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The influence of urbanization on local perception of the effect of traditional landscapes on human wellbeing: A case study of a pondscape in Chongqing, China

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ABSTRACT

Pondscapes, a type of multifunctional landscape that frequently embodies traditional wisdom, possess a significant potential to inspire ecological design and advance sustainability. Nevertheless, their significance to human well-being was not fully acknowledged during China's urbanization process, leading to the abandonment, filling, or alteration of numerous pondscapes and the loss of the ecosystem services they offered. Public perceptions of these landscapes have yet to be investigated. Taking the case of Liangjiang New Area in Chongqing, China, this study sought to explore public perceptions of pondscapes' services for ecosystem and human health, pondscapes loss, and preferences for future pondscape applications. Three resident groups, representing diverse experiences with pondscapes - rural residents, urban locals, and urban immigrants - were compared. Second-order clustering, descriptive statistical analysis, non-parametric tests, and correspondence analysis were applied. As anticipated, individuals with varying urbanization backgrounds held varying attitudes and preferences towards traditional pondscapes. The perceived importance of pondscapes for ecosystem health was consistent among all groups, but urban residents viewed their impact on human health as more significant than rural residents did. Rural residents tended to be less concerned about pondscape loss, while urban residents preferred to preserve them. In general, all three groups yearned for a landscape combining modernization and tradition: a transitional landscape representing a win-win solution that considers ecological and human health. The findings have both theoretical and practical implications for the transformation of multifunctional landscapes embodying traditional wisdom in modern society.

1. Introduction

Pondscapes, a multifunctional landscape type that often embody traditional wisdom, have a profound capacity to inspire ecological design and help us move towards a sustainable future (Wang et al., 2019; Shi and Yu, 2021). The question of how to transform and utilize such multifunctional traditional landscapes in modern society is a matter of concern for both researchers and policy-makers (Geiger, 2015; Zhang, 2018; Wang et al., 2019). Traditional landscapes are seen as originating in premodern times and having relatively stable and slow development; they are unique cases that can reflect the historical continuity of local landscape forms and practices (Renes et al., 2019). The public's attitudes towards traditional landscapes partly determine how they will be

developed in the future. Concerning pondscapes, people may not have fully recognized their value during China's rapid urbanization process. This question has yet to be investigated and thus people's values around pondscapes have not been fully incorporated into land use decision-making. Accordingly, this research aims to understand how the public perceives and values traditional pondscapes in current society, to inform policy-making in this area.

Public perceptions of and preferences for urban and rural landscapes (including pondscapes) have become an essential part of landscape research (Zheng et al., 2011; Ruskule et al., 2013; Wang et al., 2021). Various factors influence the public's perceptions of landscapes. People's preferences for landscapes are likely to be affected by their physical aspects (Rogge et al., 2007), such as naturalness (Kaplan et al., 1972;

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Iverson Nassauer, 1995; van den Berg et al., 1998), openness (Kaplan and Kaplan, 1989), maintenance (Nassauer and Westmacott, 1987; van den Berg et al., 1998) and diversity (Arriaza et al., 2004). Meanwhile, attitudes towards landscapes are shaped by sociodemographic factors, such as age (Howley et al., 2012), place of residence (van den Berg et al., 1998), familiarity with the landscape, and environmental value orientation. Among the forms of traditional landscape, ponds are a unique type. Their major components include ponds, paddy fields, farmland, forest land, canals, and roads (Yu et al., 2015). Existing studies have investigated perceptions of the ecosystem services (ES) provided by a variety of functional ponds. For example, a French study used principal component analysis and econometric models to investigate ES perceptions among fish farmers, economic and institutional stakeholders, pond users, and villagers living close to ponds (Blayac et al., 2014). In a Polish study, fish farmers were found to value the production and biodiversity protection provided by carp ponds (Turkowski, 2021). A study in India found that rice planting increased the population of mosquitos—potential vectors of diseases such as malaria and Japanese encephalitis—and may thus have a specific impact on public health (Sarkar et al., 2011). Although many studies have focused on the relationship between ES and human wellbeing in general, there have been few studies on local perceptions of traditional ponds and their relationship with human wellbeing.

According to the Millennium Ecosystem Assessment, human wellbeing requires “basic materials for a good life, freedom of choice, good social relationships, security and health” (Finlayson et al., 2005). In this context, ponds provide essential ES which contribute to human wellbeing (Fang et al., 2009; Gao et al., 2015; Yu et al., 2015; Shi and Yu, 2021). ES has an impact on human wellbeing both directly, via human health (“a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity”; Nutbeam, 1986) and indirectly via ecosystem health (“a state of an ecosystem and its associated structure and processes to function normally, particularly regarding its ability to deliver ES”; Rapport et al., 1998). Some ES, such as crop production, fish production, irrigation, vernacular landscapes, and providing spaces for leisure and recreation, social activities, and spirituality, are directly beneficial to human health. Others, such as stormwater regulation, groundwater recharge, water purification, climate regulation, and biodiversity, are related more to ecosystem health and thus have indirect benefits. The wellbeing benefits of urban green space can be influenced by people’s perceptions of these spaces (Kothencz et al., 2017); thus, public perceptions of ponds are relevant in understanding their contribution to human wellbeing.

At various stages of urbanization, ponds with different characteristics can play diversified roles. As awareness of ecological issues is gradually increasing, ponds have become multifunctional ecological landscapes (Yu et al., 2015; Fang et al., 2018; Sinclair et al., 2020). However, the typical characteristics and functions of different ponds have radically shifted due to urbanization (Fang and Huang, 2012; Jiang, 2016; Wang and Zhu, 2017; Fang et al., 2018; Jiang et al., 2019). These changes will affect people’s perceptions; urbanization may change or even completely disrupt the way people interact with local landscapes (Jiang, 2016; Dou et al., 2019) and this will in turn have impacts on people’s health and wellbeing (Dou et al., 2021). However, few studies have focused on how urbanization has impacted preferences for ponds.

In summary, there is little empirical evidence relating to public perceptions of ES provided by ponds. Furthermore, the influence of urbanization on how people value these ES is still poorly understood. Thus, the present study explores the influence of urbanization on people’s perceptions of the ES provided by traditional ponds. The aim is to facilitate the transition of ponds from a form embodying traditional wisdom to one that is embraced by modern society. Accordingly, the following research questions (RQs) will be addressed:

RQ1: What are residents’ perceptions of the ways in which traditional ponds provide ES in terms of both ecosystem health and human health? Are there differences between rural and urban residents?

RQ2: How do people perceive the ongoing abandonment and potential future reconstruction of ponds? Are there differences between rural and urban residents?

RQ3: What pond or other landscape types would people prefer in various future land use scenarios (industrial areas, residential areas, public gardens)? Are there differences between rural and urban residents?

We hope the results will help policy-makers understand changes in ponds, stakeholders’ perceptions of these changes, and recommended future scenarios. They will also provide valuable suggestions on vernacular landscape protection policies and encourage sustainable ecosystem-oriented management practices (Jiang et al., 2021).

2. Materials and methods

2.1. Study area

Liangjiang New Area (LNA) is located in the municipality of Chongqing, China (Fig. 1). The total planning area of LNA comprises around 1200 km², and the built area is around 150 km². The original natural areas covered by the plan (including water bodies and mountainous areas), upon which development is forbidden, comprise around 650 km². According to the general plan, the primary land uses of LNA are intended to be high-technology research, financial and commercial centres, manufacturing, and ecological protection. Given the prevalence of slope fields and gullies in Chongqing, new parts of the city were constructed on land obtained by levelling mountains, rivers, and ponds. Since 2010, when the study area was given the status of national-level development zone, rapid developments have begun to destroy original ponds, change the runoff pathway of natural water systems, and deteriorate water quality in rivers and lakes. In LNA, ponds are both a typical vernacular landscape form and an essential part of the rural water system. However, LNA’s rapid urbanization process has resulted in a terrible loss of ponds (Table 1). Assuming that the storage depth of ponds is 1.5 m, the water storage capacity in LNA has been reduced by $7776 \times 10^4 \text{ m}^3$, equivalent to a medium-sized Chinese reservoir (Jiang, 2016).

2.2. Research methods

This study explored public perceptions through questionnaires and statistical analysis. We proposed two ways to explore the impact of urbanization on people’s perceptions of the importance of ES provided by traditional ponds. First, we assumed that people with varied experiences of ponds and urbanization would have different perceptions and preferences. Second, we assumed that people’s preferences for how ponds should be linked to different forms of land use in the future would also vary. Based on these approaches, RQ1 will be answered through the public’s perceived importance of ES provided by ponds. RQ2 will be answered using the public’s perceptions of current and future changes to ponds. RQ3 will be answered by analysing the public’s preferences for specific proposed pond types in different land use scenarios.

2.3. Data collection

We obtained the number and area of ponds in LNA using remote sensing image interpretation and water index extraction to select areas whose residents were likely to have had pond experiences. The remote sensing image data were obtained from the Chinese Academy of Sciences International Spatial Database. We used LandsatETM + remote

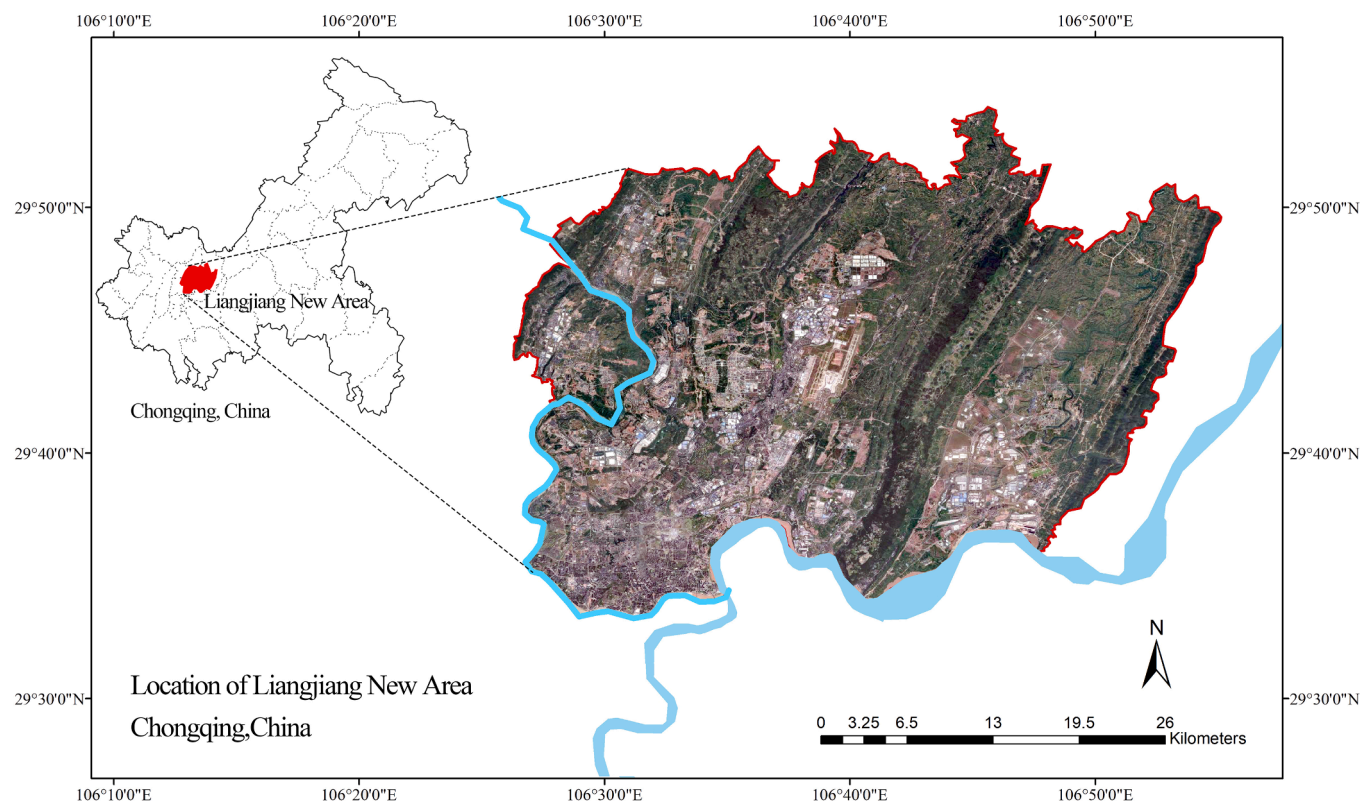


Fig. 1. Location of Liangjiang New Area, Chongqing, China.

Table 1
Changes in the number and area of ponds (Jiang, 2016).

	1988	2000	2012	Decrease compared to 1988
Number of Ponds	6461	4327	2572	60.19 %
Pond Area(km ²)	58.06	15.86	6.22	89.29 %

sensing images taken from 2 July 2000 and 2 April 2012, with strip number 128 and line 39, and Landsat 4–5 T.M. remote sensing images from 1 September 2006. Sociodemographic data were obtained from the 2000–2012 Statistical Yearbooks of Chongqing City, Beibei District, Yubei District, and Jiangbei District.

Respondents from metropolitan areas were randomly selected around Guanyin Qiao Commercial Center, Shaping Ba Square, the government of Yubei District, and some towns' markets. According to the general planning of LNA and its details on the non-rural population and current situation of villages, 27 villages were also selected. These villages are categorized as rural, transition, growing, or urbanized villages. Rural villages are remote villages with little urbanization. Transition villages are either in the development process or have been marked for development. Growing villages are in the process of increased residential development and migration. Urbanized villages form part of the rural–urban continuum, and agricultural people who move to these villages are given non-agricultural status.

With little statistical data relating to rural areas, we conducted on-site face-to-face visitor questionnaires. A pre-investigation was conducted in September and November 2014 to collect basic knowledge about the study area to improve and complement the questionnaire. The final questionnaire consisted of four sections (Appendix A) and was conducted in June 2015. Respondents included local governmental officials, villagers, and urban residents. A stratified and random sampling method was adopted. In the first section (RQ1), we explored the values of ponds to ecosystem health and human health as reflected in

twelve ES. In the second section (RQ2), we studied the residents' attitudes toward ongoing pondscape transformation. The third section (RQ3) asked about the preferences for different future land use scenarios. The study enquired about three future land use types in LNA—residential areas, parks, and industrial areas—to reflect the future application of pondscales under different types of urbanization. Four possible approaches to changing pondscales were included: natural waterscapes, artificial waterscapes, grassy areas without ponds, and paved areas. These four previews also represent the potential future impact of pondscales on ecosystem health and human health. The ecosystem health level represented by natural waterscapes is the highest, and that represented by paved areas is the lowest. For the benefits of human health, the order is the opposite. Combining the three land use and four pondscape types, we obtained 12 design scenarios and asked respondents to rate their preferences on 5-point Likert scale (from 1, *do not like at all*, to 5, *like very much*). Finally, the fourth section inquired about sociodemographic variables (current residence, residence before age 15, gender, age, education, occupation). The anonymous voluntary interviews took 30–40 min. We completed the formal questionnaire survey from 13 to 25 June 2015 in 27 villages in 4 teams. We finally received 413 valid questionnaires (233 from urban and 180 from rural residents) with a 93.9 % response rate.

2.4. Data analysis

We applied second-order clustering, descriptive statistical analysis, non-parametric tests, and correspondence analysis according to the research purpose and collected data. Second-order clustering, which is also called two-step clustering, can deal with discrete and continuous variables simultaneously. This method automatically analyses and outputs the optimal cluster number. The respondents were divided using the second-order clustering method based on the residential data before age 15, current residence, and age. We analysed the evaluations of different clusters regarding the ES provided by pondscales using

descriptive statistical analyses and non-parametric tests. A non-parametric (Kruskal-Wallis) test was applied to analyse the variance of multiple groups of independent samples when the normal distribution conditions were not satisfied. Previous studies have used this method to examine differences in landscape preferences among different social groups (Leite et al., 2019; Das et al., 2022; Zhang et al., 2022). We analysed people’s attitudes towards the abandonment or reconstruction of pondscares by correspondence analysis. Correspondence analysis can only be used to analyse two qualitative variables, and the relationship between variables is mainly obtained by analysing their contingency table data. All analyses were conducted in SPSS.

3. Results

3.1. Sociodemographic characteristics of respondents

Our 413 respondents ranged from under 18 to more than 60 years old; 74.2 % were 18–59. Respondents comprised 229 men (55.4 %) and 184 women (44.6 %). Regarding residential area, 56.4 % lived in urban areas and 43.6 % lived in rural areas (Fig. 2). According to an analysis of the 2014 Chongqing census data, the demographic features of this sample were generally consistent with the population structure of Chongqing (Fig. 2). Therefore, we can say that this sample’s pondscape perceptions represent the general pondscape perceptions of Chongqing residents. Regarding occupation, the respondents were primarily farmers (27.6 %), office employees (27.3 %), others (21.2 %), or pensioners (9.5 %). Of the respondents living in urban areas, 59.7 % lived in rural areas before they were 15 years old. Most urban respondents (92.7 %) had seen pondscares; 77.7 % had experienced leisure time in a pondscape, and more than half of the urban respondents (51.1 %) reported working in a pondscape. Second-order clustering was used to analyse the population; Table 2 shows that respondents can be divided into three groups: rural residents (44.7 %), urban immigrants (40.5 %), and urban locals (14.8 %).

3.2. RQ1: Public perceptions of the importance of pondscape ES for ecosystem and human health

The results with respect to RQ1 show that rural residents, urban locals, and urban immigrants had similar perceptions of the importance of pondscape ES for ecosystem health; however, their evaluations with respect to human health differed (Table 3). Urban residents (both locals and immigrants) think pondscares have more benefits for human health than rural residents (Fig. 3a). Regarding individual items, there were no significant differences among the three groups in how they evaluated the importance of pondscares for stormwater regulation, crop production, fish production, and leisure and recreation (all these items were evaluated highly). However, there were significant differences in their evaluations of the importance of pondscares for different aspects of ecosystem health, such as groundwater recharge, water purification,

Table 2
Clustering results for respondents.

Sample size and variables		Rural Residents	Urban Immigrants	Urban Local
Sample proportion		44.70 %	40.50 %	14.80 %
Current residence	Rural area	100.0 %	0.0 %	0.0 %
	Urban area	0.0 %	73.2 %	26.8 %
Place of residence before 15 years of age	Rural area	52.5 %	47.5 %	0.0 %
	Urban area	0.0 %	0.0 %	100.0 %
Age (years)	Below 18	50.0 %	33.3 %	16.7 %
	18–33	9.9 %	60.4 %	29.7 %
	34–49	50.0 %	39.3 %	10.7 %
	50–59	54.8 %	38.7 %	6.5 %
	Above 60	67.8 %	23.0 %	9.2 %

Table 3
Non-parametric test results of the three groups regarding pondscares in the ecosystem and human health (*P < 0.05; **P < 0.01).

		Kruskal-Wallis Test	P Value
Ecosystem Health	Storm Water Regulation	3.144	0.216
	Groundwater Recharge	27.282	0.000**
	Water Quality Purification	11.816	0.003**
	Climate Regulation	98.004	0.000**
	Wildlife Habitat	17.191	0.000**
	Ecosystem Health	0.581	0.748
Human Health	Crop Production	3.065	0.216
	Fish Production	2.897	0.235
	Irrigation	9.755	0.008**
	Vernacular Landscape	8.891	0.012*
	Leisure & Recreation	5.194	0.075
	Social Communication	13.194	0.008**
	Spiritual Services	14.877	0.000**
	Human Health	10.535	0.005**

climate regulation, and wildlife habitat. For example, for climate regulation services, urban residents believed pondscares were much less important than rural residents (Fig. 3b). There were also significant differences among the human health items, including irrigation, vernacular landscape, social activities, and spirituality. For example, urban immigrants and rural residents believed ponds’ irrigation function was more important than urban locals.

3.3. RQ2: Different perceptions of ongoing pondscape changes

With respect to RQ2, respondents believed that filling in or abandoning pondscares was the most prominent trend with the development

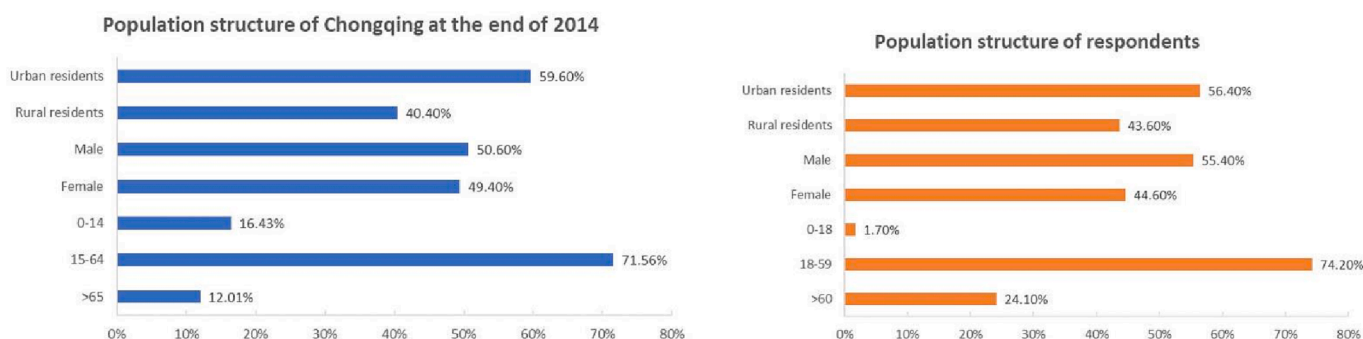
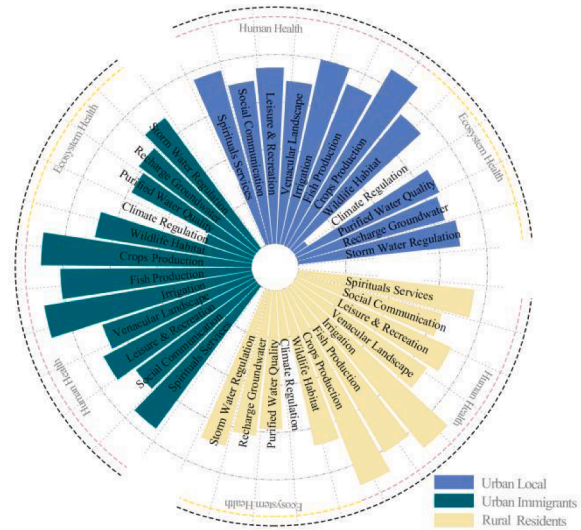
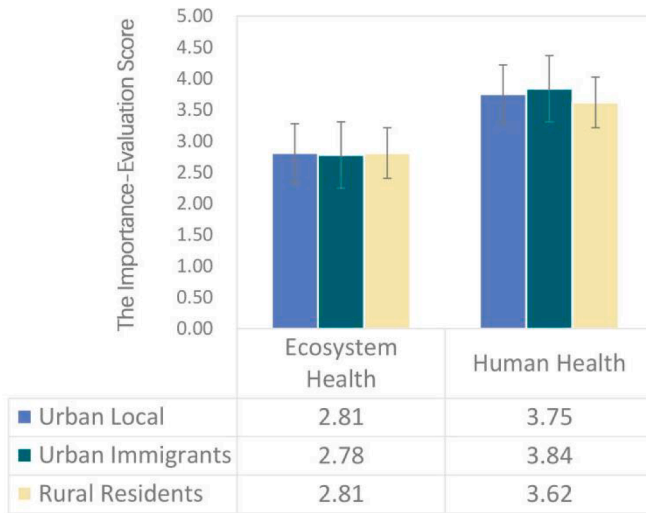


Fig. 2. Comparison of population structure.



a) Overall evaluation results

b) Itemized evaluation results

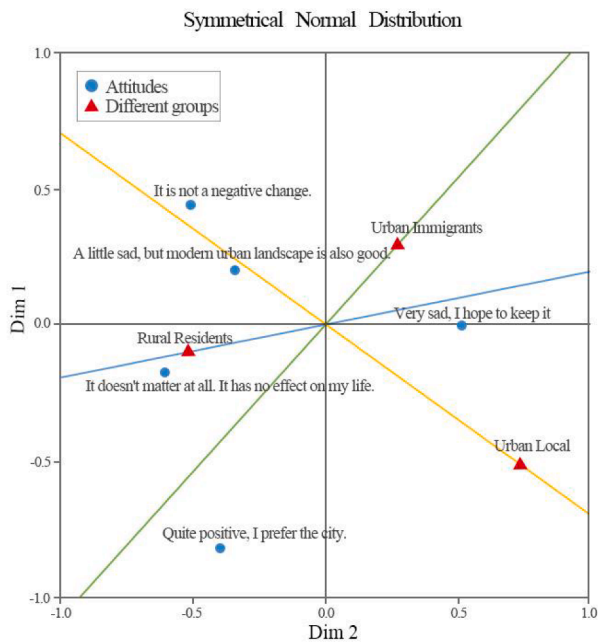
Fig. 3. The importance-evaluation of pondscape in the ecosystem and human health.

of urbanization. They believed that only a tiny part of pondscape were being retained and transformed into leisure and recreation spaces. According to the statistical results of the questionnaire, 57 % of urban respondents indicated that they often saw abandoned pondscape, 45 % of urban respondents expressed that they often saw filled-in pondscape, and 82 % of interviewees never had or only rarely saw a preserved pondscape. Thus, the public perceived pondscape being abandoned and deteriorated, reflecting a potential conflict between current urban development and natural resource protection.

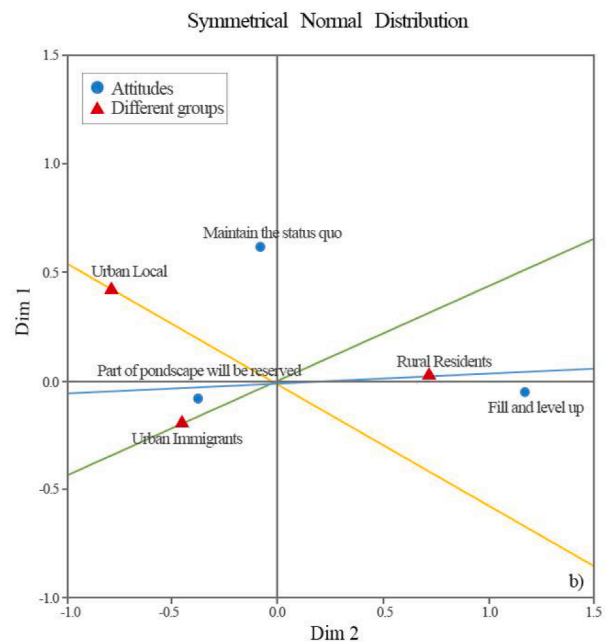
Overall, 50.13 % of interviewees were upset by abandoned or filled-in pondscape and hoped to preserve them. Additionally, 69.7 % of respondents said they hoped that pondscape would be retained,

redesigned, and partially reused in future urbanization. Thus, the public apparently wants to preserve or increase pondscape ES in local areas.

However, different groups had different attitudes towards the abandonment of pondscape (Fig. 4a). Most urban locals did not perceive any issues, and had stronger preferences for the urban landscape. Urban immigrants either believed it did not matter at all or were quite positive about it. Rural residents showed a contrast between feeling very sad or being completely indifferent. As for pondscape reconstruction, the attitudes of the three groups overall are consistent; namely, that partial rebuilding is needed (Fig. 4b). However, among rural residents, there were some contradictory attitudes; many wanted pondscape to be filled-in and levelled. This may be explained by a lack of understanding



a) Attitudes towards abandoned pondscape



b) Attitudes towards pondscape reconstruction

Fig. 4. Attitudes of different groups towards abandoned pondscape and pondscape reconstruction.

of pondscapes and the ES they provide; it could also reflect a yearning among rural residents for a modern and urbanized landscape. Thus, urban residents tend to want to maintain pondscapes, while some rural residents do not care about maintaining them.

3.4. RQ3: Preferences for different pondscape types in future land use scenarios

Regarding RQ3, as shown in Fig. 5, for all land use scenarios, rural residents liked artificial waterscapes most, natural waterscapes, grassy areas without ponds, and paved areas. The results here also highlight that urban and rural residents partially differ in their perceptions of how pondscapes should fit into future urbanization projects and land use scenarios. While all three groups generally preferred artificial waterscape scenarios, urban immigrants and rural residents liked natural waterscapes more than urban locals. In contrast, rural residents liked paved areas more than urban residents.

There were also differences relating to land use scenarios. For public gardens, all groups strongly preferred natural waterscapes over other land use types. For residential areas, all groups indicated a weaker preference for paved areas. However, there were no significant differences in the preferences of the three groups for artificial waterscapes and grassy areas without ponds in any of the land use types. This suggests that the three groups yearn for a landscape falling somewhere between








modernization and tradition: a transitional landscape. This also shows that urban and rural residents prefer a win-win solution considering ecological and human health.

4. Discussion

4.1. Urbanization influences the public's perception of traditional pondscapes

Our study found that people with different urbanization backgrounds have different attitudes and preferences towards traditional pondscapes. Compared with rural residents, urban locals and urban immigrants pay more attention to pondscapes' impact on human health and would prefer to maintain them. Thus, agricultural background significantly impacts landscape perception (van den Berg et al., 1998). Consistent with our research, a previous study found that farmers tend to have a strong aesthetic preference for a well-managed environment (Rogge et al., 2007). Thus, rural residents preferred paved areas more than urban residents.

Urbanization significantly impacts the public's perception of traditional pondscapes from various perspectives. First, urbanization has changed traditional landscapes, which shapes people's perceptions. In our study context, as Jiang (2016) revealed, from 1988 to 2012, the number of ponds was reduced by 60.19 %, and the area was decreased

Ecosystem Health		Human Health		
	Natural Waterscapes	Artificial Waterscapes	Grassy Areas without Ponds	Paved Areas
Industrial Area				
Urban Locals	3.57	4.29	3.76	3.16
Urban Immigrants	4.04	4.29	3.75	3.25
Rural Residents	3.97	4.18	3.86	3.76
P Value	0.00**	0.39	0.55	0.00**
Residential Area				
Urban Locals	3.47	4.2	3.67	3.35
Urban Immigrants	3.97	4.32	3.65	3.4
Rural Residents	3.82	4.26	3.82	3.59
P Value	0.01*	0.81	0.16	0.08
Public Garden				
Urban Locals	4.2	4.1	3.73	3.2
Urban Immigrants	4.07	4.31	3.77	3.29
Rural Residents	4.08	4.24	3.87	3.6
P Value	0.64	0.15	0.48	0.00**

Note: *P<0.05; **P<0.01.

Fig. 5. The public's preferred pondscape design in the future.

by 89.29 % (Table 1); this change in landscape likely transformed people's perceptions. Second, urbanization has affected the position from which people perceive the landscape. The shift from rural to urban residence has changed environmental value orientations and affected people's cognition of the traditional landscape. Third, the variety of land use scenarios in urbanization also affects public perceptions of the appropriate use of ponds. For example, urban locals preferred natural waterscapes in the context of parkland. However, rural residents and urban immigrants preferred artificial waterscapes.

4.2. Pondscales' functions in ecosystem health and human health

The three resident groups all thought pondscales were essential to stormwater regulation, crop production, fish production, and leisure and recreation. Thus, the advancement of urbanization, the transformation of agriculture in mountainous areas, and the development of rural tourism have all decreased the perceived importance of the irrigation function of pondscales and increased the importance of fish production and leisure and recreation (Jiang, 2016; Fu et al., 2018). Meanwhile, although pondscales have various functions, rural residents did not consider them essential to ecosystem health. In our study, rural residents considered crop production and irrigation provided by pondscales as the most important ES. In one study, farmers believed that the production provided by carp ponds is their most important function; another service they valued highly was biodiversity protection (Turkowski, 2021).

Urban locals and urban immigrants rated the importance of water purification, groundwater recharge, and wildlife habitat higher than rural residents. They also rated the overall importance of pondscales for ecosystem health and human health higher. Overall, urban residents paid more attention to the important role of pondscales in ecosystem health. In contrast, rural residents seemed to be unaware of the importance of these traditional local landscapes. Meanwhile, urban immigrants and rural residents paid more attention to the material benefits of the pondscape, such as irrigation, compared to urban locals.

Furthermore, urban residents paid more attention to spiritual and leisure values, especially vernacular landscapes, social activities, spirituality, etc. This result is inconsistent with existing research conclusions. For example, respondents in rural areas of Yantai, Shandong Province, used freshwater ES more frequently and were more willing to pay for the protection of ES (Pan et al., 2016). A study in the Yanhe River Basin showed that rural residents gave higher importance to flood control and aesthetic ES than urban residents (Yang et al., 2019). Meanwhile, due to having a less direct connection with the ecosystem, urban residents along the coast of the Solomon Islands paid less attention to the ecosystem than rural residents (Lapointe et al., 2020).

Many studies have shown that pondscales play an essential role in both urban and rural areas (Briggs et al., 2019; Oertli and Parris, 2019). For example, maintaining the diversity and heterogeneity of pondscales is crucial in protecting the variety of aquatic insects (Charl et al., 2018). Therefore, it is essential to enhance rural residents' understanding of the importance of pondscape ES to improve regional ecological functions and promote the ecological transformation of pondscales. To ensure the future protection and utilization of pondscales, we should strengthen their functions for human health, such as aesthetics, leisure, and entertainment, to meet the needs of urban residents. At the same time, rural residents should be made aware of the importance of pondscales as a local landscape and play a participatory protection role at all social levels. In summary, the present research on the perceptions of different groups can provide a significant scientific basis for local governments' management and policy decision-making.

4.3. Implications for pondscape governance

Many ponds in southern China provide hydrological, biogeochemical, and socioeconomic benefits. However, they lack construction and

protection regulations, rural nonpoint source pollution, and invasive species. The insufficient social and political awareness of ecological protection threatens the ponds' capacity to provide ES (Chen et al., 2019). Due to weak environmental management, the ponds' economic value and ecological functions are in decline (Fu et al., 2018; Chen et al., 2019). Nowadays, rural land management must no longer merely aim to produce economic benefits—it needs to meet the multi-functional needs of society, including non-commercial benefits such as entertainment and quality of life and ensuring biodiversity and ES (Ruskule et al., 2013). Therefore, it is necessary to carry out ecological management of ponds in alignment with the social changes occurring in mountainous areas and promote the protection and utilization of ponds (Fu et al., 2018; Yu, 2021). In the protection process, we should thoroughly investigate public awareness and adopt the policy of combining top-down supervision and bottom-up participation to promote the sustainable development of pondscales (Chen et al., 2019).

There is considerable potential to combine pondscales with stormwater management facilities in future urbanization processes. As wetland complexes, the ecological functions of pondscales are embedded or integrated into a larger ecosystem (Yu et al., 2015; Chen et al., 2019). Consequently, the protection of pondscales should not only consider the management of a single pond but also pay attention to the management at the watershed and regional scale (Briggs et al., 2019; Chen et al., 2019; Yu, 2021). In the future, pondscape protection and utilization should apply to the watershed, city, and fields. Considering the spatial planning of pondscales in the watershed, this can comprise spongy units consisting of a spongy watershed. To ensure stormwater regulation by small bodies of water in the urban area, the "water area rate of the pond" should be considered and integrated into the spongy city evaluation system. Furthermore, in rural areas, gullies, paddy fields, ponds, rivers, and ditches should be identified and saved as water ecological infrastructure to help regulate stormwater. As a connection between grey and green infrastructure, pondscales can form open spaces in urban areas that can maintain ecosystem health and contribute to human wellbeing. At the same time, local factors such as design, water quality, hydro-period, biotic characteristics, population density, and impervious surfaces should be considered to avoid undermining ES (Oertli and Parris, 2019). Ecological design and maintenance should be strengthened on the field scale to improve source management capacity. Furthermore, maintaining a series of ponds with different water level fluctuations and naturally diverse marginal vegetation can significantly promote the diversity of local and regional aquatic insect communities (Jooste et al., 2020). In addition, the future development of pondscales should also consider the public's aesthetic preferences and meet people's needs in various domains (Sun et al., 2013).

4.4. Limitations of our study

Despite its contributions, our study has some limitations that should be mentioned. First, in the process of random sampling, 51.33 % of the respondents had rural household registration, which was higher than that in 2015 (when the study was conducted), when the rural population of Chongqing accounted for 39.06 % of the resident population. Thus, clarifying whether this led to bias in the responses is necessary. Furthermore, the sample size was potentially slightly small. In the future, if possible, increasing the sample size may provide more accurate results and facilitate more sophisticated statistical analyses. Second, the results may be affected by factors such as the respondents' occupation, age, and education level. The study did not analyse the impact of these factors on the perceptions and preferences of the three groups; this deserves more attention in the future. In addition, this study only considered the public's perceptions of pondscales and did not consider experts' opinions. In the future, this study could be complemented by a survey of experts and scholars. In addition, in the mountainous areas of China, there are abundant ponds and pondscales. Thus, in the future, comparative studies between regions should be conducted.

5. Conclusions

The study aimed to reveal the potential influence of urbanization on residents' perceptions of the ES provided by traditional ponds. Our results confirmed the research hypothesis that people with different urbanization backgrounds have different perceptions. For example, while rural residents, urban immigrants, and urban locals rated the ecosystem health aspects of ponds as equally important, they differed in their ratings on human health; urban residents thought ponds had more significant impacts on human health. There were also some differences in the public's attitude towards the abandonment of ponds, while attitudes were consistent with respect to pond reconstruction (partial rebuilding was supported). With respect to future pond applications, the three groups yearned for a transitional landscape represented by artificial waterscapes, a win-win solution that combines ecological and human health.

In summary, traditional multifunctional landscapes face many challenges in the rapidly urbanizing world. The government-led top-down urbanization has brought damage to rural landscapes, and ES and multifunctional traditional landscapes have also been seriously affected. More understanding of public perceptions may contribute to protecting and developing traditional multifunctional landscapes. Research investigating local residents' perceptions can help contribute to establishing a more bottom-up perspective. Therefore, different groups' social attributes and demographic characteristics should be fully considered when studying public perceptions of traditional landscapes. Finally, there are some related problems that deserve further study: how to use participatory methods to integrate public attitudes into planning policies, design schemes, and landscape management; how to maximize the ecological and social value of multifunctional landscapes; and how to coordinate the protection and utilization of traditional landscapes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ecoser.2023.101521>.

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