

## **The Khabour River as the Backbone of Urban Mental Image: Examining Spatial and Social Visibility in Zakho City**

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### **ABSTRACT**

This study examines the role of the river as the backbone of the urban mental image in Zakho City and investigates the interplay between spatial and social visibility. Focusing on the River Khabour, this research unravels the ways in which the river shapes the perception and imageability of Zakho City. The study takes into account the historical context and different historical periods to understand the river's influence on the city's spatial configuration. Through a comprehensive analysis of spatial and social visibility, the research explores how the presence of the river impacts the perception and use of public spaces in Zakho City. It employs space syntax methodology, including the analysis of axial lines and the isovist analysis, to assess the spatial visibility of key areas along the river. Additionally, land-use patterns and pedestrian observations are employed to evaluate the social visibility and user dynamics of these spaces. The findings reveal that the current distribution of the city's elements is in a situation of de-contact with the river; landmarks and nodes are placed far from the waterfront, and no significant paths pass by the shore. The integration levels of the streets show that in the historic periods, the major generator of the pattern was the river, but as time passed, the high integration levels seemed to be in the deep structure of the city, and only the old bridges maintained their value. Even new bridges have low integration values. The study sheds light on the complex relationships that exist between natural characteristics and urban development. The research problem is that when we investigate the city of Zakho and the presence of the Khabour river, the city's physical and visible relationship to the river has deteriorated. The main issue that this study investigates is stating that fact. The research has implications for urban planning and design, highlighting how rivers may be used as amplifiers to improve a city's overall livability and image.

**KEYWORDS:** Imageability, Social Visibility, River cities, spatial configuration

### **1 INTRODUCTION**

A substantial portion of spatial cognition research has focused on the concept of "imageability." To put it concisely, this notion assumes that within any given environment, whether natural or artificial, certain elements will stand out among the rest due to their unique characteristics such as shape, color, size, or symbolic importance (like historic sites, religious places, or cultural symbols). Because these elements are exceptional, they tend to be noticed, recalled, and used as orientation points by a majority of people in that context. This concept aligns with the idea of a "landmark" promoted by Lynch's foundational work on the "Image of the City."

Anchor points, or simply anchors, share similarities with landmarks in that both are considered significant cognitive cues in an environment. However, research suggests that while landmarks are perceived both collectively and individually, anchors are more closely linked to an individual's cognitive maps. While some geographical landmarks might also serve as anchors in an individual's cognitive map,

several anchors (like personal locations such as home and work) are too individualized to hold meaning for unrelated individuals (Tobler et al., 1987). Additionally, landmarks are mainly seen as factual knowledge about space, while anchor points are expected to actively contribute to cognitive functions like organizing spatial knowledge, aiding navigation, estimating distances and directions, and more.

Unlike landmarks, which are concrete visual cues, anchor points can be more abstract features that don't necessarily have to be specific points (for example, a river or an entire city on a regional cognitive map). In summary, we can consider anchor points as adapted, process-oriented, and sometimes abstract aspects that may or may not align with the mutually experienced landmarks that define a city's public image.

This study's limitations stem from its exclusive focus on Zakho city and its growth dynamics. Consequently, the findings are specific to Zakho's unique context and may not generalize to broader urban settings with diverse geographical, cultural, or historical factors.

### 1.1 The Rule of Urban Water Elements in the Creation of The Image of The City

Lynch (1960) suggested in *The Image of the City* that Venice and similar Dutch cities that were rich in water elements were frequently very imageable contexts (Figures 1 and 2); in particular, He observed that Dutch urban designers constructed polder cities as "a total scene" that allowed inhabitants and visitors to easily "identify its parts" and "structure the whole." (p. 13). Hooimeijer (2011) viewed this urban planning heritage as a technique to keep urban development dry in a watery area below sea level. Lynch, however, highlighted the aesthetic goal underpinning these imaginable aquatic towns.



**Figure 1:** The city of Venice



**Figure 2:** Charles River in Boston

De Jonge (1962) noted more detail in sketch maps produced closer to water features during an imageability research with tourists and locals in three Dutch water cities. These findings suggest a strong possibility that water-based elements could function as higher-order spatial anchors, which are described as spatial information organizers by the anchor-point hypothesis (Golledge, 1992). Nevertheless, of their cognitive forms, or, in Lynch's (1960) characteristics of imageability, waterscapes appear to arise initially in sketch maps, according to Jodelet and Milgram (1976) and De Jonge (1962). Since all other spatial information must be arranged around them, it is likely that during spatial memory recalls, water-based elements show up first.

The Charles River is an edge on Bostonians' mental maps, according to Lynch (1960). The Seine River was the first feature to appear on participants' sketch maps of Paris, according to Jodelet and Milgram (1976). The Seine River's prominence in the cognitive maps of Paris can be linked to both its physical presence as water and its cognitive shape as an edge. Despite the fact that many cities have rivers running through them, Lynch would not consider the bulk of them "imageable" towns like Venice or the Dutch Polder cities, which are usually differentiated by the existence of well-integrated water bodies inside their urban patterns. Channels or water pathways may have thinner linear water surfaces than rivers or water's edges, making them more noticeable water-based spatial anchors.

Rivers play a significant role in shaping the urban geographical landscape and have a profound impact on the structure of cities and the development of societies (Silva et al., 2006). These water bodies

not only create favourable conditions for settlements to grow and expand, but they also contribute to the aesthetic aspects of urban design and impact the size and functioning of cities (Čakarić, 2010).

Despite their importance, the influence of river systems on the spatial configuration of cities has not been extensively explored within the field of urban morphology, with only a limited number of brief and scattered studies available (Silva et al., 2006; Kubat et al., 2007; Mello and Holanda, 2009; Asad and Ahsan, 2012; Hossain and Bahauddin, 2013). For instance, Silva and co-authors (2006) conducted research on the correlation between rivers and cities, considering features such as urban population, riverfront length, water body size, and the number of river passages. Their findings indicated that these factors indeed affect the structure of cities built around rivers, while the extent of this influence can vary due to demographic and physical variables.

In an alternative study, Mello and Holanda (2009) utilized space syntax analysis in two Brazilian cities to assess both physical and visual accessibility. The researchers used integration values at different scales to inspect the level of urban development and the role of rivers in these cities. The results highlighted disparities between the two cities in their interaction with river areas, leading to higher urban development in one city and lower development in the other. Mello and Holanda emphasized the significance of social interactions between residents and riverfront areas as determinants of urban development in cities along rivers. Their research complements the current study by underscoring the importance of employing space syntax methodologies to analyze diverse facets of the morphology of cities near rivers. This work underscores the necessity for future research to conduct a more in-depth exploration of this subject.

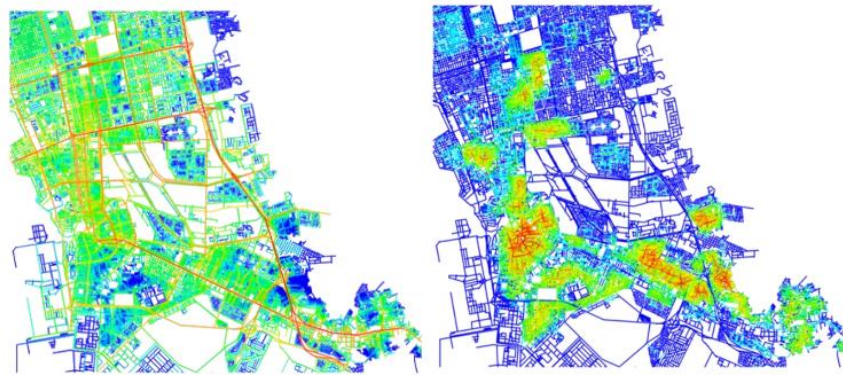
## 1.2 Spatial Characteristics of Visibility

Th Imageability, also known as legibility and visibility according to Lynch (1960), refers to the visual quality that evokes a sense of identity. Lynch (1960, p. x) defines a highly imageable city as one that is well-formed, discrete, and notable, captivating the attention and participation of its observers.

In the realm of space syntax research, the notion of "intelligibility" is a focal point, encompassing the understandability and navigational coherence of an environment (Dalton & Bafna, 2003, p. 59.1). Intelligibility is characterized by the extent to which the immediate experience within a system facilitates the comprehension of the broader-scale system without requiring conscious effort (Hillier, 1996, p. 171). Dalton and Bafna (2003) advance the notion that there exists a symbiotic relationship between visually distinct elements and spatial arrangement, indicating a cognitive foundation for space syntax. Their contention asserts that the interplay between intelligibility and imageability constitutes compelling evidence for this cognitive underpinning (p. 59.1). While imageability primarily addresses the visual attributes of urban settings, intelligibility seeks to unveil the underlying spatial rationale. Intelligibility metrics contribute to the elucidation of a city's imageability, as articulated by Dalton and Bafna (2003, p. 59.19) who assert that "all cities with pronounced imageability must possess intelligibility, but not all intelligible cities need necessarily be endowed with imageability". Intelligibility deals with the connection among local visual signals and the global features of a spatial configuration inside a system, allowing an integrated comprehension of the whole through its constituent parts."

The city can be experienced through movement, and spatial and visual accessibility are critical in imagining it. Accessibility, especially in terms of pedestrian movement, represents a direct engagement with the city and its residents. Analyzing pedestrian traffic enables the identification of the most accessible regions, which are frequently essential areas with a larger potential for social interactions. Hillier and Hanson (1984) pioneered space syntax, which uses evidence of this interaction to study and depict urban spaces, with the goal of understanding how people navigate and use areas. Hillier's "natural movement" hypothesis proposes that spatial and movement patterns are inseparably linked (Hillier et al., 1993), and spatial configuration can influence complex social processes through its influence on street movement patterns and potential economic activity (Hillier, 1999).

Many research studies have showcased the significant influence exerted by the spatial arrangement of streets in dictating variations in the awareness of movement (Hillier, 1996, 1999; Penn et al., 1998). Therefore, both movement patterns and the accessibility of public spaces play a pivotal role in shaping a city's distinct identity. Within the framework of space syntax, the concept of integration, a fundamental metric, is closely tied to accessibility. A space that is well integrated into the spatial layout is inherently accessible and commands a dominant role within the overall pattern (Figure 3).

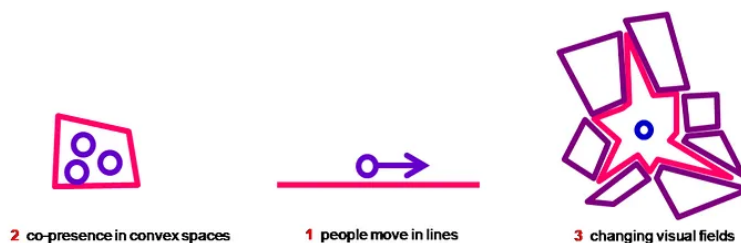


**Figure 3:** local and global integration analysis of the city of Jeddah in space syntax theory

Accessibility encompasses facets of both spatial and social visibility and should be perceived as a reciprocal process. The space syntax theory introduces the notion of an "isovist," which characterizes the spatial visibility emanating from a specific point. It furnishes a lucid depiction of the strategic vistas originating from or encompassing a designated location (Turner & Penn, 1999) (Figure 4). An isovist pertains to the area that lies directly within the visual field of a particular point within a spatial environment (Turner et al., 2001).

### 1.3 Social Characteristics of Visibility

The research expands the concept of spatial visibility in public spaces by considering its social characteristics, where visibility encompasses the presence of diverse clusters of people sharing these spaces. This social visibility is closely intertwined with the activities taking place within these spaces. Steinitz (1968) emphasizes the need for a deeper understanding of the communication among urban form and activity and its role in the transmission of meaning to create noteworthy environments. He argues that the environment should effectively communicate the type of activity occurring in a particular location, enabling individuals to locate, identify, and describe these activity-based places. Thus, the alignment between



**Figure 4:** the logic of isovist analysis in space syntax.



physical form and actions raises more expressive and distinguishable cities for their residents (Steinitz, 1968).

Despite the challenges faced by historical city centres in maintaining their vibrancy, they remain attractive hubs, particularly due to their ability to establish a sense of continuity with the past, as discussed by Edgü et al. (2015). The appeal of a place is often linked to its crowdedness, which is associated with the presence of pedestrians. According to Edgü et al. (2015, p. 176), the presence of pedestrian flow is crucial for encouragement of social interaction. Once a space becomes visible and accessible to people, it naturally attracts greater density and suitable spreading of land uses. As various authors have noted, activities within the physical setting are influenced by land use, pedestrian flows, movement patterns, and movement flows, all of which contribute to the vitality of a place (Jacobs, 1961; Gehl, 1989; Montgomery, 1998).

Diversity and vitality are two observable and consistent characteristics of public spaces, as defined by Sezer (2018). Diversity discusses the spatial mixture of people and functions, and a variety of land uses particularly enhances it. This social visibility and variety contribute to community cohesion. According to Holland et al. (2007, p. ix), "Different types of people's public visibility is promoted by their existence in public spaces, and people's view of their community is formed in part by people and items and places they see in public." Sezer (2018) investigates sociocultural inclusion in public places and emphasizes that they provide opportunities for individual participation and interaction. Having these venues occupied at the same time helps city people to see and observe one another, establishing a sense of community (Sezer, 2018). Such social features of visibility in public areas draw attention to the spaces themselves and add to the city's global atmosphere.

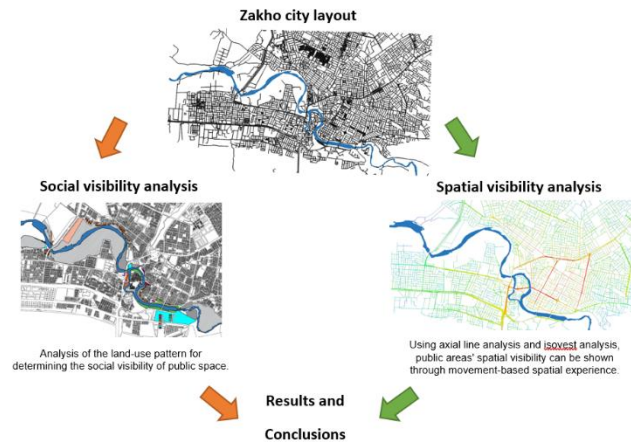
## **1 ANALYSIS METHODOLOGY**

The analysis methodology revolves around comparing the visibility constraints of riverside areas using a two-step method (Figure 5). For the first stage, space syntax is employed to examine and discuss the spatial visibility of community spaces, while for the second stage, the social visibility of these places is analyzed based on land-use patterns. For the syntactic research, axial lines and isovist analyses are conducted. The city of Zakho is examined using the integration and isovist mechanisms of the space syntax methodology.

The main public spaces' syntactic properties are initially analyzed through axial line analysis within the designated area of the cities' present layouts. Axial line analysis, a fundamental component of space syntax, helps identify the "most integrated axes" from which all others are least connected. Global integration, known as integration-n level, is used to assess the accessibility of spaces inside the entire plan. Integration-n level indicates the degree to which a unit is integrated or segregated from the overall scheme.

Spatial visibility of the places is also assessed by isovist analysis, intentionally locating the viewer point inside the plan. Point isovist values are interpreted built on area and border properties. The area evaluates the visible space from the viewpoint and vice versa, while the perimeter quantifies the distance of the visible space's edge. These properties help identify the extent of unobstructed breadth and visual range, enhancing the visibility of a space and enabling social interaction.

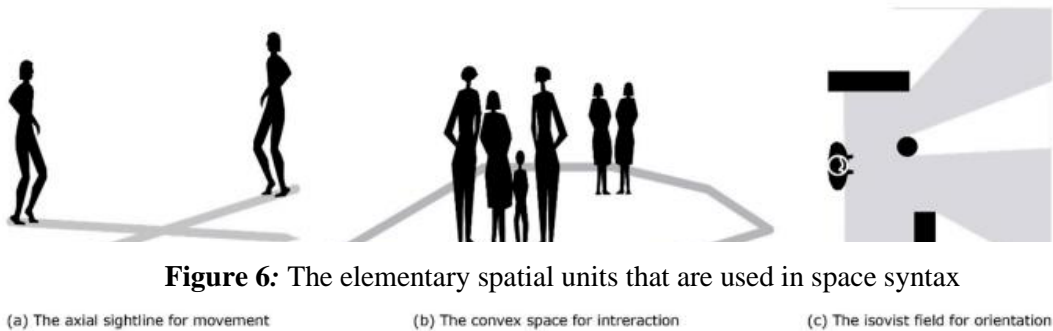
The social visibility of spaces is exposed through land-use pattern analysis and pedestrian counts. The distribution of functions impacts both the movement density and the attendance of people, though the social visibility of a space relies on the diversity of functions it offers. The findings obtained through direct observation are correlated with the results derived from syntactic and functional pattern analyses.



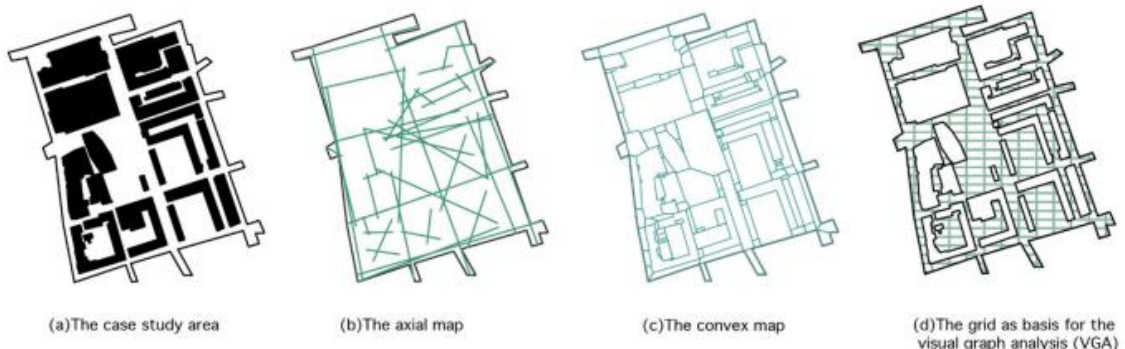
**Figure 5:** Two phased analysis method

### 1.4 Space Syntax Theory

Space syntax theory is a prominent approach in urban design and analysis, focusing on spatial configuration and its impact on human behaviour and movement within the built environment (Figure 6). Developed by Bill Hillier and Julienne Hanson in the 1970s, this theory seeks to understand the relationships between spatial layouts and the patterns of movement and social interaction in cities (Hillier & Hanson, 1984). At its core, space syntax theory emphasizes that the physical arrangement of streets, buildings, and public spaces profoundly influences how people navigate and use urban spaces (Cho, 2004). The theory posits that certain spatial configurations, such as well-connected street networks and open public spaces, tend to encourage more pedestrian movement and social interactions, fostering vibrant urban environments (Porta et al., 2006).



**Figure 6:** The elementary spatial units that are used in space syntax



**Figure 6:** Three different types of maps that are used in space syntax analysis

To operationalize the concepts of space syntax theory in urban design research, the DepthmapX software has emerged as a powerful tool (Figure 7). Developed by Alasdair Turner, DepthmapX is an advanced GIS-based software that enables researchers to perform depth map analysis and generate various space syntax metrics (Turner, 2004). By utilizing this software, researchers can quantitatively analyze the spatial integration, accessibility, and connectivity of urban layouts, allowing for a deeper understanding of the relationships between space and human activities within a city (Kropf, 2014).

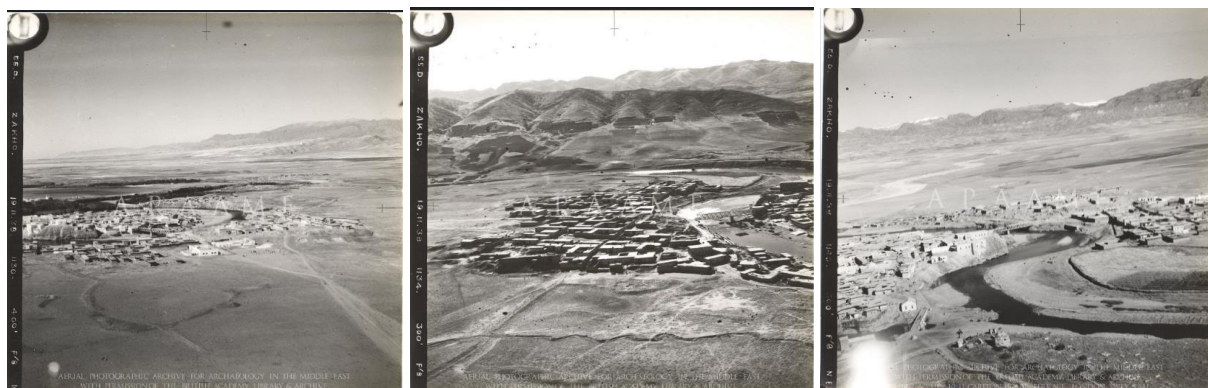
The DepthmapX software provides a range of analytical tools, such as axial maps, which represent the visibility and connectivity between different points in the urban fabric. Axial maps illustrate the prominence of streets and pathways as they relate to one another, revealing the hierarchical structure of the street network (Omer & Tiesdell, 2016). Furthermore, the software facilitates space syntax analysis by generating isovists, convex spaces that represent what is visible from a particular location within the city. By analyzing isovists, researchers can identify key sightlines and focal points, shedding light on the visibility and legibility of urban spaces (Bafna et al., 2018).

In an urban design research context, space syntax theory and DepthmapX software enable scholars to evaluate the performance of different urban layouts, inform pedestrian-oriented design strategies, and contribute to the creation of more inclusive and livable cities (Silva & Barcellos, 2015). By integrating space syntax analysis with other design principles and user-oriented research methods, urban designers can develop a comprehensive understanding of the relationship between spatial configurations and urban experiences, ultimately leading to the creation of more sustainable, efficient, and people-centred urban environments.

## 2 CASE STUDY: THE CITY OF ZAKHO

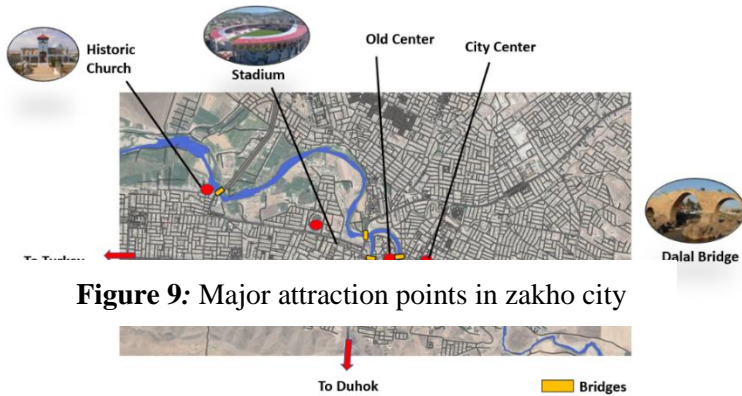
After Zakho has a rich historical legacy that is divided into two parts: the historic centre and the surrounding residential region, the city's spatial organization, reminiscent of an organic form, has evolved, including ancient Assyria, Greek influence, and the Islamic era (Figure 6). The existence of green and open spaces in the city core, on the other hand, has been overlooked. The main streets frequently lead to dead ends, whilst the narrow secondary paths are intended to maintain the cultural solitude of the area.

The key components of the city centre include the old bazaar, known as the "dark bazaar," the central mosque located within the bazaar, and other significant structures such as Khans (caravanserais) and oriental bathhouses (Figure 8). Notably, one of the prominent landmarks is the Zakho Castle, which was extended by Prince Ali Khan and built upon the remains of an older castle. Historical records indicate that the castle dates back to the 13th century when it belonged to the Badini Princedom (Duhok Municipalities Directory, 2011). However, the building material of Zakho Castle has suffered significant damage over time, and some parts have been modified for temporary purposes.

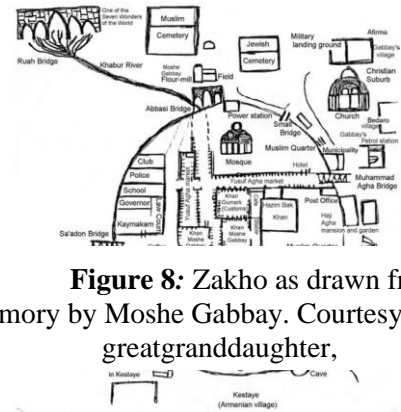


**Figure 7:** three aerial photographs by Sir Stein M. Aurel (1938)

The overall urban form of Zakho has been shaped by these historical influences, reflecting the cultural and architectural characteristics of the different periods. However, the preservation and restoration of the city's historical structures are crucial for maintaining its unique identity and promoting tourism and



**Figure 9:** Major attraction points in zakho city



**Figure 8:** Zakho as drawn from memory by Moshe Gabbay. Courtesy of his greatgranddaughter,

cultural heritage in Zakho (Figures 9, 11 and 12). As shown in Figure 10, a visual map drawn by memory by a Jewish resident who lived in Zakho during the 19<sup>th</sup> century shown how khabour river was indeed the backbone of cognitive mental image that was shaped in the minds of its residents and visitors.

### 1.1 Data Collection:

The data collection process for this research on Zakho City involved multiple steps. Initially, the CAD file of Zakho City was acquired from cadmapper.com, which provided foundational spatial information, including road networks, building footprints, and administrative boundaries. This CAD file served as a basis for subsequent analyses.

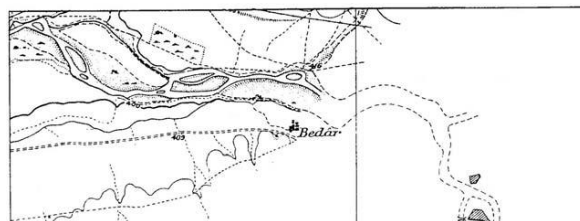
To evaluate the city's connectivity and spatial integration, the CAD file was processed using the depthmap software. This software facilitated the computation of urban network metrics, such as accessibility indices, which were essential in understanding the city's overall connectivity and identifying significant nodal points. The integration of the CAD file with depthmap analysis provided valuable insights into Zakho's urban structure.

The land use map was meticulously prepared by employing supervised classification techniques on the satellite imagery, with the assistance of ground truth data from the municipality. By combining cadmapper.com data, satellite data, and municipality information, the data collection process yielded a robust and comprehensive analysis of Zakho City's urban land use.

In addition to the CAD data, depthmap analysis, and satellite imagery, aerial historical images from the Aerial Photographic Archive for Archaeology in the Middle East, The British Academy, Sir Stein M. Aurel Collection were employed to identify the historical development of Zakho City. These invaluable



**Figure 11:** the khabour river and the "qisf" building 1922 source Gertrude Bell Archive



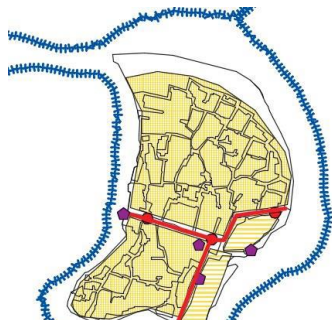
**Figure 10** Zakho, an island in the river. Courtesy of the British Library.



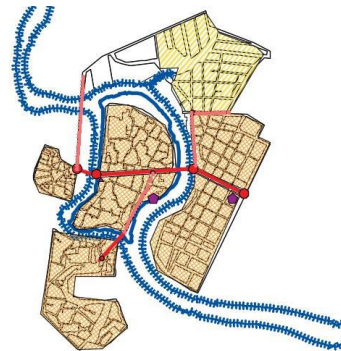
historical aerial images provided a unique perspective on the city's evolution over time, offering glimpses into its past urban form and spatial dynamics. By comparing and analyzing these historical images with contemporary data, the research gained insights into the transformation of Zakho City, tracing its historical development, and understanding the factors that have shaped its current urban fabric. The integration of aerial historical images added a temporal dimension to the study, enriching the understanding of Zakho's urban history and contributing to a more comprehensive and nuanced analysis of the city's urban landscape.

## 1.2 City Growth Development and the Khabour River:

The imageability analysis conducted to examine the urban development of Zakho City across different historical periods has yielded significant insights into the spatial relationships between its nodes, landmarks, and the waterfront. During the historic period, it was observed that nodes and landmarks exhibited a robust connection to the waterfront, both physically and visually. The historical urban fabric of Zakho City displayed a strong affinity towards its riverfront, emphasizing the importance of waterways in shaping the city's spatial layout and identity (Figure 13).



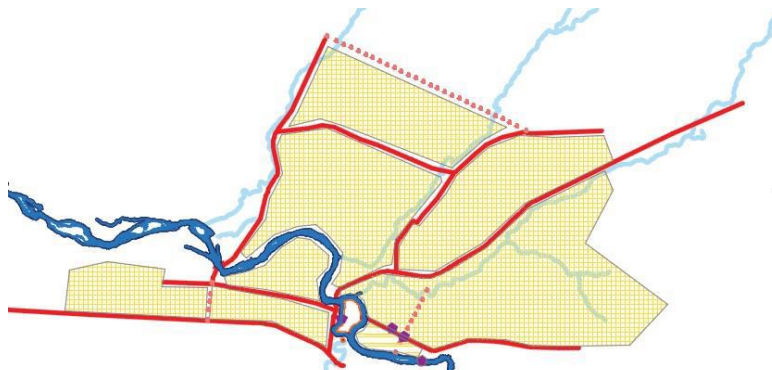
**Figure 13:** showing the elements of the city in the period of 1940-1970 (source: researcher)



**Figure 14:** showing the elements of the city in the historic era (source: researcher)

However, a notable transformation occurred during the period from 1940 to 1970 (Figure 14), as the city experienced growth beyond the riverfront, resulting in a reconfiguration of its elements with continued reference to the waterfront. This phase witnessed the expansion of the city to other parts, while still maintaining a significant relationship with the river. The waterfront remained a prominent feature in the city's design, with its influence reaching into the newly developed areas.

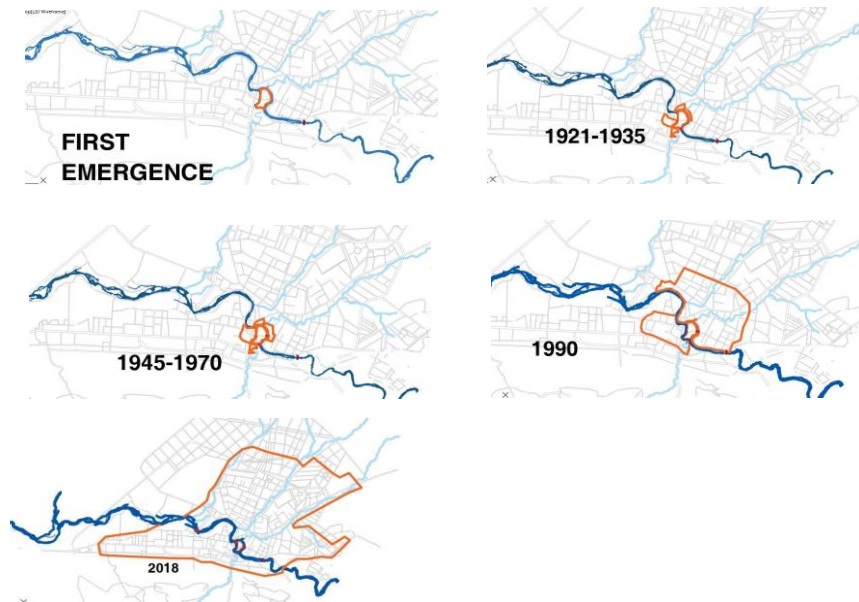
In contrast, the contemporary urban landscape of Zakho City presents a distinct shift in its spatial orientation. The city's growth has now veered away from the waterfront, resulting in a neglect of the riverfront both in its physical presence and visual prominence. Presently, city elements are concentrated deeper within the urban fabric, leading to a diminished emphasis on the waterfront in urban planning and development (Figure 15).



**Figure 12:** showing the elements of the city in the current era -2018 (source: researcher)

An examination of the city's growth reveals a marked disparity between the north-east bank and the south-west bank. The north-east bank showcases a stronger orientation and adjacency to the river canals, which, although currently active only in winters, still exert a considerable influence on the city's spatial organization. On the other hand, the south-west bank is characterized by a different orientation, predominantly aligned with a major street leading to the borders of Turkey. This distinction highlights how the city's development has been influenced by its geographical context and connectivity with neighboring regions (Figure 16).

The imageability analysis has provided valuable insights into the historical evolution and contemporary state of Zakho City. The observations indicate a gradual departure from a strong connection to the waterfront in its historic past to a more inward-focused development in the present. The study's findings underscore the significance of considering historical patterns and geographical context in urban planning and design to ensure a coherent and sustainable urban environment that respects the city's heritage while responding to its evolving needs. This research contributes to the broader field of urban studies and provides a foundation for future investigations into the dynamic relationship between cities and their waterfronts in a global context.



**Figure 16:** showing 6 stages of city development through history (source: researcher)

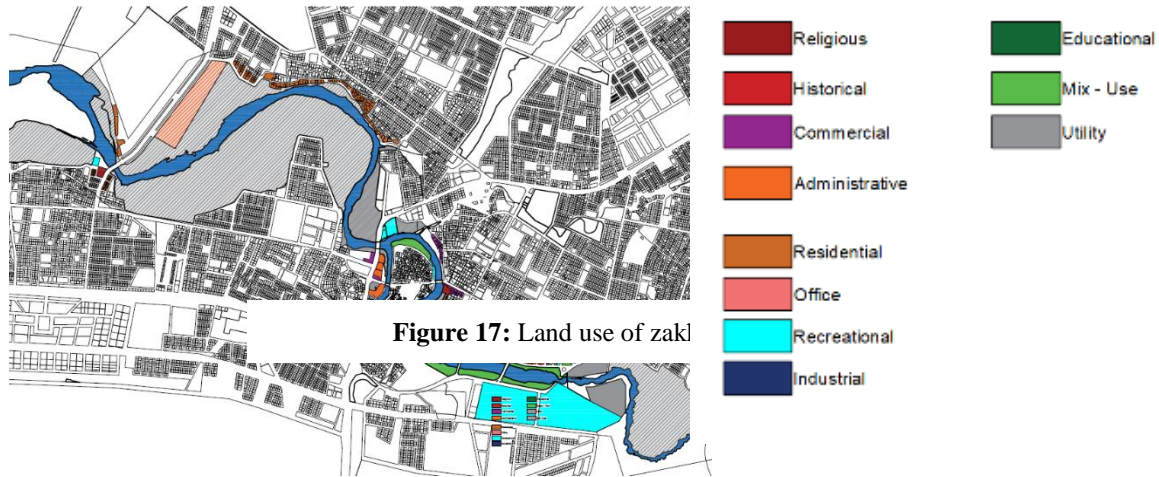
### 1.3 Social Aspects of Visibility:

The land use pattern alongside the Khabour River in Zakho exhibits distinct characteristics, with a predominant focus on residential and administrative functions. The proximity of the river has made these areas desirable for residential developments, fostering a close connection between the inhabitants and the water's edge. Additionally, administrative facilities, such as government offices and institutions, are strategically located alongside the river, ensuring convenient access to essential services for the city's residents.

However, despite the prevalence of residential and administrative land uses, there are significant stretches of unused lands adjacent to the river that remain inaccessible and undeveloped. These underutilized areas represent missed opportunities for urban growth and development, and their inaccessibility may be attributed to various factors, such as lack of infrastructure or regulatory constraints (Figure 17).

Moreover, the recreational areas along the Khabour River are limited, with the historic Dalal Bridge being a prominent spot for leisure activities. The scarcity of recreational spaces near the riverfront restricts

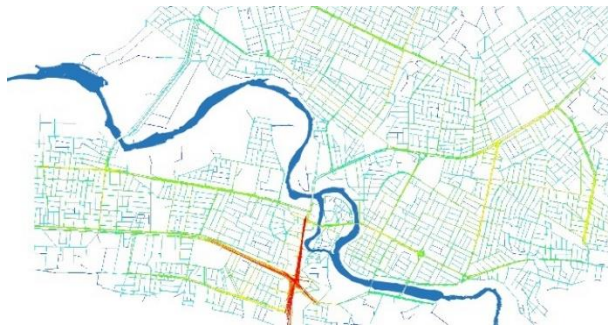
opportunities for public engagement and social interaction in these areas. To enhance the livability and attractiveness of the riverfront, there is a need to consider revitalizing unused lands and promoting accessible recreational spaces that cater to the diverse needs and interests of the city's residents. The social aspects of visibility play a crucial role in shaping the perception of public space alongside the Khabour River. A diverse mix of functions, such as residential, administrative, and recreational spaces, can contribute to a vibrant and dynamic urban environment, fostering a sense of community and belonging among the city's inhabitants. By creating more accessible and diverse public spaces along the river, Zakho can embrace its cosmopolitan identity as a port city, providing its residents with opportunities for meaningful interactions and fostering a stronger sense of place and pride in their surroundings.



**Figure 17: Land use of zakho**

#### 1.4 Spatial Aspects of Visibility:

The spatial analysis results of the integration and isovist visibility test conducted in Zakho city (Figure 18 and 19), with a focus on its relationship with the Khabour riverside, reveal intriguing patterns. The findings indicate that the global integration of the space syntax analysis demonstrates a notable difference between the newly developed roads and sectors of Zakho compared to the oldest sectors concerning their relationship with the riverside areas. The oldest sectors exhibit a strong integration with the riverside, suggesting a historically significant and well-connected relationship between these areas. In contrast, the new main roads and sectors of the city demonstrate lower integration levels with the riverside, indicating a potential spatial disconnect between these newer developments and the river.



**Figure 18: Local Integration analysis r=3**



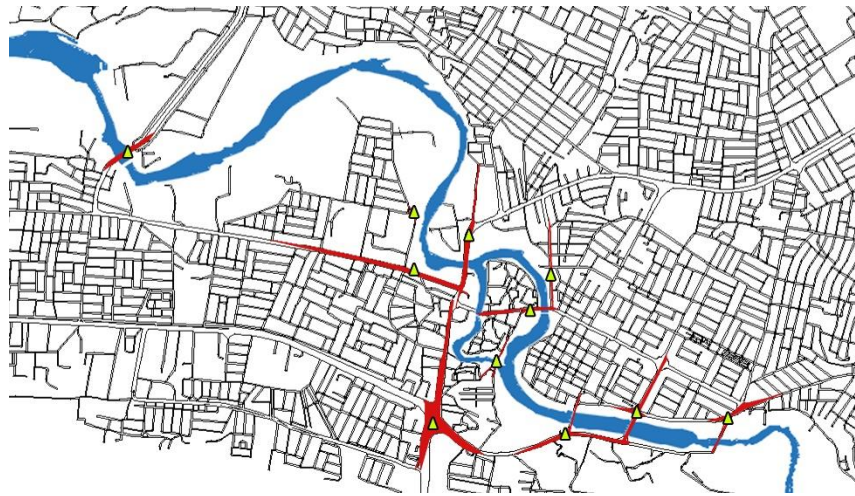
**Figure 19: Global Integration Analysis r=n**

The visibility analysis conducted using Depthmap software has yielded insightful outcomes concerning the visual relationships along the Khabour River. The examination of key points adjacent to the river's course reveals distinct patterns in terms of visibility. Notably, the results indicate that along the



eastern side of the city, the river enjoys enhanced visibility from these vantage points. This suggests a more pronounced and unhindered visual connection between these areas and the river. Furthermore, the analysis illustrates that the visibility extends to considerable depths into the nearby streets, indicative of the river being perceptually accessible from the adjacent thoroughfares.

Conversely, the findings suggest a contrasting scenario on the western side of the city, where the river's visibility appears to be significantly diminished. This discrepancy in visibility implies that the river's visual prominence is notably reduced in this sector. This observation is of particular importance in the context of urban design and planning, as it accentuates the spatial variations in the city's visual experience along its riverfront. Consequently, these insights contribute to a comprehensive understanding of the city's urban fabric, enabling informed decisions for optimizing the visual relationships with the Khabour River. In a broader context, these findings underscore the significance of employing advanced spatial analysis tools like Depthmap to uncover nuanced aspects of urban environments, which in turn inform strategies for enhancing both visual aesthetics and functional connectivity within cities (Figure 20).



**Figure 20:** visibility analysis of main points alongside the Khabour river

## 2 CONCLUSION

The intricate interplay between spatial visibility and the Khabour River's presence in Zakho City reveals a captivating narrative of urban evolution and potential. The culmination of spatial analysis results, conducted through the lens of integration and isovist visibility, provides a profound understanding of the city's dynamics, particularly in relation to its riverside. These insights illuminate how Zakho's historical and contemporary sectors exhibit varying degrees of integration and visibility with the river, painting a vivid picture of its past symbiosis and present spatial transformation.

The spatial analysis unfurls a tale of two trajectories. The older sectors, steeped in history, exhibit a profound connection and integration with the riverside, underscoring the river's historical significance as a central life force that shaped the urban fabric. The newly developed roads and sectors, on the other hand, portray a divergence from this historical integration, suggesting the emergence of spatial disconnect between the city's core and its riverfront. This transformation highlights the evolving relationship between Zakho and its river, emblematic of a broader urban transition where modernity sometimes reshapes the ties to the past.

The Depthmap-driven visibility analysis adds another layer to the narrative, offering a visual perspective on the city's relationship with the Khabour River. The eastern side emerges as a stronghold of enhanced visual connectivity, where the river assumes a prominent role in the city's visual identity. However, the western side of Zakho witnesses a diminished river visibility, signifying the nuanced visual



experiences within the urban fabric. This divergence emphasizes the importance of strategic urban planning that thoughtfully enhances the visual connections with the river, fostering a balanced blend of historical heritage and contemporary urban aesthetics.

In conclusion, the intricate tapestry of spatial visibility, historical dynamics, and the Khabour River's presence narrates Zakho City's story of evolution. This journey transcends physicality, encapsulating the essence of a city that weaves its past, present, and future. The findings underscore the significance of preserving historical relationships while embracing contemporary transformations, a harmonious fusion that crafts an identity both rooted in heritage and adaptive to change. As Zakho navigates the path of sustainable urban growth, these insights provide a compass, guiding urban planners and stakeholders towards a future where the river's legacy harmonizes with a city that thrives as an embodiment of its multifaceted narrative.

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