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DEVELOPING A SUSTAINABLE URBAN RIVERFRONT LANDSCAPE: PLANNING AND DESIGN STRATEGIES FOR AL-ADHAMIYAH AND AL-KADHIMIYAH IN BAGHDAD

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ABSTRACT

Baghdad's Tigris River, once a defining feature of the city's identity, is now disconnected from the urban fabric due to fragmented land use, unplanned expansion, and environmental decline. This study addresses the lack of an integrated and sustainable planning framework for Baghdad's riverfront – focusing specifically on the Al-Adhamiyah and Al-Kadhimiyah districts. Using a three-tier analytical framework (design, planning, and environmental strategies), the research conducts a comparative spatial analysis of both areas and draws from global precedents such as the Sabarmati Riverfront (India) and Kansas Riverfront Revitalization (USA). Findings show that while Al-Kadhimiyah enjoys stronger spatial integration and investment potential, Al-Adhamiyah faces challenges of disjointed land use and limited public space. Based on this, the study proposes interconnected green corridors and enhanced river transport systems as localized strategies to re-integrate the Tigris into Baghdad's urban life. These interventions aim not only to restore ecological and social connectivity, but also to transform the riverfront into a dynamic and inclusive urban landscape.

Keywords: urban riverfront, Tigris River, sustainable urban planning, riverfront design strategies, urban integration with the river, environmental sustainability

INTRODUCTION

Urban riverfronts play a vital role in shaping the identity and development of cities. They significantly enhance quality of life, support economic activity, and promote sustainable urban development. Baghdad, a city historically defined by the Tigris River, is a prime example of a place whose urban form and character were closely tied to a central waterway. However, in recent decades, weak urban planning, deteriorating infrastructure, and environmental decline have eroded the river's role as a vibrant and active public space. Today, the Tigris Riverfront in Baghdad faces numerous challenges, including the absence of a cohesive planning strategy, uncontrolled urban sprawl, and a lack of accessible public areas – factors

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that have collectively diminished the river's ecological, recreational, and economic significance. This study investigates the Tigris Riverfront in Baghdad by building a theoretical framework grounded in core concepts of urban design and sustainable landscape planning. It then evaluates the river's current condition and draws insights from successful international examples, such as the Sabarmati Riverfront project in India and the Kansas River revitalization in the United States, to extract practical strategies applicable in the local context. The research focuses on land use analysis in two key districts – Al-Adhamiyah and Al-Kadhimiyah – and assesses the effectiveness of planning, design, and environmental interventions using a three-tiered evaluation model that measures the degree of integration between the river and the surrounding urban fabric. The study also proposes practical solutions, including design strategies for rehabilitating the riverfront, planning approaches to reconnect the city with the river, and environmental measures to enhance water quality and safeguard the riverbanks. Ultimately, the research highlights the importance of adopting a multidimensional approach that blends urban design, sustainable planning, and ecological thinking to ensure the long-term vitality of the Tigris Riverfront and restore its role as a dynamic urban asset. This research addresses the absence of an integrated and sustainable planning framework for the Tigris Riverfront in Baghdad, particularly in the historically and socially significant districts of Al-Adhamiyah and Al-Kadhimiyah. Despite the river's centrality to the city's identity, uncoordinated development and the lack of river-oriented urban design have weakened the interface between the river and the surrounding city. Therefore, this study addresses the following research question: How can the integration between the Tigris River and its adjacent urban fabric be improved through sustainable planning and design strategies? In answering this question, the research adopts a context-sensitive approach that draws from global best practices to inform localized urban regeneration efforts.

URBAN LANDSCAPE DEFINITION AND ITS COMPONENTS

The urban landscape is a complex system composed of physical, visual, social, and cultural elements, whose interaction contributes to shaping the identity of the city and the experiences of its users. Kevin Lynch (2015) defines it as the mental image formed in the minds of inhabitants through elements such as paths, landmarks, and nodes. Gordon Cullen (2012) on the other hand, focuses on the dynamic visual dimension through his concept of "serial vision." Norberg-Schulz (1980) adds the cultural dimension, emphasizing the relationship between the landscape and its historical and contextual meaning. Jan Gehl (2022) highlights the human dimension and social interaction as key in forming the urban experience. In addition, Carmona (2021) stress that the urban landscape is the outcome of the integration of planning, design, and community activities, making it a framework for achieving sustainability. In recent urban theory, evolving planning concepts such as "planning flexibility" and "adaptive models" are increasingly emphasized as essential tools for shaping responsive, future-proof urban identities that can accommodate change and uncertainty. Thus, the urban landscape consists of planning elements (Lynch, 2015), visual elements (Cullen, 2012), interactive/human elements (Gehl, 2022), and complementary details (Norberg-Schulz, 1980), all working together to build a harmonious urban environment.

Application to the Tigris Riverfront in Baghdad

Urban landscape theories emphasize the necessity of reconnecting cities with their rivers, a principle that directly applies to the Tigris Riverfront in Baghdad. Kevin Lynch's theory on spatial legibility sheds light on the weak visual orientation along the river, while Gordon Cullen's concept of serial vision reveals the fragmented and disjointed visual experience, particularly between Adhamiyah and Kadhimiyah. Additionally, Norberg-Schulz highlights the

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Table 1. Urban Landscape Components According to Previous Studies

Main Component	Sub-elements	Scientific Interpretation
Planning Elements	Paths, districts, nodes, landmarks	Define the general structure of movement and spatial organization in cities (Lynch, 2015) (Spreiregen, 1965)
Visual Elements	Skyline, façades, colors	Influence visual perception and the sensory experience of urban spaces (Cullen, 2012)
Human Elements	Activities, pedestrian flow, interaction	Reinforce identity and social belonging through public spaces (Gehl, 2022) (Carmona, 2021)
Complementary Elements	Nature, monuments, detailed planning	Add artistic and cultural character to the space and contribute to uniqueness (Singh & Norberg-Schulz, 1980)

Source: Researcher.

overlooked relationship between historical landmarks and the riverfront, and Jan Gehl underscores the absence of interactive public spaces as a major limitation to urban vitality.

Complementing these theoretical perspectives, local studies further contextualize these issues within Baghdad's specific urban fabric. Ecological design strategies implemented in areas such as Abu Nuwas have shown potential in promoting sustainable redevelopment and environmental integration (Khauin & Al-Alwan, 2020). Moreover, the role of spatial identity is vital in shaping Baghdad's historic riverfront, contributing to the preservation of cultural memory and urban continuity (Al-Ani, 2014; Farhan et al., 2025). The application of design criteria also plays a significant role in enhancing the coherence and aesthetic quality of riverfront facades, which are key to reinforcing the visual and functional relationship between the city and the river (Al-Hankawi & Khalaf, 2016). Together, these theoretical insights and local findings, summarized in Table 1, offer a comprehensive framework for diagnosing current deficiencies and guiding context-sensitive interventions along the Tigris River.

DEFINITION AND COMPONENTS OF URBAN RIVERFRONT LANDSCAPE

The urban riverfront landscape is a multidimensional spatial system that integrates physical, urban, and visual elements, shaping the identity and function of river-adjacent city areas. It is defined as the urban space that emerges around rivers within cities, encompassing the infrastructure, activities, and aesthetic experiences linked to the river (Carmona, 2021; Lynch, 2015). According to Lynch (2015), rivers serve as structural and visual references, while Cullen (2012) emphasizes their dynamic visual role through serial vision. Norberg-Schulz (1980) adds the cultural and place-based significance of riverfronts, and Gehl (2022) highlights their function in enhancing livability and public interaction. These components work collectively to transform riverfronts into sustainable and vibrant urban destinations. Table 2 below summarizes the key elements that constitute the urban riverfront landscape.

To build upon this theoretical understanding, the following section presents practical strategies that translate these components into actionable urban interventions. These strategies serve as tools for enhancing river-city integration through design innovation, flexible planning, and sustainable environmental solutions. In this study, the urban riverfront landscape will be evaluated through physical, visual, and socio-functional indicators derived from these theories. This approach provides a structured framework for analyzing the spatial relationship between the river and the urban fabric in Baghdad.

To consolidate the theoretical findings presented in Sections 2 and 3**,** Fig. 1 illustrates the integration between urban riverfront landscape components and broader urban landscape elements. The diagram highlights how visual (e.g., riverfront facades and lighting), human (e.g., public services and activities), and planning aspects (e.g., connecting corridors and

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Table 2. Components of Urban Riverfront Landscape

Main Category	Sub-elements	Scientific Interpretation
Physical Elements	River channel and morphology	Water flow, terrain, and geomorphological influence on riverform
	Riverbanks and riverfronts	Transitional zones between city and river, ranging from natural to urbanized
	Bridges, ports, and waterways	Infrastructure enabling river crossing and navigation
	Open spaces and green areas	Parks and landscapes that improve urban environmental quality
Urban Elements	Buildings and riverfront skyline	Architectural rhythm and height shaping riverfront identity
	Land use along the riverfront	Residential, commercial, and recreational activities with balanced sustainability
	Urban design and riverfront integration	Pedestrian access, public spaces, and seamless visual integration into the city fabric
Visual & Aesthetic Elements	Visual perception and river perspective	User experience shaped by dynamic sequential views and open river vistas
	Lighting and riverfront perception	Night and interactive lighting enhance attractiveness and public engagement
	Public art and sculptures	Cultural symbols reinforcing identity and creating interactive visual landmarks

Source: Researcher.

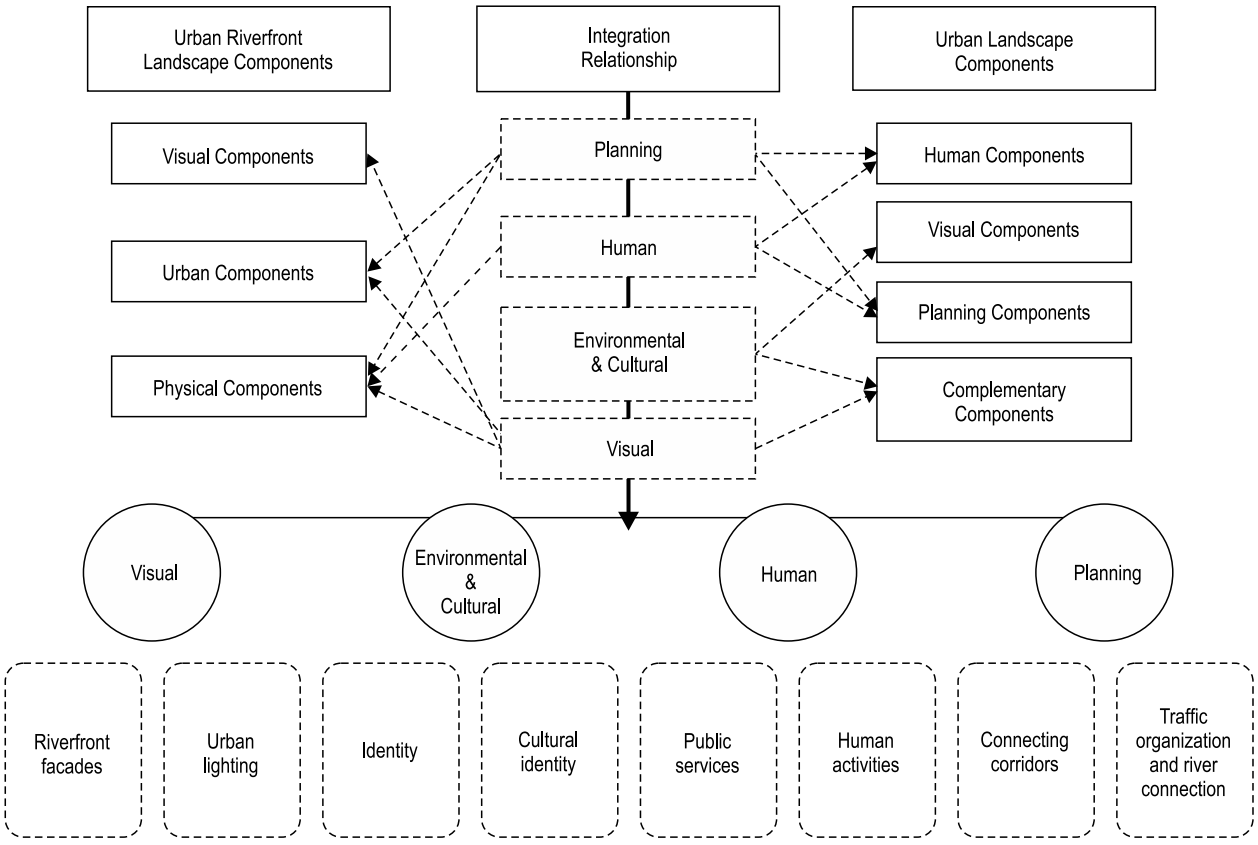

Fig. 1. Framework of Integration Between Urban Riverfront Landscape and Urban Landscape Components
Source: Researcher.

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traffic organization) intersect between the riverfront and the city. At the core of this integration lies the environmental and cultural layer, serving as a central axis that aligns spatial identity and functional interaction. This framework provides the basis for evaluating the river–city interface in Baghdad.

SUSTAINABLE URBAN RIVERFRONT LANDSCAPE DESIGN STRATEGIES

Sustainable urban riverfront development strategies focus on achieving a balance between urban growth and the preservation of environmental and cultural identity. These strategies fall into three main categories: design, planning, and environmental solutions. Design strategies focus on revitalizing riverfronts through the rehabilitation of river-facing facades, creating walkways and bike paths, implementing smart lighting technologies, and designing interactive spaces for cultural activities (Carmona, 2021; Cullen, 2012; Gehl, 2022). Planning strategies emphasize integrating the river with public spaces, reusing land in line with ecological and economic needs, applying flexible planning approaches to adapt to climate change.

Table 3. Strategies for sustainable urban riverfront landscape development and their implementation mechanisms, adapted from previous studies

Main Strategy	Implementation Methods	Practical Example
	1. Design Strategies	
Revitalizing riverfront facades	– Create green areas – Repurpose abandoned industrial zones – Integrate natural elements	Redevelopment of the Seine Riverfront in Paris (Carmona, 2021; Cullen, 2012; Gehl, 2022)
Pedestrian & cycling paths	– Build walkways and bike lanes – Promote active mobility	Han River, Seoul: enhanced pedestrian & bike routes (Danilova, 2022; Unagaeva, 2012; Valencia & García, 2023)
Smart nighttime lighting	– Install LED systems – Use interactive/dynamic lighting	Thames R iver, London: smart LED lighting project (Carmona, 2021; Singh & Norberg-Schulz, 1980)
Cultural platforms on riverfront	– Provide seating and public event zones – Design open exhibition spaces	Danube Riverfront, Vienna: spaces for cultural events (Gehl, 2022; Lynch, 2015)
	2. Planning Strategies	
Integration with public spaces	– Connect neighborhoods and commercial areas with the river – Use bridges and open plazas	Cheonggyecheon River, Seoul: urban-river integration (Cullen, 2012)
Riverfront land reuse	– Redevelop unused/abandoned riverfronts – Create eco-commercial and tourism hubs	Hamburg Port: industrial-to-cultural transformation (Carmona, 2021; Valencia & García, 2023)
Flexible urban planning	– Design flood barriers – Use sustainable drainage – Create flood-absorbent zones	Danube flood management with adaptable infrastructure (Danilova, 2022; Singh & Norberg-Schulz, 1980)
Supportive urban policies	– Enact laws to protect riverfronts – Encourage community engagement	Amsterdam: riverfront protection through environmental policies (Gehl, 2022)
	3. Environmental Sustainability	
Ecological water purification	– Use constructed wetlands – Apply natural water filtration techniques	Cheonggyecheon, Seoul: water restoration using green purification (Unagaeva, 2012)
Enhancing riverbank vegetation	– Plant native trees – Create green areas to reduce erosion and pollution	Rhine River: urban forestation along riverbanks (Cullen, 2012; Valencia & García, 2023)
Renewable energy integration	– Install solar panels along river paths – Use river turbines for clean energy	Thames River: renewable energy projects (Danilova, 2022)

Source: Researcher.

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Planning flexibility refers to the capacity of urban planning systems to adapt to changing environmental, climatic, and socio-economic conditions. Adaptive models are planning approaches that support dynamic, responsive solutions tailored to context-specific challenges, allowing cities to adjust strategies over time and enacting supportive urban policies (Danilova, 2022; Valencia & García, 2023). Environmental solutions include improving water quality through natural purification systems, increasing vegetation along riverbanks, and incorporating renewable energy sources in riverfront infrastructure (Istiaque et al., 2018; Unagaeva, 2012).

CASE STUDIES OF RIVERFRONT CITIES

Reconnecting a Divided Urban Core through Riverfront Design in Topeka, Kansas

The Topeka Riverfront Project in Kansas represents a strategic urban redevelopment effort aimed at reestablishing the connection between North Topeka, downtown, and the Kansas River after years of disconnection due to levees, industrial growth, and infrastructure expansion. The project seeks to transform the neglected riverfront into an inclusive public space that promotes sustainability, enhances mobility, and restores the city's cultural and historical identity. Through rezoning and adaptive reuse of riverfront properties, the initiative focuses on introducing mixed-use developments, civic and commercial functions, and green spaces to reintegrate the river into the urban landscape. Special attention is given to revitalizing North Topeka, while planning efforts are underway to repurpose the industrial-dominated southern bank. The overall goal is to balance economic revitalization with sustainable planning, ensuring the riverfront becomes a central recreational, cultural, and economic feature within Topeka's urban fabric (Johnson, 2019).

Revitalizing the Sabarmati Riverfront: A Model for Sustainable Urban Waterfronts

Sabarmati Riverfront Development Project in Ahmedabad, India is a leading example of activating the urban riverbank through the rehabilitation of the neglected riverbank and their changes in a permanent urban environment that supports social, economic and environmental activities. Initiated in 2005 and officially inaugurated in 2012, the project covers 501.1 acres along a 55-kilometer stretch of the river. It focuses on land-use reorganization, a two-level riverside promenade, infrastructure upgrades, water treatment, and the construction of retaining walls to prevent flooding (Dempsey et al., 2020; Shah & Kunte, 2025; Simons et al., 2024). The project aims to connect the city with the river, improve the city's environmental quality, increase the tourism identity of the city and create a permanent place that supports social, cultural and economic works. Major challenges included informal settlements (more than 12,000 slums), sewage and contamination from industrial waste, insufficient infrastructure, disorganized land use (such as informal "Gujari" markets) and weak connection between the river on the width of the river. Important initiatives included repetition of land to create new urban locations, maintain walls to prevent erosion, redirect wastewater for wastewater treatment plants, improve the infrastructure of pedestrians and cycling, and develop public parks such as "flower garden" and "urban jungle". The project integrated financial activities such as the market and entertainment site to promote local tourism and support permanent economic development.

Strategies Implemented in the Project

The Sabarmati Riverfront project adopted a set of **planning, design, and environmental strategies** to transform the neglected riverbanks into a thriving urban space. These strategies are mentioned in Table 5.

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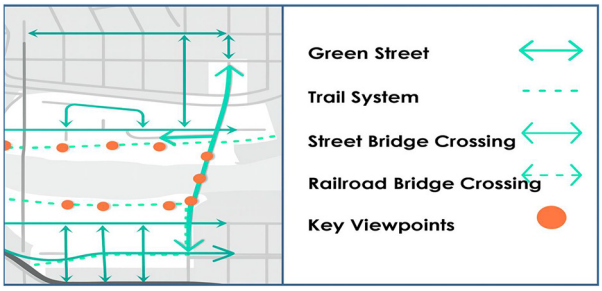
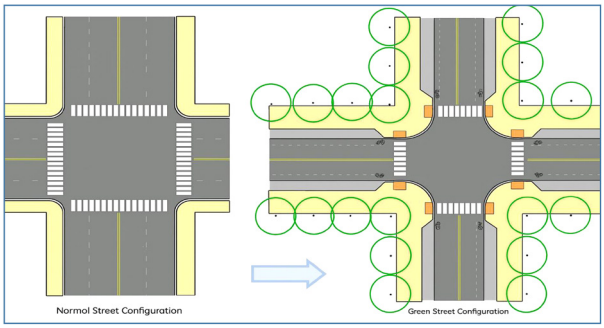
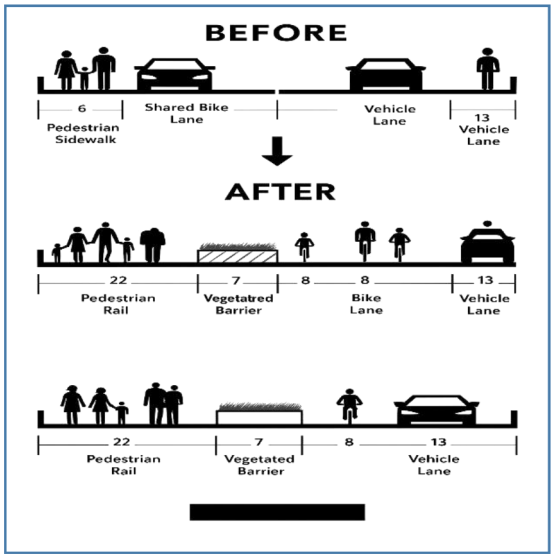
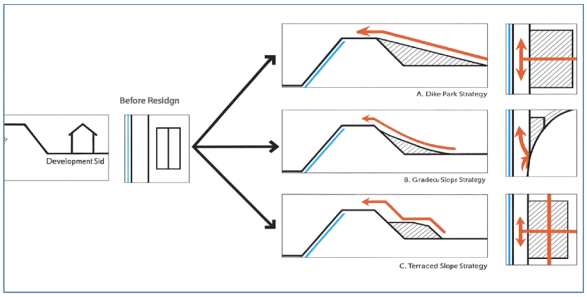
Table 4. Sustainable urban riverfront development strategies in Topeka, Kansas, adapted from previous urban planning and design literature

Strategy	Approach	Implementation Details
1. Adapting to Nature (Environmental)		
Creating a green network linking the riverfront to the city	Transforming streets into green pathways	Implementation Details Designing pedestrian-friendly green corridors that seamlessly connect the city with the river, enhancing urban-ecological integration. 
		Implementation Details Redesigning urban streets with added greenery, shaded walkways, and dedicated cycling lanes to support sustainable mobility. 
2. Sustainable Mobility (Planning)		
Prioritizing pedestrians and cyclists	Improving access to natural barriers like levees	Implementation Details Establishing safe and spacious walkways and bike lanes along the riverfront and bridges to encourage active transportation. 	Implementation Details Developing scenic trails and viewing platforms on levees to enhance connectivity and engagement with the river. 
3. Natural Environment (Environmental)		
Enhancing access to floodplains and interactive water zones		Designing adaptable spaces that respond to seasonal water level changes, allowing for immersive and interactive riverfront experiences.
4. Social Interaction (Planning)		
Establishing attraction points at street termini		Developing public spaces such as open markets, cultural hubs, and recreational zones at the ends of streets leading to the river to foster social vibrancy.

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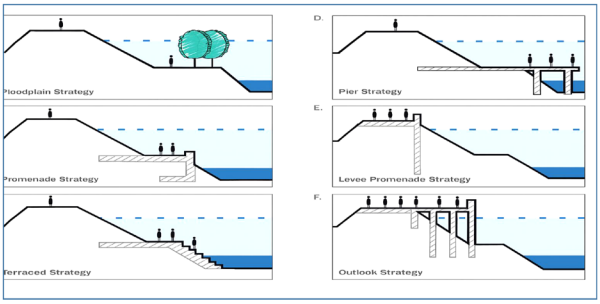
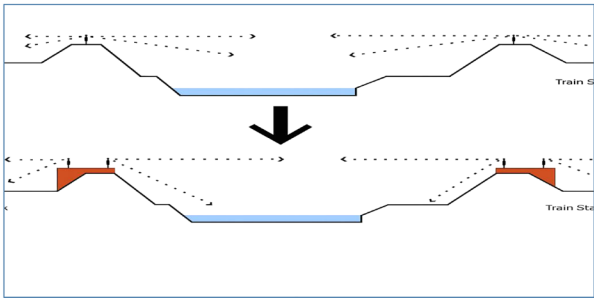
cont. Table 4



4. Eco-Friendly Design (Design)

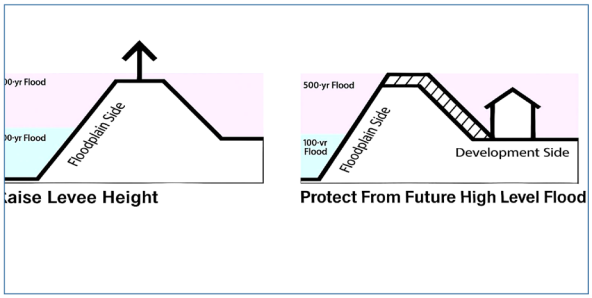
Creating designated viewpoints along levees

Introducing public seating and observation decks along levees to offer scenic river views and encourage community engagement.



Elevating levee heights to protect the city from flooding

Constructing levees that safeguard urban areas from floods while maintaining visual and physical connectivity with the rive

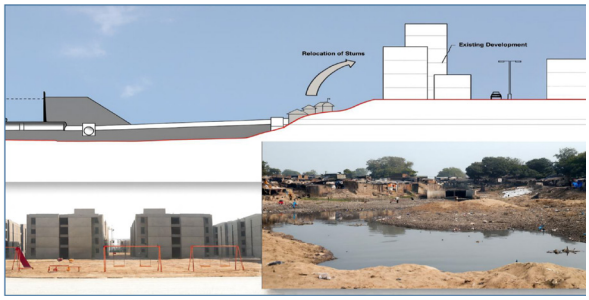


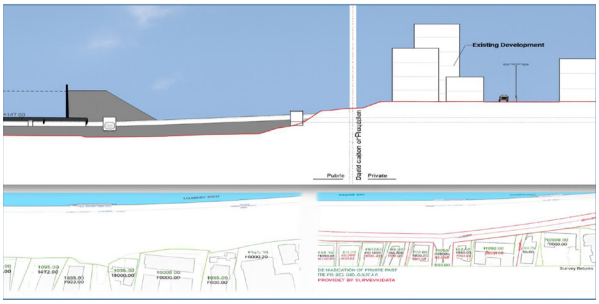
Source: adapted from Carmona (2021), Gehl (2022), Valencia & García (2023), Danilova (2022), and Cullen (2012).

To contextualize the strategies presented in Table 3, the global case studies of the Topeka Riverfront Project in Kansas and the Sabarmati Riverfront in Ahmedabad offer valuable practical insights. These projects demonstrate how cities have successfully addressed issues of river disconnection, informal development, poor accessibility, and ecological decline by applying integrated design, planning, and environmental strategies. For instance, Topeka's focus on reconnecting divided urban sectors

Table 5. Highlights Strategies for Sustainable Urban Riverfront Development: Planning, Design, and Environmental

Planning strategies	Description
Relocation Housing Residents from informal settlements along the river were relocated to newly developed housing, improving their living conditions and reducing unplanned urban sprawl.	Project Boundary Definition The project designated clear boundaries for development and redefined land use along both sides of the river to ensure efficient planning and optimal utilization of urban spaces





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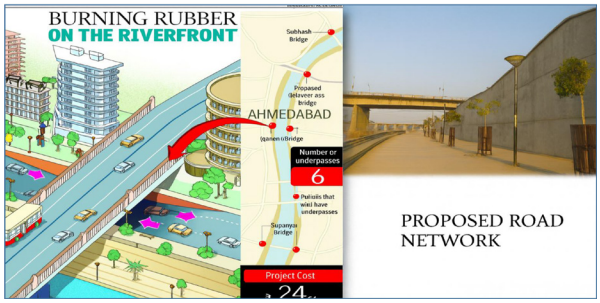
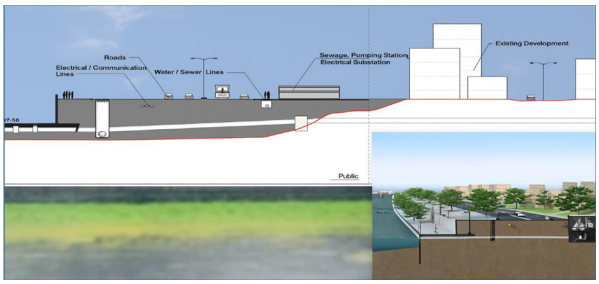
cont. Table 5

Proposed Road Network
New roadways and tunnels, such as West River Drive and East River Drive, were introduced to enhance traffic flow and reduce congestion in surrounding areas.

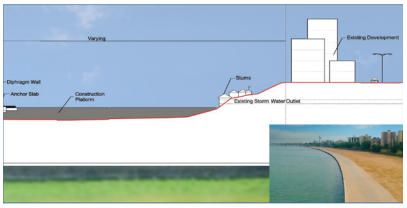


Infrastructure Development
Investment in essential infrastructure – including roads, electricity, sanitation, and communication networks – was prioritized to support sustainable growth and improve urban services.

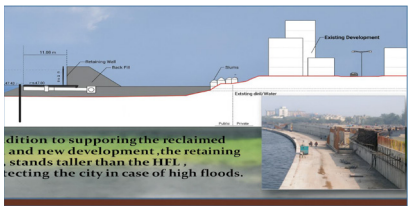


design strategies

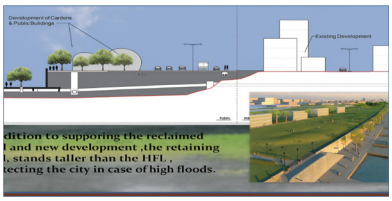
Lower Promenade
A continuous pedestrian and cycling path was built along the lower riverbank, ensuring direct access to the water while enhancing the user experience.



Retaining Walls
Concrete retaining walls were constructed to stabilize reclaimed land, protect new urban developments from flooding, and prevent soil erosion, ensuring long-term sustainability

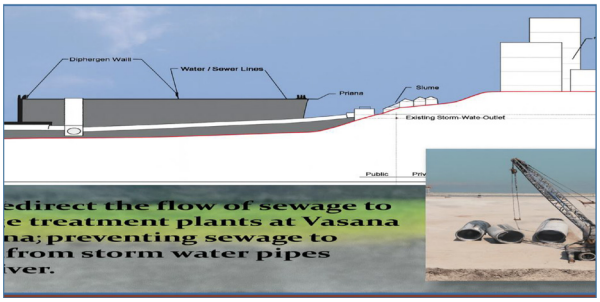


Gardens and Public Spaces
About 40% of the reclaimed land was dedicated to green spaces, including parks and recreational areas, to improve urban livability and promote ecological balance.

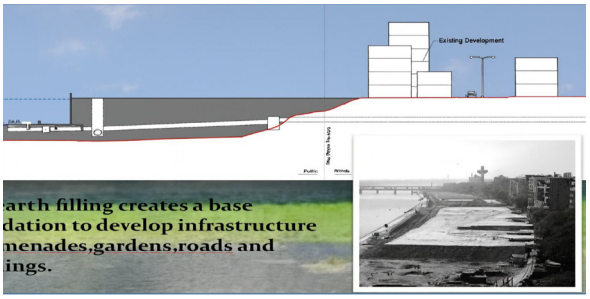


environmental strategies

Interceptor Sewers
A system of underground sewer channels was constructed to divert wastewater to treatment plants, effectively preventing river pollution and improving water quality



General Fill
Reclaimed land was used to support public amenities, infrastructure, and green spaces, contributing to a healthier urban environment and promoting sustainable land use.



Source: own elaboration based on Simons et al. (2024).

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through green corridors and pedestrian access parallels Baghdad's need to bridge gaps between the river and its surrounding neighborhoods. Similarly, Sabarmati's emphasis on land reclamation, boundary regulation, and ecological restoration provides a framework that could guide interventions along the Tigris. The summarized strategies in Table 3, therefore, serve as an adaptable reference for the local context of Al-Adhamiyah and Al-Kadhimiyah, allowing lessons from global best practices to inform sustainable urban riverfront development in Baghdad.

These two international case studies provide applicable models for Baghdad in areas such as land use restructuring, riverside promenade design, and flood mitigation infrastructure. However, their successful adaptation in Baghdad requires careful consideration of local political instability, socio-economic challenges, informal urban settlements, and infrastructure limitations. Tailoring these strategies to the unique conditions of Al-Adhamiyah and Al-Kadhimiyah is essential to ensure their long-term sustainability and relevance.

PRACTICAL STUDY

Implementing Riverfront Development Strategies for the Tigris River in Baghdad

The Tigris River has long played a central role in shaping Baghdad's urban identity since its founding in 762 AD, directly influencing land use patterns, street layouts, and the city's climate through its cooling effect (Abbas & Ebraheem, 2024). As illustrated in Fig. 2, the river's course has changed over time, while unplanned urban expansion has weakened its role in the city's spatial structure (Al-Attar, 2018). Today, the Tigris faces several challenges, including poor integration with surrounding areas, inappropriate land uses, and the lack of public spaces—factors that have diminished its connection with the city's residents (Al-Saffar, 2024). Drawing on successful global strategies such as the Sabarmati Riverfront project in India (Dempsey et al., 2020; Simons et al., 2024) and the Kansas Riverfront project in Topeka (Johnson, 2019). Baghdad's riverfront can be reactivated in a way that balances environmental, social, and economic development. Figure 3 shows the city's urban growth over 81 years, with the Tigris running 52.3 km through Baghdad, including key islands like Baghdad Island and Abu Rumaila Island (Al-Furat Center for Irrigation Projects Studies and Designs, 1999). The river is also subject to sedimentation and erosion due to flooding and fluctuating water levels, impacting the riverfront's dynamics. Figure 4 presents the results of a 2018 land-use survey (based on aerial imagery from 2007 and 2011), which revealed that 81% of Baghdad's municipal area is now urbanized. It also highlighted the disappearance of green belts and orchards, a decline in agricultural spaces, a rise in residential and commercial uses, and the deterioration of heritage areas. These findings underline the urgent need for integrated and sustainable planning to reactivate the Tigris as a vibrant urban core.

Applying Global Strategies to Baghdad's Riverfront

To bridge the gap between global practices and local implementation, this study adapts key strategies from the Sabarmati and Kansas riverfront projects to the Tigris River context. Inspired by Sabarmati's land-use restructuring and flood resilience measures,

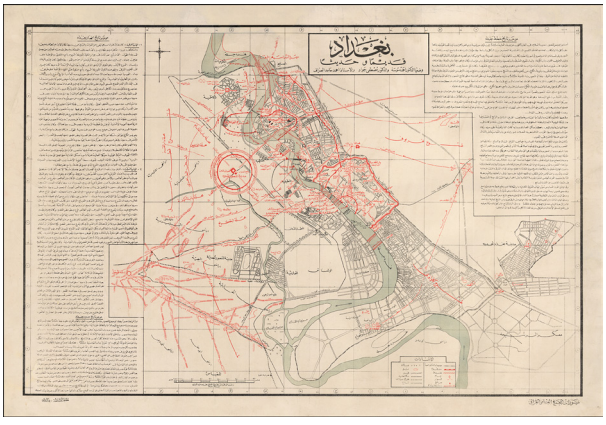

Fig. 2. The old and new courses of the Tigris River
Source: Adapted from Jawad & Susa, 1960.

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the research recommends re-zoning of informal riverside zones and constructing retaining walls in flood-prone areas of Baghdad. From Topeka, the study draws on the creation of green pedestrian corridors and interactive public nodes at street termini to improve accessibility and social engagement along the riverbanks. These strategies are particularly suitable for Al-Adhamiyah and Al-Kadhimiyah, where fragmented land use and limited green spaces require integrated interventions combining environmental, planning, and design solutions.

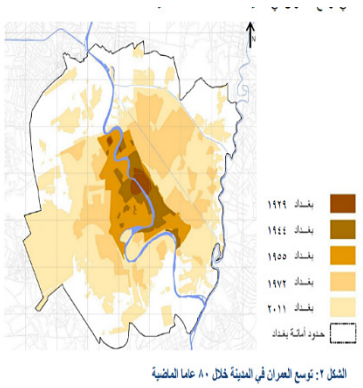

Fig. 3. The urban expansion of Baghdad over the past 80 years
Source: Baghdad Comprehensive Development Plan, Baghdad Mayoralty, 2015.

Diagnosing the Urban Riverfront Landscape of the Tigris River in Baghdad: A Case Study of Adhamiya and Kadhimiya

The Tigris River's urban landscape in Baghdad reflects a wide variety of land use types, ranging from recreational zones to administrative institutions and residential neighborhoods. As shown in Fig. 5, the riverfront can be divided according to the main bridges crossing the river, facilitating a better understanding of spatial variation. In the northern segment between Baghdad's entrance and Al-Muthanna Bridge (1–2), Baghdad Island emerges as a key recreational destination, offering diverse facilities including restaurants, pools, sports amenities, and green open spaces that enhance the river's tourism value (Al-Furat Center for Irrigation Projects Studies and Designs, 1999). Moving south to the area between Al-Muthanna Bridge and Al-A'imma Bridge (2–3), the riverbank along Al-Muheet Street in Al-Kadhimiyah features numerous cafes and social spaces, making it a notable recreational hub. In contrast, Al-Adhamiyah retains a quieter character, with orchards and some traditional buildings still present (Al-Furat Center for Irrigation Projects Studies and Designs, 1999). In the

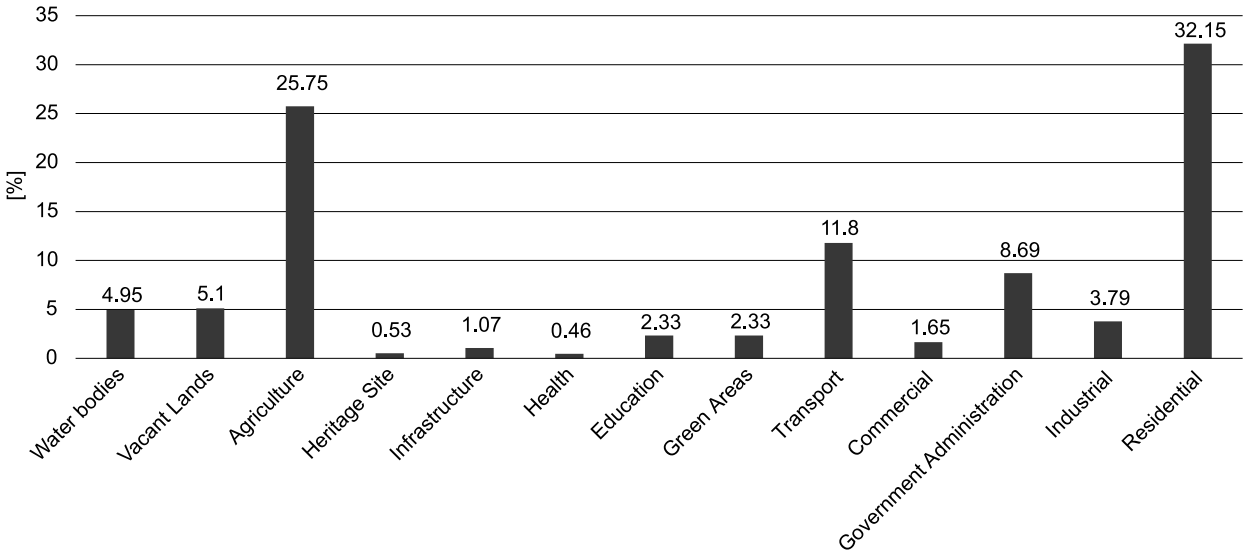

Fig. 4. Land Use Distribution in Baghdad
Source: Comprehensive Development Plan for Baghdad, Ministry of Planning, Iraq, 2009.

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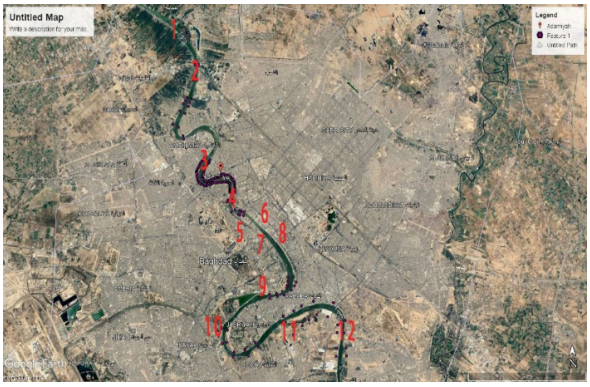

Fig. 5. The course of the Tigris River in Baghdad within the administrative boundaries of the city, highlighting the regulated riverfront limits and the designated study areas

Source: Google Earth (March 15, 2024).

central section between Al-A'imma and Al-Sarafiyah Bridges (3–4), the riverfront transitions to a mix of administrative and residential uses, including former presidential complexes and underutilized open areas, indicating a clear need for strategic development (Al-Furat Center for Irrigation Projects Studies and Designs, 2000a). Between Al-Sarafiyah and Al-Jadriya Bridges (4–10), the landscape is more fragmented, combining governmental facilities like the Medical City with recreational elements such as the Karkh Corniche, alongside unregulated piers that highlight the need to enhance river transport systems (Al-Furat Center for Irrigation Projects Studies and Designs, 2000b). In the southern part between Al-Jadriya and Al-Twaireej (Double-Decker) Bridges (10–11), the scene is dominated by Abu Nuwas Street, which narrows closer to Al-Jadriya Bridge. This area includes green spaces and water features belonging to former presidential compounds, along with unimplemented projects such as the site of the College of Fine Arts (Al-Furat Center for Irrigation Projects Studies and Designs, 2000b). The variation in riverfront character between Al-Adhamiyah and Al-Kadhimiyah reflects successive waves of urban development and underscores the pressing need for integrated strategies. Such strategies should enhance the river's relationship

Fig. 6. Agricultural map of Kadhimiya municipality

Source: Baghdad Municipality. (n.d.). Agricultural land use map of Kadhimiya municipality [Map]. Baghdad Municipality, Iraq.

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with the city, reactivate underutilized spaces, and promote a balanced framework that supports diverse urban functions while fostering sustainability along the Tigris.

Selecting the Study Areas and Analyzing Land Use Patterns

Al-Adhamiyah and Al-Kadhimiyah were selected as field case studies for analyzing the urban riverfront landscape in Baghdad due to their strategic location along the Tigris River, diverse land uses, and rich historical significance. Al-Adhamiyah, located on the eastern bank, is known for its religious and cultural character but faces challenges such as urban overlap and weak integration with the riverfront (Aldahwi et al., 2018). Al-Kadhimiyah, situated on the western bank, is home to the Imam Al-Kadhim shrine and features a mix of residential, commercial, and green areas, offering strong potential for sustainable riverfront redevelopment (Al-Akkam, 2013). The Tigris significantly influences the morphoclimatic character of both areas, yet declining water quality and environmental degradation highlight the need

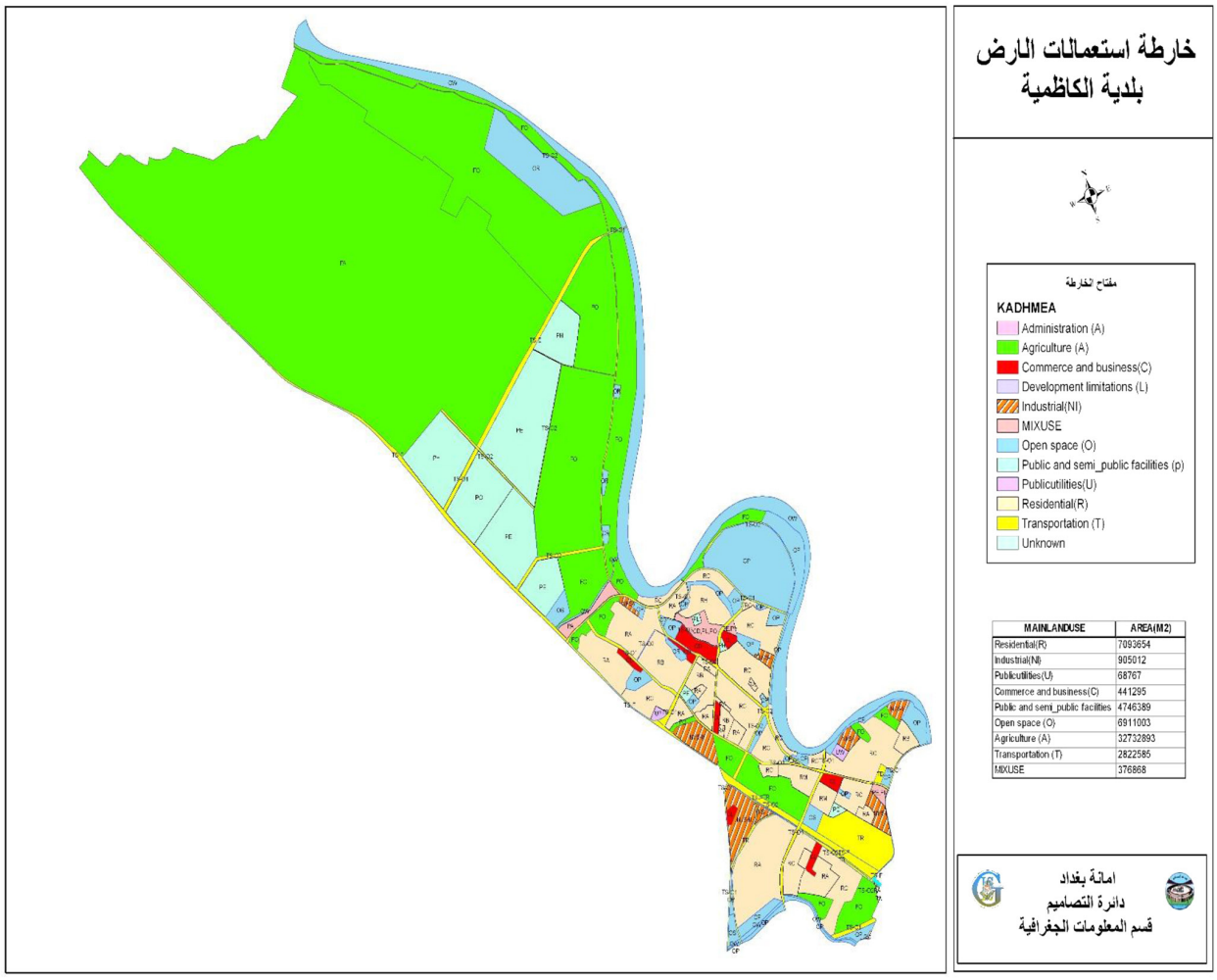

Fig. 7. Agricultural map of Adhamia municipality
Source: Baghdad Municipality. (n.d.). Agricultural land use map of Adhamia municipality [Map]. Baghdad Municipality, Iraq.

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for sustainable planning interventions (Ali, 2013). The diversity in land use—religious, residential, and commercial—enables a comprehensive assessment of the relationship between the river and urban fabric, as illustrated in Figures 6 and 7. These combined factors make both neighborhoods ideal for studying urban riverfront planning strategies and identifying opportunities for ecological and spatial enhancement.

Diagnosis of urban landscape challenges in river front in Adamia and Kadhimiya

Based on land use assessments, visual analysis of available maps, and contextual field observations, the challenges of the urban landscape along the Tigris River in the Adhamiya and Kadhimiya districts have been diagnosed according to specific factors that hinder integration between the urban fabric and the river. These factors include visual and functional connectivity, accessibility, the availability of public spaces, and the interaction between heritage landmarks and the riverfront. The diagnostic process focused on evaluating how each district performs across these criteria, highlighting strengths and gaps in spatial planning and design. Table 6 illustrates the comparative evaluation of challenge factors between the two areas, with Kadhimiya generally demonstrating stronger integration with the river due to its religious significance and relatively organized spatial structure.

Comparing Results Across Different Areas: Evaluating Strategies in Adhamiya and Kadhimiya

This section evaluates the effectiveness of urban riverfront development strategies in Adhamiya and Kadhimiya based on a three-tier scale (1 = Low, 2 = Moderate, 3 = High). The analysis includes design, planning, and environmental strategies derived from land use maps. The results indicate that Kadhimiya consistently scores higher across most criteria,

Table 6. The challenge factored between Adhamiya – Kadhimiya

Challenge Factor	Adhamiya	Kadhimiya	Overall Evaluation
Connectivity between city center and river	Weak – lacks clear transverse axes	Better – streets connect to river, especially near the shrine	Kadhimiya is better
Availability of open public and recreational spaces	Exists but poorly utilized, dominated by private use	Exists, some areas need further development	Kadhimiya is better
Clear riverfront entrances	Undefined, lacks adequate parking	More defined but needs better organization	Kadhimiya is better
Connection between residential areas and river	No direct visual or functional link	Stronger connection, especially near shrine	Kadhimiya is better
River transport system	Lacks defined stations or service	Has potential, but unorganized	Both areas need improvement
Pedestrian network	No continuous pedestrian paths	Some exist but are disconnected	Kadhimiya is better
Integration between both riverbanks	No direct pedestrian bridges	One bridge exists, but needs enhancement	Kadhimiya is better
Economic and investment planning	Unorganized commercial use, limits access	Better tourism potential, underdeveloped	Kadhimiya is better
Integration of historical landmarks	Near heritage sites but lacks planning integration	Shrine offers strong potential for heritage-based development	Kadhimiya is better
Vision for riverfront development	Lacks clear organizational strategy	More structured, needs strategic direction	Kadhimiya is better

Source: Researcher (2025).

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particularly in riverfront aesthetics, recreational activation, land use optimization, and environmental quality due to its wider green spaces and better integration with the Tigris River. In contrast, Adhamiya shows moderate to low effectiveness, facing greater constraints from dense mixed-use zones and limited access to the river. Both areas need significant improvements in smart lighting and pedestrian connectivity, but Kadhimiya holds greater potential for sustainable riverfront transformation.

To ensure transparency and objectivity in the comparative evaluation, the scores in Table 7 were derived through a multi-source assessment framework. This included systematic field observations, spatial analysis of high-resolution satellite imagery, and a review of existing urban planning documents. Where available, informal consultations with local planners and experts familiar with Al-Adhamiyah and Al-Kadhimiyah provided additional context. Each criterion was scored on a three-level scale (1 = Low, 2 = Moderate, 3 = High), reflecting the extent to which the condition exists or performs effectively in promoting sustainable riverfront development. This structured matrix enables a reliable comparative analysis across the two districts.

Discussion of Results: Comparative Analysis Between Adhamiya and Kadhimiya

The comparison of design strategy effectiveness (Fig. 8) clearly highlights Kadhimiya's superiority over Adhamiya, with a total score of 9 versus 6. This indicates that Kadhimiya benefits from stronger urban integration with its riverfront, supported by wide green spaces that provide substantial potential for activating recreational and cultural functions. In contrast, Adhamiya suffers from overlapping land uses and a shortage of open spaces, limiting its ability to develop a vibrant riverfront. Although both areas

Table 7. Comparative Evaluation of Strategies in Adhamiya and Kadhimiya

Strategy Category	Criterion	Adhamiya Score	Kadhimiya Score	Evaluation Summary
Design Strategies	Riverfront Aesthetics	2	3	Kadhimiya has clearer views and wider green spaces.
	Pedestrian & Cycling Paths	1	2	Kadhimiya shows better potential with improvement needs.
	Riverfront Lighting	1	1	Both areas lack smart/night lighting.
	Recreational & Cultural Spaces	2	3	Kadhimiya has more usable open areas.
Planning Strategies	Integrating Public Spaces	2	3	Kadhimiya better integrates open spaces with the river.
	Optimizing Land Use	2	3	Kadhimiya offers more potential for sustainable use.
	Water Transport Connectivity	1	2	Neither has a defined system; Kadhimiya has potential.
	Riverbank Connectivity	2	2	Both areas require better pedestrian connections.
Environmental Strategies	Improving Water Quality	2	3	Kadhimiya benefits from green/agricultural zones.
	Riverbank Erosion Control	2	2	Both areas need erosion protection strategies.
	Expanding Green Spaces	2	3	Kadhimiya has more space to preserve the natural landscape.

Source: Researcher (2025).

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require improvements in lighting infrastructure, Kadhimiya is better positioned to implement pedestrian pathways and cultural spaces. It is therefore recommended that Adhamiya focus on reducing urban congestion and increasing open public space, while Kadhimiya should enhance its infrastructure and capitalize on existing environmental assets.

Regarding planning strategies (Fig. 9), Kadhimiya again outperforms Adhamiya, particularly in integrating public spaces with the riverfront, scoring 3 versus 2. This advantage is attributed to the presence of green areas that support stronger connections between urban space and the river. Land use in Kadhimiya supports sustainable development, with opportunities to repurpose land for ecological and recreational purposes. On the other hand, Adhamiya faces organizational challenges due to unstructured mixed-use developments. Although both areas lack a functional water transport system, Kadhimiya has better potential for establishing docks, scoring 2 versus Adhamiya's 1. For connectivity between riverbanks, both received a score of 2, indicating the shared need for new pedestrian bridges and improved access.

In terms of environmental strategies (Fig. 10), Kadhimiya continues to lead with a higher score of 3 for water quality improvement. This is due to

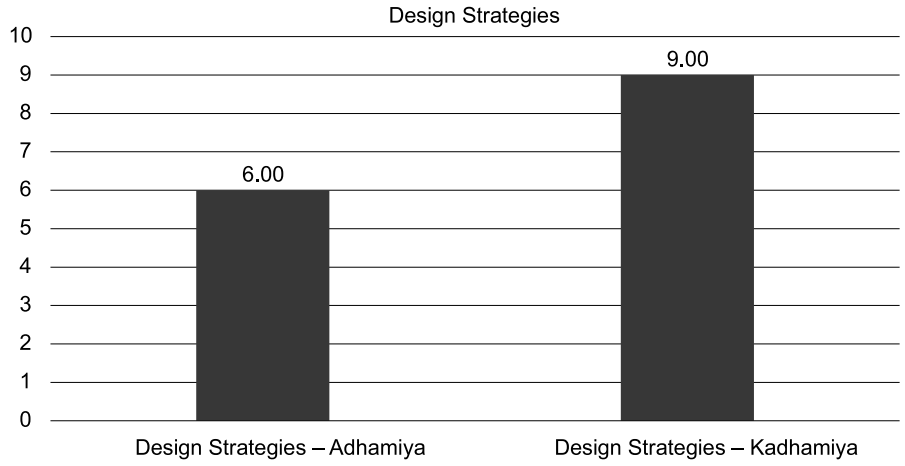

Fig. 8. The comparison of design strategies between the two areas
Source: Researcher.

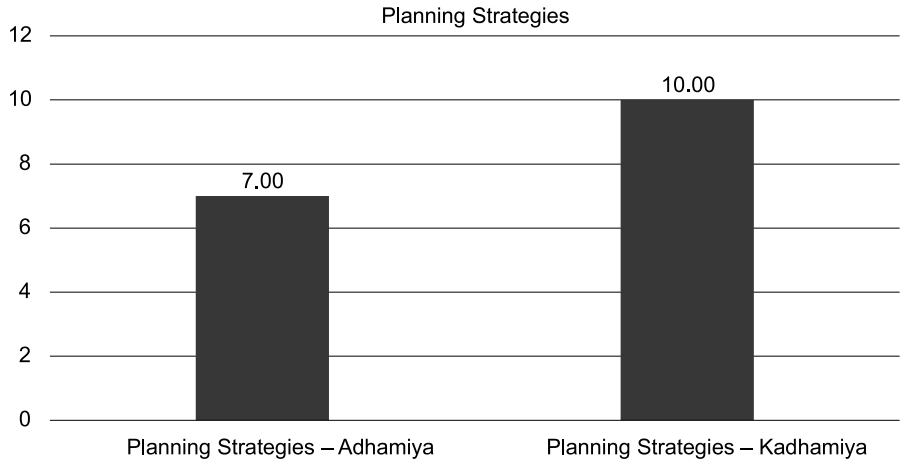

Fig. 9. The comparison of planning strategies between the two areas
Source: Researcher.

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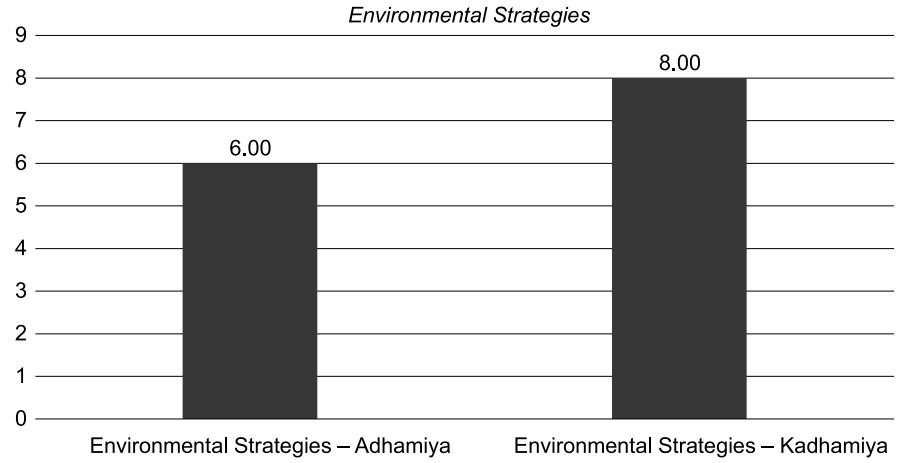

Fig. 10. The comparison of environmental strategies between the two areas
Source: Researcher.

the presence of green and agricultural zones that mitigate pollution and improve the surrounding river environment. Adhamiya faces higher environmental risks due to the proximity of industrial and commercial zones to the river. Both areas scored equally (2) for riverbank protection, reflecting the need for reinforced infrastructure to prevent erosion and degradation. Kadhimiya also outperforms Adhamiya in green space expansion (3 vs. 2), reflecting greater availability of land suitable for ecological restoration.

The comparative evaluation summarized in Table 7 and illustrated through Figures 8, 9, and 10 confirms Kadhimiya's overall advantage across the three evaluated dimensions: design, planning, and environmental strategies. Figure 8 confirms Kadhimiya's advantage in visual and functional continuity, supported by wider green corridors and clearer urban–river transitions, compared to Adhamiya's more fragmented urban edges. This highlights Kadhimiya's stronger spatial coherence and design readiness for future riverfront activation. Figure 9 illustrates stronger planning integration in Kadhimiya, where public space distribution and river-oriented land use align more effectively with sustainable urban development principles. In contrast, Adhamiya suffers from irregular, uncoordinated land use patterns that hinder spatial integration with the river. Figure 10 demonstrates Kadhimiya's relative strength in environmental indicators such as improved water quality and greater green space coverage. These factors create more favorable ecological conditions, positioning Kadhimiya as the more viable candidate for sustainable riverfront revitalization.

Together, these visual and quantitative comparisons provide strong evidence that while both areas require improvement, Kadhimiya currently holds greater spatial, planning, and environmental potential to support strategic and sustainable transformation of Baghdad's riverfront.

Implications for Urban Policy in Baghdad

The comparative analysis between Al-Adhamiyah and Al-Kadhimiyah reveals actionable pathways for riverfront revitalization in Baghdad. In the short term, urban policy should prioritize reducing congestion in Adhamiyah by reallocating space for public use, improving access to the river, and implementing localized greening initiatives. Simultaneously, Kadhimiyah's existing assets—such as green zones and civic spaces—should be leveraged by enhancing pedestrian infrastructure and introducing riverfront lighting and recreational features. In the long term, both districts would benefit from an integrated waterfront master plan that incorporates ecological restoration, smart mobility networks, and socio-cultural programming. Policies should also address the need for climate resilience, infrastructure investment,

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and coordination between planning authorities to foster sustainable, inclusive development along the Tigris.

General Conclusions

1. The urban riverfront landscape is a vital component in shaping the urban identity of cities, playing a significant role in enhancing environmental, social, and cultural functions, and improving the quality of life in areas adjacent to rivers.
2. Nighttime lighting significantly contributes to activating the riverfront, not only by enhancing visual aesthetics but also by stimulating social interaction, exploration of the scene, and reinforcing the cultural identity of the place.
3. Planning and environmental design strategies directly affect the integration of the city with its river, as continuous pathways, public spaces, and smart lighting create greater opportunities to transform the riverfront into an active urban space.
4. The Tigris River in Baghdad remains relatively underutilized despite its historical and ecological importance, and the analysis of the Al-Adhamiya and Al-Kadhimiya districts reveals a clear contrast in how the urban fabric connects to the riverfront.
5. Al-Kadhimiya outperforms Al-Adhamiya in implementing riverfront development strategies, due to the availability of green spaces, diversity of activities, and the potential to strengthen the connection between the river and the urban structure. Al-Adhamiya suffers from overlapping land uses and weak planning.
6. Both districts lack a sustainable investment vision that could activate the economic and cultural potential of the riverbanks, hindering the transformation of the Tigris into a hub for tourism, community life, and economic development.
7. The integration of design, planning, and environmental strategies in light of international experiences—such as the Sabarmati and Kansas riverfront projects—offers valuable guidance for reactivating the Tigris River in Baghdad, provided the solutions are adapted to the local context and include community participation.
8. Overall, the comparative assessment reveals that Kadhimiya exhibits greater readiness for implementing riverfront development strategies due to its stronger performance across the three evaluated dimensions: design, planning, and environmental. Its existing spatial structure, availability of green spaces, and better connectivity with the river provide a solid foundation for immediate interventions. In contrast, Adhamiya, while rich in cultural and historical significance, suffers from fragmented land use, limited public space, and weaker river integration. Therefore, it is recommended that Kadhimiya focus on enhancing infrastructure and capitalizing on environmental assets, while Adhamiya should prioritize reducing urban congestion and increasing the availability of open public spaces to strengthen its connection with the Tigris River.
9. This study contributes to the theoretical understanding of river–urban integration in Middle Eastern cities by bridging global riverfront redevelopment strategies with the contextual realities of Baghdad. It proposes an adaptable framework rooted in spatial, visual, and socio-functional indicators that can guide local planning authorities in formulating context-sensitive riverfront revitalization plans. The comparative approach between Al-Kadhimiya and Al-Adhamiyah offers a replicable model for assessing integration performance, highlighting both strengths and structural gaps within urban riverfront systems in the region.

Recommendations

In light of the findings, the following recommendations are proposed to guide the sustainable redevelopment of the Tigris Riverfront in Baghdad:

1. Adopt an integrated riverfront master plan that prioritizes connectivity between the urban core and the river through green corridors, pedestrian pathways, and multifunctional public spaces.

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2. Develop specific strategies for each district:
   a. For Al-Kadhimiya, leverage its relative readiness by investing in infrastructure upgrades, cultural tourism promotion, and ecological restoration along the riverbank.
   b. For Al-Adhamiya, implement targeted urban regeneration projects to reorganize fragmented land use, reduce built-up congestion, and increase access to the river through open public and recreational spaces.
3. Introduce a smart lighting framework across the riverfront to enhance nighttime activity, ensure safety, and accentuate the scenographic and cultural features of the urban landscape.
4. Establish river transport systems that connect key nodes along the Tigris, including strategic stops at heritage, recreational, and commercial destinations, in order to stimulate economic mobility and public engagement.
5. Encourage public-private partnerships (PPPs) and community participation in riverfront development to ensure financial sustainability, inclusivity, and cultural appropriateness of implemented projects.
6. Draw from successful international models, such as the Sabarmati Riverfront and Topeka Riverfront, adapting their planning, design, and environmental strategies to fit Baghdad's local socio-spatial context and institutional capacities.
7. Implement environmental protection measures, including natural purification systems, riverbank stabilization, and vegetation buffers, to mitigate erosion, reduce pollution, and enhance the ecological resilience of the riverfront.

Limitations and Future Research

While this study offers a comprehensive framework for sustainable riverfront redevelopment in Baghdad, it is limited by the availability of recent spatial data and the lack of stakeholder field interviews. Future research could expand on this model by incorporating user behavior analysis, participatory design approaches, and seasonal environmental impacts. Such enhancements would provide a more holistic understanding of the socio-spatial dynamics along the Tigris River and support more inclusive and adaptable planning strategies.

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