL)	Shoreline length (R_N)	Natural vegetation revetment	5
			Vegetation planted on hard slope	3
			Hard, vegetation-free revetment	1
		Water visibility (W_v)	All visible	5
			Part visible	3
			invisible	1
	Village recreational value (VR)	Types of recreational activities (A_s)	>5 species	5
			3 – 5 species	3
			1 – 3 species	1
		Distribution of recreational facilities (F_s)	Set up stop platform	5
			Set up walkways	3
			No recreational facilities	1
	Scientific, educational and cultural value (VT)	Historical monuments and reservations (H_R)	Fully save	5
			Partial save	3
			No save	1

Source: Based on ecosystem services classification systems provided by Costanza (2008)

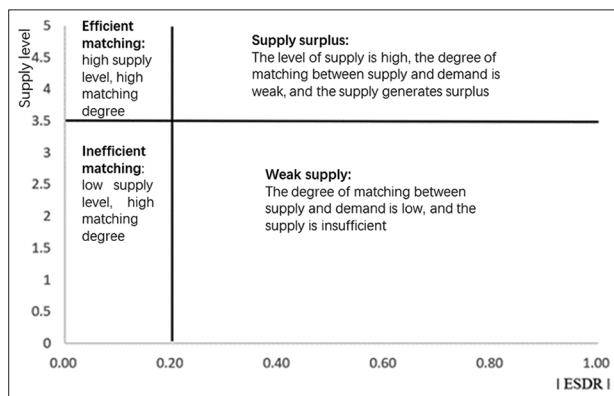


Figure 3. Supply-demand match-supply-level model of ecosystem services in riparian zones. Source: Figure modified by authors based on Jiang & Liang (2022)

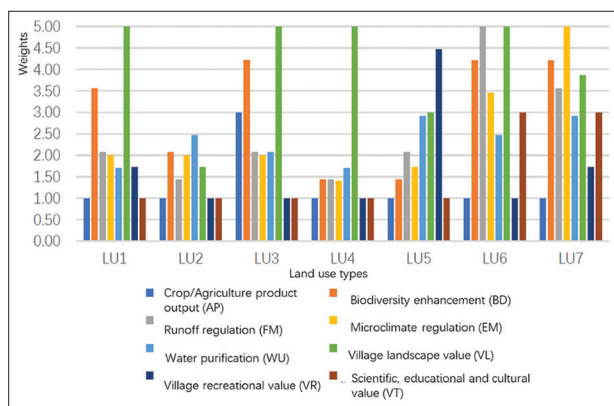


Figure 4. Evaluation results of ecosystem service supply of seven types of riparian zones in reservoir villages. Source: Bar chart by the authors

> vegetation diversity level (3.56) > runoff regulation service (2.08) > microclimate regulation service (2.00) > provision of recreational value service (1.73) > water purification service (1.71) > agricultural product output service (1.00) = provision of scientific, educational, and cultural value service (1.00). Among them, the provision of village landscape value service (VL) shows a strong supply level, while vegetation diversity (BD) is at a moderate level. The supply levels of other services are all below 3.00, indicating a relatively low supply capacity.

As shown in Figure 5, in the demand evaluation results for the residential area boundary riverbank zone (LU1), the demand evaluation for recreational value services (VR) and scientific, educational, and cultural value services (VT) is below 2.50, indicating a lower demand level. The demand for other types of services exceeds 3.00, indicating a moderate to high level of demand for improving village landscape value services among production services, supporting services, regulating services, and cultural services.

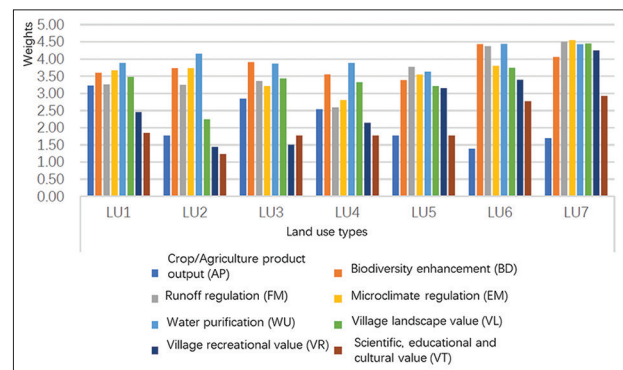


Figure 5. Evaluation results of ecosystem service demand of seven types of riparian zones in reservoir villages. Source: Bar chart by the authors

The results showed that in terms of village landscape value (VL), the seven types of riparian zones exhibited higher supply efficiency. R1–R5 riparian zones showed weak supply in regulating services. In addition, the supply efficiency of the seven types of riparian zones exhibited differentiated results, where the riparian zone at the boundary of residential areas (R1) exhibited weak supply in agricultural product output, the riparian zone at the boundary of industrial land (R2) showed weak supply in biodiversity, the riparian zone at the boundary of agricultural land (R3) showed weak supply in all three types of regulating services, the riparian zone at the boundary of ponds (R4) exhibited weak supply in agricultural product output (AP), biodiversity (BD), runoff regulation service (FM), microclimate regulation service (EM), and water purification service (WU), the riparian zone at the boundary of commercial and service land (R5) exhibited weak supply in biodiversity level (BD), and the riparian zones at the ecological land boundary (R6) and the green space boundary (R7) showed similar supply efficiency evaluation results, with village recreational value services (VR) being in a weak supply state.

The ecologically sensitive areas of the reservoir village, including the ecological land boundary riparian zone (R6) and green land boundary riparian zone (R7), exhibited higher levels of ecosystem service supply in supporting and regulating services than other types of riparian zones. Meanwhile, the ecological land boundary riparian zone (R6), commercial land boundary riparian zone (R5), and green space boundary riparian zone (R7) – three types of riparian zones closely related to human activities – exhibited higher levels of cultural services than other types of riparian zones. These findings confirm a strong correlation between the supply of ecosystem services in rural riparian zones and the land use types in their vicinity. When assessing the ecosystem services of rural riverbanks, local land use types can be taken into account and relevant

ecological restoration recommendations can be proposed based on the local land use types.

4. Discussion

Based on field investigations and literature reviews, the study establishes a framework for evaluating the supply and demand of ecosystem services in the riparian zone of water network-type rural areas. The framework includes four major services: Provisioning, regulating, supporting, and cultural services, as well as eight sub-service dimensions: Agricultural production, biodiversity, runoff regulation, microclimate regulation, water purification, rural landscape value, recreational value, and rural cultural services. Other studies have employed the ecosystem services supply and demand in urban planning. For example, in Wuhan (Chen *et al.*, 2019), Zhengzhou (Xue *et al.*, 2022), and New York cities (Herreros-Cantis & McPhearson, 2021), ecosystem service supply and demand were used to assess the urban ecological management and environmental justice. In addition, the analyzed indicators can be utilized to evaluate the water ecosystem functions in various rural landscapes. Water network-type rural riverbank areas serve as transitional spaces that connect rural river ecosystems and terrestrial ecosystems, making them important linear ecological elements. Due to their dense network of water bodies, these areas are narrow and elongated and embedded between different land uses. As a result, they possess complex functions related to production, ecology, and livelihoods. They are closely intertwined with surrounding land patterns and human activities, exhibiting a high degree of heterogeneity. Therefore, they require more refined management approaches.

In this study, we divided the riparian zone types into seven types based on land use types. Land use is the most direct interaction between human activity and natural systems. According to the research, the use of land use data to assess ecosystem service value (ESV) and explore the relationship between land use change and ESV has emerged in the scientific literature over the last decades (Li *et al.*, 2010; Scolozzi *et al.*, 2012; Fu *et al.*, 2016). These studies have collectively demonstrated that analyzing land use data is an effective method for estimating ESV.

The application of ecosystem services supply and demand matching theory and methods is widely prevalent in the field of urban riverbank ecological restoration research, both domestically and internationally. Internationally, the United States have also adopted the ecosystem services approach in urban riverbank restoration projects. In Los Angeles, the Los Angeles River Revitalization Master Plan aims to restore the river's

natural hydrological and ecological functions, while also providing recreational and cultural amenities to the local community. By understanding that the ecosystem services is required and valued by the community, restoration efforts are focused on enhancing water quality and flood regulation and providing opportunities for outdoor recreation (Hagekhalil *et al.*, 2014). Therefore, using an ecosystem-services evaluation framework at a small scale allows for more precise analysis, which provides delicate restoration approaches. However, the study has some limitations. Due to the force majeure that restricted field surveys, the empirical research in the study was conducted in October 2022 and January 2023 for the water reservoir village. As a result, the response of vegetation communities in the riparian zone to interannual climate change was insufficient, and the sample data were not comprehensive. There is still a certain gap in the accurate measurement of the actual supply level of ecosystem services in the riparian zone.

5. Conclusion

In this study, we divided the rural riparian zone into research units based on land use types and evaluated the supply-demand characteristics of ecosystem services in the riparian zone using value assessment methods. Thus, it helps gain an understanding of the ecological restoration needs of the riparian zone at the granularity of land use units. In terms of the rural landscape restoration, stakeholder engagement and collaboration with local communities, researchers, and policymakers are crucial for incorporating local knowledge and understanding the socioeconomic factors that impact water ecosystem functions. The vast and diverse water network areas in China far exceed the scope of water network rural areas in Shanghai, serving as the ecological foundation for various rural types. Due to regional differences in socio-economic development, the demand for riparian zones may vary. Future research should include field measurements. Incorporating the site-specific ES evaluation system can increase the comprehensiveness and effectiveness of the evaluation process, which contributes tailored restoration strategies that are better suited for the specific characteristics and goals of each rural area.

Acknowledgments

We would like to express our sincere gratitude to all those who have contributed to the successful completion of this research paper. We would also like to thank the members of our research team for their dedicated efforts and cooperation. Their contributions, either in data collection, analysis, or discussions, have greatly enriched the findings and conclusions of the paper.

Funding

Key Laboratory of Ecology and Energy-saving Study of Dense Habitat, Ministry of Education, in collaboration with Shanghai Tongji Urban Planning and Design institute Co. Ltd, has launched a joint open research project in 2022. The project, titled “Key Technologies for Precise Planning of Rural Ecological Restoration Supported by Digital Tools,” is identified as KY-2022-LH-A05.

Conflict of interest

The authors declare that they have no competing interests.

Author contributions

Conceptualization: Nannan Dong and Luca Maria Francesco Fabris

Formal analysis: Xinyue Chen

Investigation: Yongnan Wang

Methodology: Yongnan Wang

Writing – original draft: Xinyue Chen

Writing – review & editing: Xinyue Chen, Nannan Dong, and Luca Maria Francesco Fabris

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

The raw data were jointly owned and subject to shared rights and responsibilities with our collaborating partners. We are unable to provide the raw data to readers. If readers are interested, they can contact us to explore possibilities for research collaboration.

References

- Bai, Y., Wang, M., Li, H., & Huang, S. (2017). Ecosystem service supply and demand: Theory and management application. *Acta Ecologica Sinica*, 37(17):5846-5852.
- Buckley, C., & Piao, V. (2016). *Rural Water, not City Smog, may be China's Pollution Nightmare*. New York: The New York Times, p. 11.
- Castellano, C., Bruno, D., Comín, F. A., Benayas, J. M. R., Masip, A., & Jiménez, J. J. (2022). Environmental drivers for riparian restoration success and ecosystem services supply in Mediterranean agricultural landscapes. *Agriculture, Ecosystems and Environment*, 337:108048.
<https://doi.org/10.1016/j.agee.2022.108048>
- Chen, F., Li, L., Niu, J., Lin, A., Chen, S., & Hao, L. (2019). Evaluating ecosystem services supply and demand dynamics and ecological zoning management in Wuhan, China. *International Journal of Environmental Research and Public Health*, 16(13):2332.
<https://doi.org/10.3390/ijerph16132332>
- Costanza, R. (2008). Ecosystem services: Multiple classification systems are needed. *Biological Conservation*, 141(2):350-352.
<https://doi.org/10.1016/j.biocon.2007.12.020>
- Cui, X., Zhao, Y., Wang, H., & Wu, J. (2021). A review and prospects of rural studies. *Geographic Science Research*, 10:118.
- Ervin, D., Vickerman, S., Ngawhika, S., Beaudoin, F., Hamlin, S., Dietrich, E., et al. (2014). *Principles to Guide Assessments of Ecosystem Service Values*. Portland, OR: Institute for Sustainable Solutions, Portland State University, p28.
- European Environment Agency. (2020). *State of Nature in the EU: Results from Reporting Under the Nature Directives 2013-2018. EEA Report No 10/2020*. Copenhagen: European Environment Agency.
- Fu, B., Li, Y., Wang, Y., Zhang, B., Yin, S., Zhu, H., et al. (2016). Evaluation of ecosystem service value of riparian zone using land use data from 1986 to 2012. *Ecological Indicators*, 69:873-881.
<https://doi.org/10.1016/j.ecolind.2016.05.048>
- Fu, L., & Liu, J. (2019). The Experience and Enlightenment of Riparian Zone Management in the United States. In: *Proceedings of the 2019 China Urban Planning Annual Conference, Chongqing, China*.
- Garner, G., Malcolm, I. A., Sadler, J. P., Millar, C. P., & Hannah, D. M. (2015). Inter-annual variability in the effects of riparian woodland on micro-climate, energy exchanges and water temperature of an upland Scottish stream. *Hydrological Processes*, 29(6):1080-10895.
<https://doi.org/10.1002/hyp.10223>
- Ge, B., Wang, C., & Song, Y. (2023). Ecosystem services research in rural areas: A systematic review based on bibliometric analysis. *Sustainability*, 15(6):5082.
<https://doi.org/10.3390/su15065082>
- Graf, N., Batters, K. P., Cimpean, M., Dittrich, P., Entling, M. H., Link, M., et al. (2019). Do agricultural pesticides in streams influence riparian spiders? *Science of the Total Environment*, 660:126-135.
<https://doi.org/10.1016/j.scitotenv.2018.12.370>
- Hagekhalil, A., Kharaghani, S., Tam, W., Haimann, R., & Susilo, K. (2014). City of Los Angeles-the Green Blue City One Water Program, Part 5 of 5: Los Angeles River Revitalization, Big Picture-one Water System. In: *International Conference on Sustainable Infrastructure 2014: Creating Infrastructure for a Sustainable World*, p. 526-528.
- Herreros-Cantis, P., & McPhearson, T. (2021). Mapping supply of

- and demand for ecosystem services to assess environmental justice in New York city. *Ecological Applications*, 31(6):e02390.
<https://doi.org/10.1002/eap.2390>
- Jiang, Q., & Liang, X. (2022). Evaluation and optimization of supply and demand of river ecosystem services in Northern cities: A case study of Xingji river in Jinan city. *South Architecture*, 8:73-83.
- Kupiec, J. M., Staniszewski, R., & Kayzer, D. (2022). Assessment of water quality indicators in the Orla river nitrate vulnerable zone in the context of new threats in Poland. *Water*, 14(15):2287.
<https://doi.org/10.3390/w14152287>
- Li, T., Li, W., & Qian, Z. (2010). Variations in ecosystem service value in response to land use changes in Shenzhen. *Ecological Economics*, 69(7):1427-1435.
<https://doi.org/10.1016/j.ecolecon.2008.05.018>
- Liang, Q., Li, R., Li, J., Hou, L., & Wang, Y. (2022). Stoichiometric characteristics of soil carbon, nitrogen and phosphorus in forestland-farmland riparian zone of Luoshijiang small watershed in Erhai basin. *Southwest China Journal of Agricultural Sciences*, 35(11):2587-2594.
- Liu, Y., Wang, Z., & Dan, Z. (2021). Research on the evaluation and optimization strategy of cultural services in Suzhou rural water area spatial ecosystem. *Landscape Architecture Frontiers*, 9(2):38-49.
- Martin-Ortega, J., Ferrier, R.C., Gordon, I. J., & Khan, S. (2015). *Water Ecosystem Services: A Global Perspective*. Paris: UNESCO Publishing.
- Qian, C. (2022). *Research on Water Quality Monitoring and Assessment of Main Rivers in Shanghai Fengxian Bay Tourism Area*. China: Shanghai Institute of Technology.
<https://doi.org/10.27801/d.cnki.gsyy.2022.000189>
- Scolozzi, R., Morri, E., & Santolini, R. (2012). Delphi-based change assessment in ecosystem service values to support strategic spatial planning in Italian landscapes. *Ecological Indicators*, 21:134-144.
<https://doi.org/10.1016/j.ecolind.2011.07.019>
- Simedo, M. B. L., Martins, A. L. M., Pissarra, T. C. T., Lopes, M. C., Costa, R. C. A., Valle-Junior, R. F., et al. (2018). Effect of watershed land use on water quality: A case study in Córrego da Olaria Basin, São Paulo state, Brazil. *Brazilian Journal of Biology*, 78:625-635.
<https://doi.org/10.1590/1519-6984.168423>
- Wang, J. (2022). Spatial and temporal distribution of soil nitrogen and phosphorus in Riparian zone and analysis of influencing factors. *Technology of Soil and Water Conservation*, 4:13-16.
- Wang, J. S., Kong, L. N., Lin, M. S., & Ming, F. Y. (2011). Review on the characteristics and functions of riparian zone. *Journal of Yangtze River Scientific Research Institute*, 28(11):28-35.
- Xue, D., Wang, Z., Li, Y., Liu, M., & Wei, H. (2022). Assessment of ecosystem services supply and demand (mis)matches for urban ecological management: A case study in the Zhengzhou-Kaifeng-Luoyang cities. *Remote Sensing*, 14(7):1703.
<https://doi.org/10.3390/rs14071703>
- Yang, Y., Chang, Y., Cui, H., Huang, M., & He, Y. (2019). Experimental study on the use of ecological riparian zone for deep purification of tailwater from rural sewage treatment plants. *Journal of East China Normal University (Natural Science)*, 4:133-143.
- Yu, Y., Feng, X., Li, S., Chen, X., Wu, S., & Zhao, Z. (2021). Study on purification effect of grass planting ditches for ecological diversion at the base of riparian zone on surface runoff. *Guangdong Chemical Industry*, 48(7):120-123.
- Zepp, H., Falke, M., Günther, F., Gruenhagen, L., Inostroza, L., Zhou, W., et al. (2021). China's ecosystem services planning: Will Shanghai lead the way? *Erdkunde*, 75:271-294.
<https://doi.org/10.3112/erdkunde.2021.04.02>
- Zhang, F., Li, T., & Lu, J. (2007). Research progress on water purification, ecological function and restoration in Riparian zone. *Journal of Agro-Environment Science*, S2:459-464.
- Zhao, Y., Yin, H., Shi, C., Yu, Y., & Zhang, Y. (2022). A study on the pollutant purification capacity of riverbank vegetation zones in the Daqing river basin. *Journal of Soil and Water Conservation*, 36(5):130-135.