Renewing the city towards a linear attractors frame. Fuor cases in Iraq.

Mattia Bertin
Università Iuav di Venezia
mbertin@iuav.it

Eugenia Vincenti
Università Iuav di Venezia
evincenti@iuav.it

Javier Ruiz Sanchez
Universidad Politécnica de Madrid
javier.ruiz@upm.es

Renewing the city towards a linear attractors frame. Fuor cases in Iraq.

Mattia Bertin
Università Iuav di Venezia
mbertin@iuav.it

Eugenia Vincenti
Università Iuav di Venezia
evincenti@iuav.it

Javier Ruiz Sanchez
Universidad Politécnica de Madrid
javier.ruiz@upm.es

Abstract

The article discusses Iraq's historical cities facing challenges of reconstruction amidst large-scale destructions, emphasising the complexity of contemporary urban redevelopment, exacerbated by climate change. It proposes a replicable planning approach employing adaptable modelling strategies tailored to each city's needs, allowing for independent implementation by local administrations. The progressive strategy, adaptable to specific characteristics, uses tools like linear attractors and matrices. These tools facilitate the design of repeatable solutions and rule-based urban transformations, ensuring a balance between public-private spaces and green areas. The approach aims to create resilient, climate-responsive urban environments, tested in four northern Iraqi cities, to foster positive transformations and mitigate climate impacts. Ultimately, the proposed scenario seeks to cultivate urban environments that thrive amidst evolving climate conditions while ensuring community well-being.

Keywords

Climate change adaptation, settlement scheme, climate justice, resilience.

Introduction

Iraq hosts some of the oldest continuously inhabited cities in the world. The historical significance of its urban areas is enormous, representing millennia of human civilisation and cultural heritage. However, the Iraqi territory has recently borne the brunt of extensive destruction, leaving its cities in ruins. The devastation wrought by conflict, warfare, and natural disasters fully displays the task of rebuilding and revitalising these once-thriving urban centres. Moreover, the increasing impact of climate change compounds the urgency of reconstruction. As temperatures rise and weather patterns become progressively unpredictable, the country must confront new challenges that threaten to worsen existing vulnerabilities. Addressing climate change issues is not merely an option but necessary for Iraq's future prosperity and resilience; local authorities must devise a series of strategies tailored to the specific needs of each city, recognising that more than a one-size-fits-all approach will be needed in the face of such diverse urban landscapes. Indeed, from the ancient city of Babylon to the modern metropolis of Baghdad, each urban centre in Iraq possesses unique characteristics, vulnerabilities, and opportunities. Rebuilding and adapting these cities to withstand the impacts of climate change requires a nuanced understanding of their contexts (Berke and Campanella, 2006). In cities where the ruins of ancient temples and palaces stand as a testament to the city's

storied past, reconstructions must incorporate heritage preservation alongside climate resilience.
Furthermore, efforts to improve water management and conservation are essential to ensure the sustainability of Iraq's cities in the face of dwindling water resources. This may involve the implementation of rainwater harvesting systems, the restoration of wetlands, and the promotion of water-efficient technologies (Al, 2022). This requires investment, especially in green infrastructure, to mitigate the urban heat island effect and provide natural cooling solutions (Quigley et al., 2018). Ultimately, the reconstruction of Iraq's cities in the wake of large-scale destruction and the face of climate change is a significant task that requires a multifaceted approach (Birkmann and Von Teichman, 2010). Based on these assumptions, the research seeks to identify a replicable approach for effecting urban transformation across various scales, which aims to uncover a framework that can be adapted and applied across diverse urban contexts (Burkhard et al., 2012). The strategy uses linear attractors, such as rivers and roads, as pivotal elements driving development and transformations. These linear features serve as the cornerstone of the approach, intersecting with different types of urban fabric within the chosen contexts. Linear attractors and fabric types converge in a matrix, representing a design code's structure based on forms and parameters. Seeking to overcome a colonialist approach, the research outcomes were directed towards a flexible strategy that can be interpreted according to local design cultures. At the same time, flexibility makes it possible to imagine a system that can be adapted to different needs from time to time, making it easier to combine mitigation, adaptation, and resilience-building measures to address these numerous challenges.

Case study

The research outlined within the article specifically targets four cities in northern Iraq, designating them as the primary focal points for investigation and analysis.
The first city selected is Al-Dour, part of the Saladin Governorate, located on the Tigris River's left bank. The city is between Samarra and Tikrit and lies near Baghdad's main road with Mosul. Regarding the connection with the major regional/national transport network, Al Dour lies along the main road that connects Tikrit to Samarra, on the eastern bank of the Tigris River, and it could represent a crucial traffic point for the future development of the area; tourism, agricultural activities, and industry are the main sectors of the City. Al Dour is located rightly along the primary road running along the eastern bank of the Tigris River, which is the junction point towards the road that leads eastward to Tuz. The City's geographical location represents an important node for the movement of passengers and goods on the vertical axis, which links Mosul and the southern governorate. The city's university campus is vital to the regional and national educational system. Also, the tourism potentiality of Al Dour includes many natural areas along the river Tigris, archaeological sites which give the city touristic importance, and increased economic potential by providing rest and food stations for tourists, shops and coffee shops and recreational areas serving this purpose. (Figure 1)

The second city is Al-Sharquat, located in the Saladin Governorate on the west bank of the Tigris. It is one of the oldest cities in Iraq, and being in ancient times, the center of the Ashur Empire played a fundamental role from the archaeological perspective at the national level. The city of Sharquat lies 13 km east of the main road connecting Baghdad with Mosul, almost 320 km north of Baghdad. Two main roads run along the eastern and western banks of the Tigris River, linking the area to Samarra. In contrast, another main highway between the capital of Tikrit and Tuz covers the east-west axis. Regarding the connection with the major regional/national transport network, Sharquat is less than 15 km from the main road linking

Mosul to Baghdad, and it could become a crucial centrality for the area's future economic development, primarily associated with touristic historical and natural attractions. Sharquat district is historically significant because it was the ancient capital of the Assyrian empire. In the district, there are 272 surveyed archaeological sites. Those sites go back to different historical periods, mainly from the Assyrian period, with some historical sites belonging to the Islamic period. The most important is the Ashur Castle, even if the site needs more basic infrastructure and services to fulfil its full touristic potential. The Castle has been on the World Heritage List UNESCO since 2003, and due to the lack of maintenance, the recent armed conflicts, and the proximity of the construction of a dam entailing partial flooding and seepage, the settlement has been on the List of World Heritage Dangers. (Figure 2)

The third one is the city of Bajii, which is located on the west bank of the Tigris and in the Saladin Governorate. The city is considered a connection point between North and South, located 50 km north of Tikrit, the District capital, and 210 km north of Baghdad in the middle of the way to Mosul. The city is a critical junction of the national railway network. This makes the city an important transportation hub and a resting place for travellers between south and north. Baiji is crossed by the railway line connecting the town with the Sharquat district, Mosul to the north, and Tikrit, Samarra, and Baghdad to the south. Also, another railway line connects Baiji with Kirkuk to the east. This line is currently out of service, but if it is reactivated, it will promote the transfer of goods between Baiji and Kirkuk, contributing to the region's economy and reducing heavy vehicle traffic between Baiji and neighbouring cities. The city represents a crucial traffic point for the area's future development; tourism, trade, and industry are the main sectors in the city positively affected by the location of Bajii along this critical way of traffic. Baiji has the largest refinery in the whole country and is the most industrialised city in the Saladin Governorate. Its industrial compound, one of the largest in Iraq, made the city known as the “Industrial City of Iraq”. The presence of big factories and a good transportation connection ensures the city has a dominant position at the Governorate and national level. Thanks to its economic and strategic significance, Baiji plays a vital role at the Governorate and national level. (Figure 3)

Figure 1. The city of Al-Dour

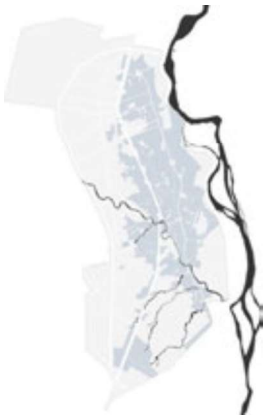

Figure 2. The city of Al-Sharquat

Figure 3. The city of Bajii

The last city selected is Mosul, the capital of the Nineveh Governorate. Mowṣil is the name the Muslim Arabs gave to ancient Nineveh, the capital of the Assyrian Empire, one of the oldest cities in the world. The site of Nineveh is located on the eastern bank of the Tigris River, while Mosul was built on the western bank. Rich in history and traditions, Mosul is a crossroads of trade and cultural exchange. It has witnessed over time the alternation of different civilisations and has been emblematic of the peaceful coexistence of other cultures in the same country, Iraq. Arabs, Kurds, Armenians, Turkmen, Christians and Syriacs coexist harmoniously. In the contemporary period, Mosul has seen its population grow impetuously, making it the third largest city by population in Iraq, after the capital Baghdad and Basra. A fertile agricultural region surrounds it, and some oil fields are nearby. A commercial centre of upper Mesopotamia, favoured by the railway linking Basra and Baghdad with the Turkish rail network, it has considerably developed its industrial sector: a refinery, cement, and textile and food factories. In the three years of occupation by the Islamic State, which had chosen it as its capital, the many battles fought left behind physical, cultural and social rubble. The war left the city with massive destruction in the infrastructure and with around 1M displaced, with an urgent need for reconstruction, in particular the housing sector (Saeed et al., n.d.). Since February 2018, UNESCO has been promoting several initiatives involving the reconstruction and rehabilitation of some of the city's sites with the support of the Iraqi government and the UN Secretary-General. The initiative aims to reconstruct its monuments and historical sites and focuses on empowering the population to change the city's fortunes through culture and education. The action, therefore, develops on a double track: on the one hand, the restoration and rehabilitation of cultural assets, and on the other hand, the revival and strengthening of educational institutions and cultural initiatives.

In conclusion, the chosen cities have the right characteristics to be used as test sites. Furthermore, considering the use of linear attractors as the main design tool, described in the following paragraphs, the four cities are most suitable for the purpose of the research. On one hand, the selected cities follow one another along the Tigris River's banks, one of the country's major historical and cultural landmarks. The Tigris and the Euphrates formed the landscape of ancient Mesopotamia, which was the cradle of Western civilisation in the past. The banks of the Tigris are characterised by a fertile agricultural landscape that, at the same time, is home to significant natural sites and some of the country's major archaeological sites. On the other hand, they follow each other across the main road and railway connecting the capital, Baghdad, with the north of the country. These two linear elements hold, in the first case, historical-cultural, social, and environmental importance, while in the second, they are strategic and commercial. For this reason, these linear elements have been identified as the major factors governing the principles of transformation.

Theoretical framework

To address a complex issue that requires a multidisciplinary and multi-scalar approach, we have relied on several topics that allow us to see the urban transformation from several points of view. Considering four Iraqi cities as test sites, the need to look at the transformation of urban space in a decolonial way was explored as a first issue. From the perspective of containing neo-colonial approaches, we referred to the research of Danielle Emma Johnson, Meg Parsons, and Karen Fisher. Their consideration was considered to help reframe and decolonise climate adaptation in line with local communities' experiences. The authors promote adaptation that draws on Indigenous capacities and aspirations for self-determination and cultural continuity, trying to mitigate the risk of maladaptation and avoid entrenching inequitable power dynamics (Johnson et al., 2022). Furthermore, reference was also made to the work of Ugo Rossi about

what is defined as 'Western urbanology' and a possible revision of the role of contemporary urbanism in economic development processes (Rossi, 2020).
Regarding the role of local communities in climate change adaptation processes, it is essential to mention the work of some authors, such as Fiona Miller and Linda Shi, who promote equitable adaptation and explored how communities and governments might anticipate and resolve some of the humanitarian, livelihood, and ecological challenges associated with resettlement in an increasingly risky climate future (Miller, 2020; Shi, 2021).

Secondly, it was essential to consider the research of some authors on Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA), assuming that the current urban model will necessarily be outdated due to climate change, favouring a long-term vision (Bertin et al., 2019). It also suggested integrating the DRR and CCA cultures to promote economic security and social inclusion for physical and social resilience. This approach can lead to a more radical consideration of climate change issues in local government, fostering new awareness and practices of care of the regional territory (Bertin et al., 2020). Following the authors, it is crucial to understand the value of uncertainty in local recovery planning to design the plan's capability to deal with a future disaster scenario in which it is also necessary to repair the social fabric (Bertin et al., 2024).

The city evolves linearly according to various statistical surveys. However, the evolutionary processes that produce the city are neither linear nor continuous (Aquilué Junyent and Ruiz Sánchez, 2021). This aspect is progressively increasing due to climate change, and uncertainty is drastically rising in environmental and urban dynamics. This makes it necessary to come to terms with a further theme: complexity. Territorial and urban systems, however anthropised, are complex systems (Ruiz Sánchez and Musco, 2021). In mathematical terms, complexity is nothing but the capacity of the system to reach a wide range of unpredictable possible futures. Consequently, the complexity of the urban form appears to stem from accepting a high level of uncertainty and contemplating adaptation at an urban scale, which is the need to recognise uncertainty as a fundamental aspect. To navigate this challenge, one approach is to encourage cities and territories to embrace increased complexity, which does not refer exclusively to diversity but to the ability to access diverse future states (Ruiz et al., n.d.). In building new cities, it's also crucial to recognise our limitations, understand what we don't know and avoid nostalgia for unattainable security (Ruiz Sánchez and Aquilué Junyent, 2023).

These considerations finally bring us to the territory that is the subject of the research proposed in this article. Deconolisation, climate change adaptation, and urban complexity are joined by thoughts and considerations about the Tigris Valley and the environmental, social and economic impacts transforming its territory. In fact, climate change is affecting the Tigris and Euphrates River basins similarly to all other parts of the Middle East and the East Mediterranean region. This is manifested in increased temperatures, reduced precipitation, erratic weather patterns, and decreased annual stream flow of the two rivers (Adamo et al., n.d.). Studies led by Nasrat Adamo and his group revealed that severe shortages occur over the five basins, water resource elements will occur, and the Tigris River stream flow will significantly decline. This situation demands that water and soil management practices be improved to reduce the expected damage (Adamo et al., n.d., n.d.). Droughts are a regular regional feature and have significant social, environmental, and economic impacts. Therefore, there is an urgent need to build riparian areas' resilience and adaptive capacity, focusing on innovative regional-based drought and agricultural investment strategies in the Euphrates and Tigris basins (Özgüler and Yıldız, 2020). As a result of these considerations, it is fundamental to consider the river as the heart of the

proposed plan. The following section describes the approach outlined by the research and the role of the Tigris River in the urban settlements considered.

Methodology

The strategy proposed in the article adopts an adaptive and progressive approach that aims to support the development of city transformation masterplans through an evolutionary model tailored to each town's unique contexts, challenges, and opportunities. By embracing complexity and uncertainty as inherent features of urban form, the strategy ensures that the masterplan remains responsive to dynamic urban landscapes, capable of flexibly accommodating diverse needs and evolving characteristics over time. Central to this approach is the recognition that one-size-fits-all solutions may be unsuitable for addressing the multifaceted complexities of urban environments. Instead, the strategy advocates for a deep understanding of each town's needs and characteristics, allowing for tailored interventions that maximise impact and relevance. Also, a flexible model enables continuous refinement to iterate and adapt strategies in response to emerging challenges and opportunities.
The proposed approach also prioritises adaptability to diverse local design cultures and boasts replicability, allowing local administrations to implement the plan independently. This replication aspect is crucial, as it empowers communities to take ownership of the strategy's implementation process, fostering sustainable and long-term results. By providing a framework that can be readily replicated across various contexts, the research endeavours to catalyse meaningful change at the base level, amplifying the impact of its outcomes. At the same time, while a rigid and colonial approach may be rooted in historical precedents, a flexible methodology seeks to overcome this tendency. It aims to establish an open and adaptable system that empowers planners and administrations to embrace the diverse project cultures inherent in local contexts. By fostering interpretability, a flexible approach strives to cultivate a more inclusive and collaborative environment where local traditions are valued and integrated into the planning process. Through this approach, the research endeavours to navigate from colonialist paradigms towards a more responsive framework for development and decision-making. This approach will apply three main tools, each with a particular role within the overall strategy: the linear attractor, the settlement block, and the matrix.

Using linear attractors as a main design tool is related to their prominent presence within the morphological fabric of urban landscapes. The selection of these elements as focal points stems from the geographical features characterising the chosen cities. For instance, the positioning of these cities along the banks of the Tigris River and adjacent to one of the country's major highways and railways, connecting Baghdad to the northern regions, emerges as crucial factors shaping their urban form.
The river and the transportation routes serve as movement channels and embody multifaceted significance. The Tigris River’s historical, cultural, social, and environmental importance is profound, acting as a conduit for trade, culture, and community life throughout the region's history. Moreover, its presence often defines the cities' spatial organisation and cultural identity along its banks. Similarly, the strategic placement of these cities along key highways and railways underscores their importance as hubs of commerce, transportation, and connectivity. These linear infrastructural elements facilitate the movement of goods and people and serve as nodes for economic activity and urban development. Their strategic significance extends beyond mere transportation routes, influencing the spatial distribution of settlements, industries, and commercial centres along their trajectories. The research recognises and harnesses the inherent value of these linear attractors, endeavouring to leverage their spatial potential in the

design process. These elements can catalyse urban development rooted in their cultural and geographical context through thoughtful integration and reinterpretation.

The settlement block as a tool is related to a widespread feature characterising most Iraqi urban areas: a settlement scheme formed by recognisable blocks. For this reason, the scale of the urban block should be taken as a starting point for developing the transformation strategy. The main goals of an approach based on a settlement block concern the relationship between public and private spaces, between open and built spaces and their possible evolution. A recurring size of blocks allows us to think of a limited number of repeatable solutions that can be combined to meet, whenever, different needs. The scale of these urban blocks plays a crucial role in determining a neighbourhood's overall character and functionality (Figure 4). Larger blocks may accommodate higher-density development, while smaller blocks may prioritise pedestrian-friendly design and green spaces. By carefully calibrating the size and configuration of blocks, it is possible to strike a balance between density and liveability, ensuring that each neighbourhood meets the diverse needs of its residents.

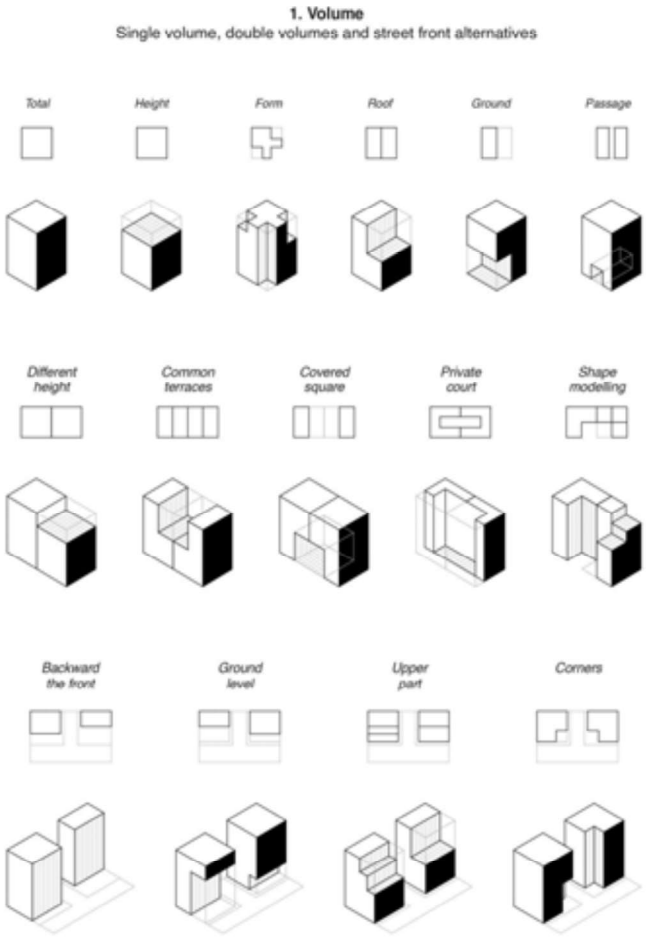

Figure 4. Abacus of volumes

In addition to physical design considerations, the settlement block approach encompasses social and cultural factors, promoting diversity and inclusivity within neighbourhoods. This may involve incorporating affordable housing units and community facilities within the fabric, fostering a sense of belonging and social cohesion. Furthermore, the settlement block approach recognises the importance of adaptive management in urban planning. Cities are dynamic, evolving entities shaped by social, economic, and environmental issues. The strategies involved must be flexible and responsive to changing conditions, allowing for iterative adjustments. Adopting an adaptive management framework makes the proposed tools continuously relevant and practical amid uncertainty and complexity.

This is strongly related to the third tool: the matrix. The matrix proposed combines the most common urban types with the main linear elements of metropolitan areas: the Tigris River and

the main road axes. Integrating a matrix that combines various urban typologies with key linear elements offers a comprehensive framework for organising and synthesising various urban typologies and spatial elements, recognising that cities are composed of diverse land uses, from residential and commercial areas to parks and transportation corridors (Figure 5). By categorising these elements according to their functional and spatial characteristics, it is possible to identify synergies and trade-offs between different components of the urban landscape. One of the key advantages of the matrix approach is its ability to facilitate integrated decision-making, developing more integrated and sustainable solutions to complex urban problems by considering the interdependencies between land uses and infrastructure systems. Moreover, the matrix approach enables planners and local authorities to explore alternative scenarios and evaluate the potential impacts of different planning decisions. By manipulating the variables within the matrix, such as land use mix and density levels, the effects of various development patterns on key performance indicators, such as traffic congestion, air quality, and social equity, may be simulated.

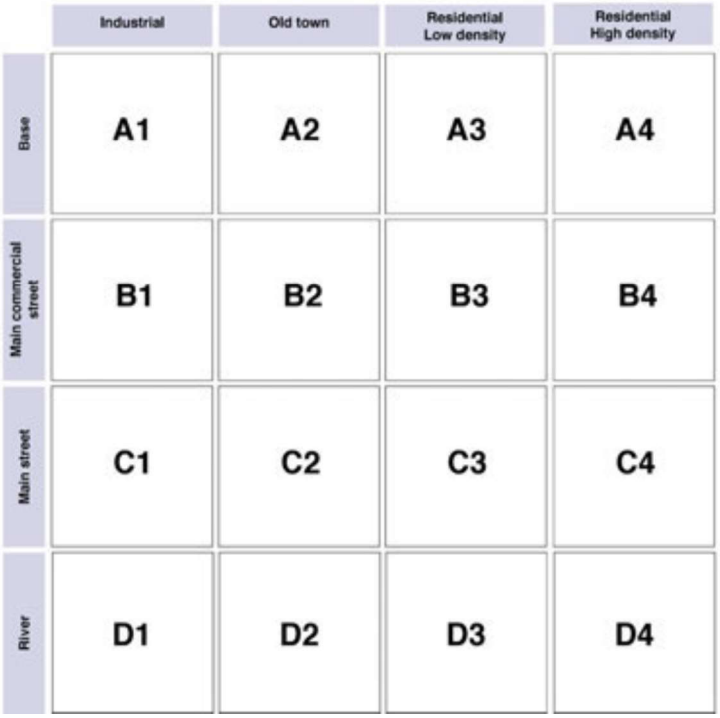

Figure 5. The matrix proposed

Finally, indicators will be used to monitor and evaluate the performance of urban interventions. Indicators provide quantitative measures of progress towards predefined goals and objectives, allowing planners and administrations to track the effectiveness of their strategies over time. Indicators play a crucial role within this approach by providing tangible evidence of the impact of interventions on various aspects of urban life. Planners can make informed decisions and adjust their strategies by establishing clear metrics for assessing environmental, social,

economic, and policy outcomes. In addition to providing valuable insights for decision-making, indicators also serve as a communication tool for engaging stakeholders and the public. By presenting data in a clear and accessible manner, it is possible to foster dialogue and collaboration around urban issues and build support for their initiatives.

Results

The results of the methodology described above unveil a comprehensive understanding of development strategies. A first application hypothesis of the proposed approach has emerged, capitalising on the chosen cities' similar geographical and settlement characteristics. This similarity facilitated the identification of a singular initial proposal, applicable uniformly across all four cities but firstly tested in Al-Dour (Figure 6), Al-Sharquat (Figure 7) and Bajii (Figure 8). Central to this were the linear attractors identified, notably the Tigris River and the principal road and railway networks. The arterial highway linking Baghdad to Mosul, alongside significant trade routes within each city, emerged as the primary consideration. These routes, influenced by traditional Arab commerce and possessing intrinsic cultural and historical significance, also held strategic importance within each city.

Figure 6. Linear attractors for Al-Dour

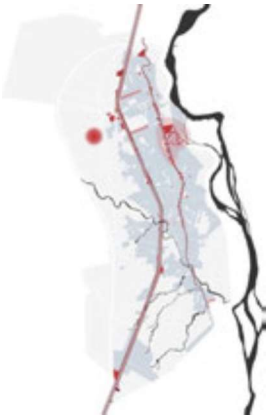

Figure 7. Linear attractors for Al-Sharquat

Figure 8. Linear attractors for Bajii

Further analysis revealed the predominant urban typologies suitable for this approach. These included the residential fabric, characterised by varying densities, the expanding industrial zones crucial for economic growth, and the cherished historical centres steeped in cultural heritage.
Consequently, a matrix emerged, integrating these elements into a clear urban development framework. The Tigris River and primary thoroughfares formed the basis of linear attractors, while residential, industrial, and historic fabrics delineated the identified urban typologies (Figures 9, 10, 11). Each intersection within this matrix was assigned an identification code as a reference point for subsequent planning endeavours.
The formulation of formal rules and parameters, alongside the establishment of abacuses of potential solutions, provided a structured approach to city transformation and development. These regulations encompassed various aspects, including building form and volume,

interventions such as green roofing, street design, and integrating green and public spaces. Additionally, considerations were made for ground floor usage and delineating buffer zones near watercourses, ensuring sustainable and resilient urban environments.

Figure 9. Different urban types for Al-Dour

Figure 10. Different urban types for Al-Sharquat

Figure 11. Different urban types for Bajii

Several considerations emerged in every city, laying the base for a comprehensive urban transformation development. Firstly, in all cities, the Tigris emerged as a complex system composed mainly of public green areas, orchards, cultivated fields, wetlands and protected areas of high landscape value (Figures 12, 13, 14). Associated with this system of green areas is the system of archaeological sites that are often located along the river. Historical city centres also stand along the banks. The city's landscape, particularly the meandering river, coupled with its strategic positioning adjacent to a major thoroughfare, signifies the potential growth across tourist and commercial sectors. Prioritising waterfront revitalisation, the urban plans emphasise the development of the different riverfronts, envisaging the creation of new tourist attractions, recreational facilities, and green spaces along the banks of the Tigris River.

Figure 12. River and green system of Al-Dour

Figure 13. River and green system of Al-Sharquat

Figure 14. River and green system of Bajii

Secondly, a strategic approach to city planning envisions the development along the central spine, primarily the main road, a common and robust urban element for all the cities considered. This structured expansion aims to optimise spatial utilisation and accessibility. Recognising the pivotal role of main roads, master plans allocate commercial zones along these arteries, capitalising on their inherent connectivity and visibility. To alleviate traffic congestion and enhance circulation efficiency, the proposal includes the implementation of a bypass strategically positioned in zones, diverting traffic away from the city centre to permit the transformation of many car-based streets into cyclo-pedestrian paths.

Lastly, formulating rules, parameters, and proposed abacuses represents a pivotal step towards envisioning a transformative system for built space. This system enhances diversity and complexity within various urban areas and serves as a cornerstone in the broader context of climate change adaptation and urban redevelopment. In the face of escalating climate challenges, prioritising complexity in urban design and planning becomes increasingly apparent. Furthermore, recognising complexity as a fundamental tool in urban transformation underscores the importance of adopting an interdisciplinary approach to city planning. The emphasis on complexity in urban transformation represents a paradigm shift towards more inclusive, adaptive, and sustainable urban futures by embracing the intricate web of interactions and interdependencies inherent in urban space. (Figures 15, 16, 17)

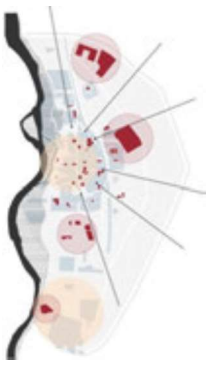

Figure 15. Strategic masterplan of Al-Dour

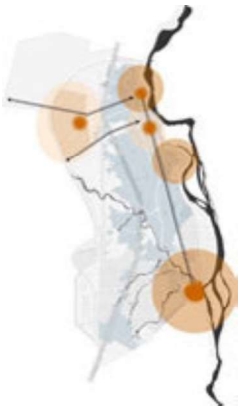

Figure 16. Strategic masterplan of Al-Sharquat

Figure 17. Strategic masterplan of Bajii

Conclusions

In conclusion, the article describes the steps of the research conducted, where the work carried out within the three minor cities emerged as a pivotal pilot experience that will feed into Mosul's transformation and reconstruction plan. Focusing on tailored strategies for each urban centre, the research underscores the potential to unlock these cities' changes while preserving their rich cultural heritage, aspiring to unearth a blueprint that can be customised and implemented in varied urban landscapes. Recognising the urgency for transformation, the study advocates for a comprehensive approach to rebuilding Iraq's cities. Additionally, departing from a colonialist approach, the research outcomes were geared towards a flexible approach tailored to embrace

local planning cultures. Simultaneously, this adaptability fosters envisioning a system amenable to accommodate varying, facilitating the encounter of mitigation, adaptation, and resilience-building measures to address today's challenges.

Acknowledgements

The research involved collaboration at all phases as a private cooperator and funder of Studio Galli SGI of Padua, without which this entire project would not have been possible. We would also like to thank Jacopo Galli and Elisa Vendemini of the Iuav University of Venice for their scientific advice on the areas in question in urban design.

References

Adamo, N., Al-Ansari, N., Sissakian, V.K., n.d. Global Climate Change Impacts on Tigris-Euphrates Rivers Basins.

Adamo, N., Al-Ansari, N., Sissakian, V.K., Knutsson, S., Laue, J., n.d. Climate Change: The Uncertain Future of Tigris River Tributaries' Basins. Clim. Change.

Adamo, N., Al-Ansari, N., Sissakian, V.K., Laue, J., Knutsson, S., n.d. The Future of the Tigris and Euphrates Water Resources in view of Climate Change.

Al, S., 2022. Multi-functional urban design approaches to manage floods: examples from Dutch cities. J. Urban Des. 27, 270–278. https://doi.org/10.1080/13574809.2021.1977112

Aquilué Junyent, I., Ruiz Sánchez, J., 2021. Ciudad, complejidad y cambio: fundamentos para el análisis de la incertidumbre en sistemas urbanos. Rev. INVI 36, 7–34. https://doi.org/10.4067/S0718-83582021000100007

Berke, P.R., Campanella, T.J., 2006. Planning for Postdisaster Resiliency. Ann. Am. Acad. Pol. Soc. Sci. 604, 192–207. https://doi.org/10.1177/0002716205285533

Bertin, M., Maragno, D., Musco, F., 2019. Pianificare l'adattamento al cambiamento climatico come gestione di una macro-emergenza locale. TERRITORIO 138–144. https://doi.org/10.3280/TR2019-089018

Bertin, M., Musco, F., Fabian, L., 2020. Rethinking planning hierarchy considering climate change as global catastrophe. Clim. Risk Manag. 30, 100252. https://doi.org/10.1016/j.crm.2020.100252

Bertin, M., Negretto, V., Musco, F., 2024. Post-earthquake Repositioning in a High-Value Heritage Context. J. Plan. Educ. Res. 44, 346–358. https://doi.org/10.1177/0739456X20984519

Birkmann, J., Von Teichman, K., 2010. Integrating disaster risk reduction and climate change adaptation: key challenges—scales, knowledge, and norms. Sustain. Sci. 5, 171–184. https://doi.org/10.1007/s11625-010-0108-y

Burkhard, B., Kroll, F., Nedkov, S., Müller, F., 2012. Mapping ecosystem service supply, demand and budgets. Ecol. Indic. 21, 17–29. https://doi.org/10.1016/j.ecolind.2011.06.019

Johnson, D.E., Parsons, M., Fisher, K., 2022. Indigenous climate change adaptation: New directions for emerging scholarship. Environ. Plan. E Nat. Space 5, 1541–1578. https://doi.org/10.1177/25148486211022450

Miller, F., 2020. Exploring the consequences of climate-related displacement for just resilience in Vietnam. Urban Stud. 57, 1570–1587. https://doi.org/10.1177/0042098019830239

Özgüler, H., Yıldız, D., 2020. Consequences of the Droughts in the Euphrates - Tigris Basin.

Quigley, M., Blair, N., Davison, K., 2018. Articulating a social-ecological resilience agenda for urban design. J. Urban Des. 23, 581–602. https://doi.org/10.1080/13574809.2018.1440176

Rossi, U., 2020. Fake friends: The illusionist revision of Western urbanology at the time of platform capitalism. Urban Stud. 57, 1105–1117. https://doi.org/10.1177/0042098018821581

Ruiz, J., Bertin, M., Aquilué, I., n.d. Forma urbana, vulnerabilidad e incertidumbre. La complejidad de la forma urbana en relación con la catástrofe.

Ruiz Sánchez, J., Aquilué Junyent, I., 2023. Post-COVID cities: some reflections on planning in uncertain times, in: Kresl, P.K., Bertin, M. (Eds.), The Impact of COVID on Cities and Regions. Edward Elgar Publishing, pp. 92–109. https://doi.org/10.4337/9781035308958.00014

Ruiz Sánchez, J., Musco, F., 2021. Incertidumbre. Planificar en marcos de incertidumbre / habitar en tiempos de incertidumbre. Rev. INVI 36, 1–6. https://doi.org/10.4067/S0718-83582021000100001

Saeed, Z.O., Almukhtar, A., Abanda, F.H., Tah, J.H.M., n.d. Housing and Displacement in Post-Conflict Zones: Planning Post-ISIS Mosul by the Eye of the Displaced.

Shi, L., 2021. From Progressive Cities to Resilient Cities: Lessons from History for New Debates in Equitable Adaptation to Climate Change. Urban Aff. Rev. 57, 1442–1479. https://doi.org/10.1177/1078087419910827