An aesthetic value of livable river space index methodology for examining recreational urban rivers

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Abstract. While increasing various water-land use index methodologies are being offered to the issue of river management in urban fluvial areas, yet there is a relative lack of research study examining the aesthetic value of livable river space index methodology for recreational purpose in context of urban river management. This research intends to offer a comprehensive methodology related to the aesthetic value of livable river space index within the framework of the river management paradigm. Since aesthetic value is closely linked to human visual preferences, the offered method of this study is used the combination of rapid appraisal of land use types and GIS-based method that analyzing certain famous recreational river area, that is Love River, Kaoshiung City in Taiwan as study area. The final contribution of study was also attempted to provide an effective solution to identify and evaluate the problems by designing a conceptual framework of an aesthetic value of livable river space index methodology for examining recreational urban rivers.

1 Introduction

Urban rivers play a crucial role in the context of regenerative livable built environment of cities by providing not only water availability benefit but also ecological, recreational, and aesthetic benefits within [1-4]. However, many urban rivers worldwide are facing significant challenges and issues due to the impacts of urbanization [5-7]. The degraded condition of urban rivers is a results of the water-land use relationship that affects many livable aspects surrounding riverfront area [8]. While increasing various water-land use index methodologies are being offered to the issue of river management in urban riverfront areas, yet there is a relative lack of research study examining the aesthetic value of livable river space index methodology for recreational purpose in context of urban river management [9]. This research intends to offer a comprehensive methodology related to the aesthetic value of livable river space index within the framework of the river management paradigm.

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Nowadays, it is necessary to consider the livable space in urban area [10,11]. As the urban area develops, the demand for sustainable and livable urban spaces increases, necessitating a systematic approach to evaluate and improve riverfront environments.

2 The importance of aesthetic value for recreational urban rivers

Rivers that flow through urban areas often have conditions that deteriorate over time along with the surrounding riverfront area. However, many countries want to designate the river as a recreational area with tourist attractions within its boundaries. The degraded urban rivers posing risks to both ecosystems and human health and related with ecological and hydrological functions. Beyond that, aesthetic value of urban rivers significantly contributes to recreational appeal, social well-being, and economic vitality. Therefore, aesthetic value for recreational urban rivers is crucial with several considerations such as the enrichment of public well-being and mental health by scenic water views, lush greenery, and well-designed riverfronts provide psychological relief from urban stress. Many previous studies indicated that aesthetically pleasing natural environments reduce anxiety and improve mood, encouraging outdoor activities like walking, cycling, fishing, climbing and/or even picnicking. Moreover, attractive landscapes with clean water, artistic bridges, and pedestrian-friendly pathways invite more visitors or tourism activities within. The other features like natural landscaping (trees, flowers beds, garden) and artificial landscaping (public art, sculptures, murals, lighting, seating, decorative installations) also can enhance the aesthetic value of urban rivers. Beautifully designed riverfronts combined with local art and heritage into river design preserves historical significance while attracting tourism. Thus, it reinforces livable urban rivers.

3 Study area

This study used data from satellite imagery which are freely available from sources such as Landsat, Google Earth Engine or open-source GIS software that can be used to classify land cover into categories especially in riverfront areas. Secondary data also can be collected from certain government agencies (national and/or regional) that have land-use maps available online or through data portals. The location of study area is Ai River or Love River, Kaoshiung City, Taiwan (Figure 1). Since various land use types surrounded this river are consisted of residential, commercial, recreational and cultural areas, Love River is a vital river for tourism and economic activities (Figure 2). Recent years, modern buildings changes in land use types have been increasingly affected by anthropogenic activities in this residential as well as commercial areas. The banks of the Love River provides a mix of urban living, scenic views, parks, recreational spaces, historical sites, green spaces and waterfront walkways. It offers opportunities for residents, locals, visitors or tourists to doing some activities such as outdoor activities, jogging, cycling, or just simply enjoying the scenic views of the river. The other function of the presence of open areas and/or green spaces are to contribute a better life-living quality and environment as well as to promote the sustainable urban development for surrounded river areas.

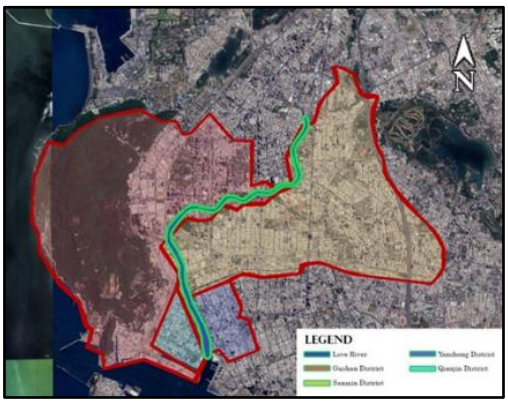

Fig. 1. Location of study area.

Fig. 2. Several location of Love River.

4 Result and discussion: Developing methodology

There are several important stages to develop the aesthetic value of livable river space index methodology for examining recreational urban rivers:

1. Defining important parameters: this stage should consider many aspects such as visual quality (scenic views, water clarity, greenery), design & artistry (public art, architectural bridges, lighting), natural elements (biodiversity, vegetation, water features), human comfort & accessibility (walkability, seating, shade), cultural & historical significance (heritage integration, local identity)
2. Data collection: this stage will offer several methods such as field surveys & photographic analysis (assessing visual appeal through image-based scoring), public perception surveys (gathering community feedback on beauty, safety, and enjoyment), expert evaluations (urban planners, landscape architects, and ecologists rating design and ecological harmony), GIS & remote sensing (mapping greenery, water quality, and accessibility).
3. Quantitative and qualitative methods:

Table 1. Offered quantitative and qualitative methods.

Category	Metrics	Measurement Scale
Visual Appeal/Visibility	Water clarity, landscape diversity	1-5 (Likert scale)
Attractiveness	Presence of sculptures, lighting quality	1-5 (Expert rating)
Scenic Beauty	Vegetation covered type, animal species diversity	Ecological indices
Amenities	Seating availability, pedestrian flow	Observational counts
Cultural Value	Historical landmarks, community events	Survey-based scoring

4. Weighting and scoring system: Different parameters may carry varying importance (e.g., water clarity might be more critical than decorative lighting) and Analytic Hierarchy Process (AHP) can help assign weights based on expert and public input.
5. Selecting appropriate analysis combined with GIS-based method: in order to develop an index, first it is important to identify and select certain land use types should be included in the developing index. Spatial data should be performed by spatial analysis that reveal the geometric or geographic properties of data. Spatial data could use a computational model such as Geographic Information System (GIS)-based model. This study proposed the rapid advancement of ArcGIS combined with Google-Earth software in spatial analyses of land use types and if necessary, validate the data by doing field survey measurements
6. Index map and classification: after step 4 and 5, the scores should be based on the relative importance of each parameters regarding the level or weight of importance. Numerically, the index can be represented as:

$$\text{Livable River Space Index} = \sum_{i=1}^{n} w_i C_i \quad (1)$$

Where w_i was the average weight factor for the ith land use type, and C_i was the standardized sub-index for each parameter. Each quality value was then multiplied by an average weight factor, to take into account the relative contribution of each parameter type to the overall index.

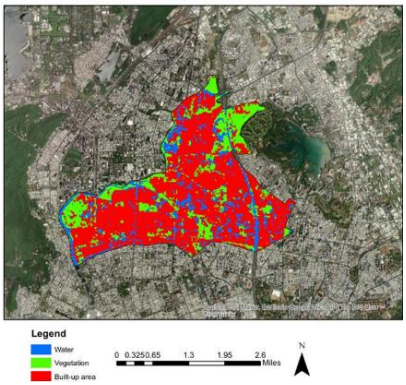

Fig. 3. Analysis of land use types at study area in 2023 by using GIS.

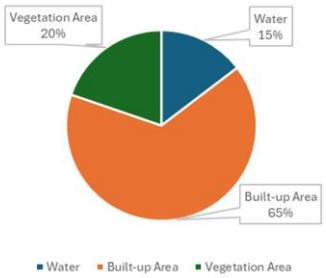

Fig. 4. Distribution of land use types at study area in 2023.

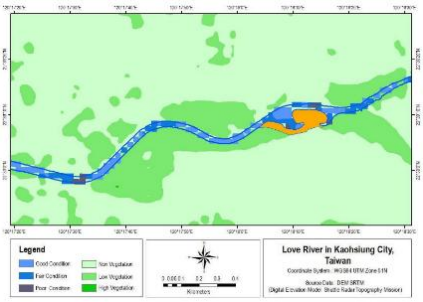

Fig. 5. Map of water quality condition at study area.

The livable river space index offers a structured, interdisciplinary methodology to evaluating and enhancing urban rivers. By integrating aesthetics, recreation, and sustainability, it supports the creation of vibrant, people-centric waterfronts that elevate urban living standards. The conceptual framework methodology for recreational urban rivers.

5 Conclusion and recommendation

Aesthetic value transforms urban rivers from mere waterways into vibrant recreational hubs that improve quality of life, foster community engagement, and drive sustainable urban development. Cities that prioritize beauty alongside urban rivers enhance lasting social, economic, and environmental benefits. However, many urban rivers have experiences in water pollution, poor accessibility, and unattractive design, diminishing their potential as livable spaces. The livable river space index emerges as a methodological framework

designed to assess the aesthetic and recreational value of urban rivers, ensuring they contribute positively to urban well-being. The final contribution of study was also attempted to provide an effective solution to identify and evaluate the problems by designing a conceptual framework of an aesthetic value of livable river space index methodology for examining recreational urban rivers. This methodology also helps urban planners, policymakers, and designers quantify and improve aesthetic value in many aspects. Early warning system due to climate change and water quality issues should be developed as well as community engagement or public awareness for enhanced livability and sustainability urban rivers.

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