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Exploring Urban Service Location Suitability: Mapping Social Behavior Dynamics with Space Syntax Theory

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Abstract: Assessing urban service locations is a key issue within city planning, integral to promoting the well-being of citizens, and ensuring effective urban development. However, many current approaches emphasize spatial analysis focused solely on physical attributes, neglecting the equally vital social dimensions essential for enhancing inhabitants' comfort and quality of life. When social factors are considered, they tend to operate at smaller scales. This paper addresses this gap by prioritizing integrating social factors alongside spatial analysis at the community level. By employing space syntax theory, this study investigates urban service suitability in Hajjah, a Palestinian urban community, presenting a novel approach in the literature. The research identifies good spots for essential governmental facilities like health clinics and fire stations using axial map analysis. It also suggests reallocation for some schools. Additionally, it shows ways to improve the placement of community amenities, finding ideal park locations but suboptimal mosque placements. Commercial services also exhibit areas for enhancement including gas stations and shops. The insights from this research can offer policymakers and planners insights to create more efficient, equitable, and accessible cities. The research approach incorporates social behavior dynamics into spatial analysis, promoting inclusive urban planning.

Keywords: space syntax; planning; urban; services; spatial analysis; social; dynamics

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Citation: Qanazi, S.; Hijazi, I.H.; Shahrour, I.; Meouche, R.E. Exploring Urban Service Location Suitability: Mapping Social Behavior Dynamics with Space Syntax Theory. *Land* **2024**, *13*, 609. https://doi.org/10.3390/land13050609

Academic Editor: Thomas Panagopoulos

Received: 12 April 2024
Revised: 27 April 2024
Accepted: 30 April 2024
Published: 30 April 2024

1. Introduction

Assessing the appropriateness of urban service location is a crucial aspect of city planning, as it affects the comfort and quality of life for residents [1–3]. It plays an important role in fostering effective urban development by offering planners and policymakers insights to make cities more efficient and easier to use for people [4–6]. However, many current approaches often prioritize spatial analysis of physical attributes, overlooking the equally vital social dimensions that are just as important in improving the overall well-being of residents [7–10]. Social factors are often considered at smaller scales, despite including important factors like accessibility, safety, inclusivity, and community cohesion [11–13]. Considering their crucial roles, it can be challenging for researchers to quantify and map these social components [14–16].

There have been many different approaches proposed to quantify them, including social return on investment (SROI), impact assessment tools, stakeholder engagement, sustainable development goals, and analyzing social networks [17]. However, unlike conventional approaches that primarily focus on describing social phenomena in numerical terms, neglecting their spatial manifestations, space syntax analysis stands out for its ability to untangle spatial dynamics influencing social behavior [18]. While some spatial analysis methods concentrate solely on the physical attributes of societies, space syntax has evolved into a comprehensive framework initially designed to explore the interplay between society and spatial configurations [19]. Moreover, the theory of space syntax provides specific metrics derived from empirical studies that correlate with human spatial behavior, making space syntax a valuable tool for predicting architectural and urban design impacts [20–22]. This contrasts with other spatial methodologies that often overlook social dimensions or confine their analyses to smaller scales.

This concept's fundamental premise is dividing spaces into constituent elements that are then taken apart as networks of choices. Connectivity, integration, and choice are central tenets in analyzing spatial structures such as street networks within space syntax theory [23]. Connectivity refers to the extent of linkage between streets and urban features, facilitating movement [24]. Integration assesses the accessibility and linkage between different urban areas [25]. Choice quantifies the diversity of pathways available to navigate the urban space and the degree of freedom afforded to individuals [22].

These analyses yield graphical representations and maps that illustrate the spatial structure of urban space including axial maps, convex spaces, and isovists [19,24,26,27]. Among these, the axial map emerges as the most prevalent, depicting primary movement routes within the city [24,27]. Axial lines, integral to space syntax theory, delineate the lengthiest continuous pathways of movement, including major thoroughfares like boulevards [27]. These lines constitute the structural backbone of urban spaces, their interconnection pivotal to urban functionality [24].

Space syntax components enable quantitative assessment and characterization of navigational ease, aiding in optimizing urban service distribution [18,28]. Moreover, space syntax analysis forecasts correlations between spatial configurations and societal phenomena like crime rates and traffic patterns [22]. Integrating space syntax theory with geographic information systems (GIS) enhances analytical capacity, data management, visualization, and evidence-based decision-making [20,29].

Recent studies, however, have highlighted the significance of space syntax theory in shaping urban service provision at the broader city/urban scale. Space syntax theory, with its fundamental perceptions of space, integrates certain parameters like integration, connectivity, choice, and spatial configuration analysis, which are used to understand the performance of urban services [30]. Similarly, space syntax and built environment factors were applied to the four residential complexes of Tirana, showing how the location and type of activities are related to visual and spatial integration [28]. Space syntax in tourism-oriented rural areas was utilized, optimizing layouts and facilities to promote sustainable development [31].

Various studies demonstrate that incorporating integration, choice, and connectivity values is crucial in allocating urban services [30,32–43]. Li and Li (2023) studied community-based elderly care facilities, finding that areas with higher integration and choice values attracted more users. Körmeçli (2023) observed that increased street connectivity and integration improved accessibility to essential services, indicating the importance of a well-interconnected street grid in delivering urban services. Moreover, Xing and Guo (2022) developed a method merging space syntax theory with geographic information systems for urban space analysis. They found a positive link between area integration and specific building traits in Wuxi's old city [44]. This approach holds promise for understanding urban dynamics and addressing challenges [44–46].

In summary, there is a notable trend toward using space syntax for analyzing urban services. However, few studies integrate geographic information systems (GIS) alongside these applications, as evidenced by data from the Web of Science. Nevertheless, the bulk of research in this domain predominantly concentrates on the microscale, delving into building or neighborhood-level analyses. While this approach caters to individual cases' specificity and privacy concerns, it often needs more breadth to formulate standardized recommendations applicable across entire cities or urban areas.

The main contribution of this paper is to bridge this crucial gap by prioritizing integrating social factors alongside spatial analysis at the community level. By employing space syntax theory, this study investigates urban service suitability rooted in inhabitants' social behavior facilitated by GIS-based technological tools. By categorizing services by size into local and regional public spheres and by type into essential governmental facilities, community amenities, and commercial services, the research underscores the pertinent criteria and parameters—such as integration, connectivity, and choice—essential in applying space syntax theory. The outcomes of this analysis have significant implications for government officials and city planners. It gives them valuable insights to create urban environments that are effective and easy to navigate, meeting the diverse needs of residents. By providing a structured framework for developing cities that are more livable and inclusive, this research contributes to advancing urban planning strategies [47–52].

2. Materials and Methods

This study adopts a comprehensive approach to assess how urban services are distributed and how effective they are in a specific area. The study is organized into sequential phases. The first step involves carefully preparing the data by converting road networks into axial lines using DepthmapX software (version 0.6.0) and categorizing urban services data into different types. Subsequently, space syntax theory was applied to analyze these axial lines thoroughly, considering integration, choice, and connectivity metrics for both the network and the urban services situated on it. The final phase involved creating spatial mapping and using these metrics to build an index for each type of urban service, identifying optimal locations based on their associated values to enhance operational efficiency. Following this, a comparative analysis was made between the existing service locations and the identified optimal positions (Figure 1).

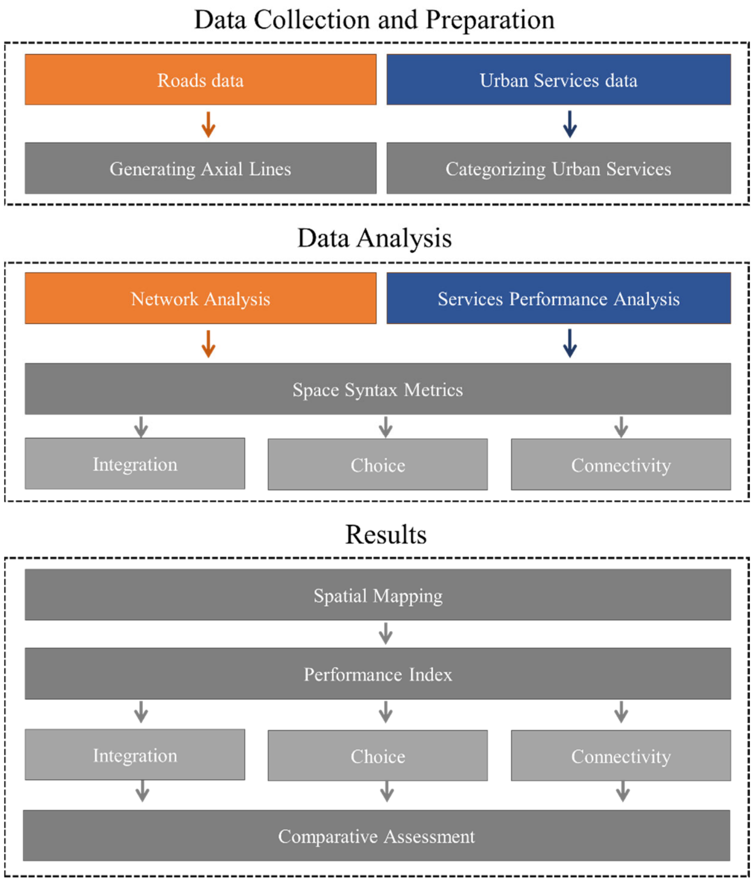


Figure 1. Research methodology.

This evaluation measures the suitability and effectiveness of current service distributions. The results from this comparison are then communicated using spatial mapping and graphs, providing stakeholders with a clear understanding of spatial dynamics of urban services.

2.1. Data Collection and Preparation

In this research, we used data from the Palestinian Ministry of Local Government Geospatial Portal (GeoMOLG), which is recognized as the main source of geospatial information in Palestine. This dataset was comprised of two primary components: the road network and the precise locations and categories of urban services. Trained surveyors gathered and digitized these data to make sure it was accurate and reliable. With ArcGIS software (version 10.7), we processed the relevant data by outlining all the streets within the administrative boundaries of the study areas, including both main and local roads. Agricultural unpaved roads lacking access to any built-up areas were excluded from the analysis. Subsequently, we transferred the data to AutoCAD to create axial lines. We performed thorough checks to ensure accuracy and consistency in the axial lines, making sure to address any inaccuracies or omissions. Metadata, containing details on how data were collected, its accuracy, and reliability, underwent thorough review and validation by the data provider to ensure its correctness. The dataset was then input into the DEPTHMAP program, which facilitated the transformation of roads into axial lines while attributing metrics corresponding to various space syntax theory concepts like integration, choice, and connectivity. This refined dataset was the base for analyzing diverse urban services' spatial configuration and efficacy within the study regions. The meticulous preparation of the data was paramount in guaranteeing the precision and dependability of the analysis that followed. Utilizing different software tools and the thorough verification of the data at every stage were integral strategies employed in this study to mitigate errors and uphold the credibility of the findings.

2.2. Data Analysis

Data analysis was conducted for the network and the urban services across several parameters, including integration, choice, and connectivity.

2.2.1. Network Analysis

Various perceptions exist to depict urban spaces, such as convex spaces, axial lines, and isovists. Among these, axial lines are the most commonly utilized, representing a city's most extended uninterrupted movement pathways. In our investigation, axial maps were selected because they are effective in examining how connected and accessible urban networks are. Although convex spaces and isovists might be better suited for open areas, axial maps are favored for urban analysis because they put emphasis on the significance of street networks.

During the analysis stage, the axial lines of the street network underwent scrutiny depending on three primary metrics: integration, choice, and connectivity. Integration assesses how important a street segment is for smooth movement flow by analyzing if it lies on the shortest path between all other segments in the network. Choice quantifies evaluates the potential of a street segment to offer an alternative route, suggesting its potential for facilitating diverse movement patterns. Connectivity gauges a street segment's interconnection with others, reflecting its accessibility potential. Local values of these parameters, such as connectivity, inform decisions regarding urban service placement; for instance, positioning a school on a highly connected road. After that, space syntax theory computes integration, choice, and connectivity values for the entire urban network.

2.2.2. Services Performance Analysis

In this phase, each category of urban service was geospatially positioned in proximity to the closest axial line, and its associated metrics were evaluated. For example, educational services were allocated a local value, considering their service provision to the residents, and were assessed based on connectivity metrics.

2.3. Performance Index Calculation

A performance index was devised for each service type to assess the effectiveness of diverse urban services, drawing upon integration, choice, and connectivity values. Depending on these metrics for each service, the spatial analysis aims to offer an exhaustive comprehension of their efficacy in the study areas.

Each metric represents distinct attributes of urban services stemming from mathematical and statistical equations. These equations have been refined to furnish a robust framework for evaluating urban services and grasping their attributes. The metrics encompass the following [19].

Integration pertains to the extent of connection that a location within the urban network maintains with other locations. The integration value can be computed through the equation:

$$I(x) = \sum(d(x,y))\hat{}(-\alpha), \quad (1)$$

where I(x) signifies the value obtained through integration at a specific location x, and d(x,y) denotes the shortest distance between locations x and y in terms of their topology. The parameter α plays a vital role in determining how quickly the influence of distance on integration diminishes.

Choice pertains to the ease of accessibility of a location from other places with the least number of steps required. The calculation of the choice value can be performed using the following equation:

$$C(x) = \sum(n(x,y))\hat{}(-\beta), \quad (2)$$

In this equation, C(x) represents how much the choice is valued at a specific location x, n(x,y) signifies the minimum number of turns necessary to get from x to y, and β is a parameter that controls how quickly the influence of turns on decisions decreases.

Connectivity refers to the level of direct linkage a location maintains with others. The connectivity value can be computed based on the equation:

$$K(x) = \sum k(x,y), \quad (3)$$

where K(x) symbolizes the connectivity value at location x, while k(x,y) stands for a binary variable equating to 1 if x and y are directly linked and 0 otherwise.

Drawing upon integration, choice, and connectivity metrics, this index precisely identifies the ideal benchmarks for each service category; hence, areas which can yield optimal performance are defined. The index computation entails determining the highest and lowest values across integration (spanning from min(I(x)) to max(I(x))), choice (ranging from min(C(x)) to max(C(x))), and connectivity (from min(K(x)) to max(K(x))) metrics. It is essential to note that the target value should ideally fall below the maximum limit also depending on the accessibility of prime locations.

The axial lines analysis combined methodologies of Bill Hillier and Julienne Hanson that offer a macro-level perspective, alongside Alasdair Turner's "Angular Analysis", which focuses on micro-level street [23,53]. The adoption of angular segment analysis with radius was deemed effective for movement analysis. Calculations were executed using DEPTHMAP software, chosen for its alignment with the analytical approach employed.

The analysis results are presented using spatial mapping and graphical representation. Then, a comparison between the current service locations and the ideal values assessed their suitability and efficacy, outlining optimal locations depending on the availability of ideal values to optimize performance.

3. Results

3.1. Research Area

The selected focal point of this study was Hajjah, a Palestinian urban community situated in the Northern West Bank (Figure 2). It is located specifically in the eastern part of the Qalqiliya governorate, as presented in the enlarged section of Figure 2. Hajjah holds significance as a local hub for the neighboring communities within the governorate, evident in the range and quality of services available to its inhabitants and the surrounding villages. This characteristic makes it perfect choice for the application of space syntax theory to scrutinize various urban services' spatial distribution and efficacy within the locale.

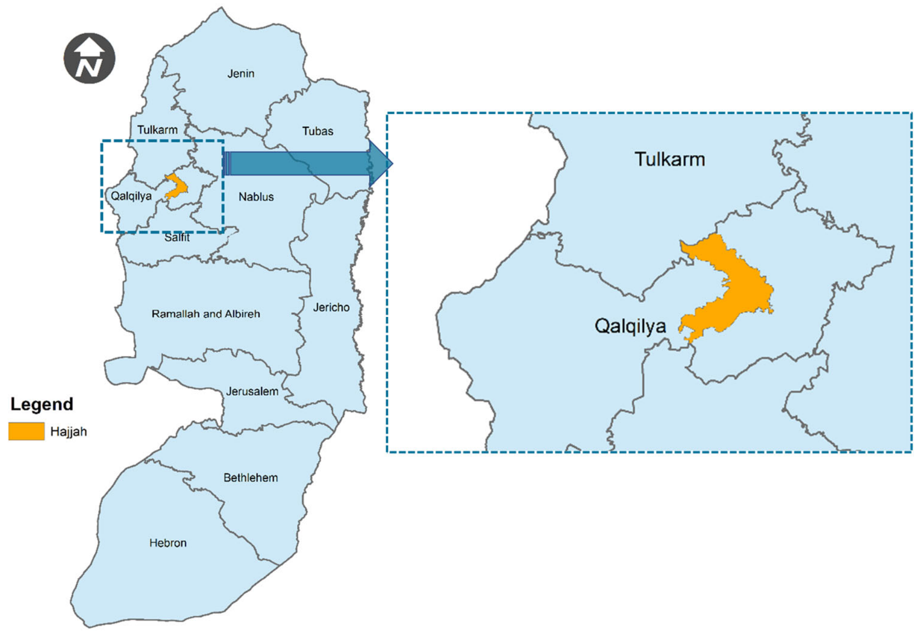


Figure 2. Study area. Note: Hajjah, a Palestinian urban community located in the eastern part of the governorate of Qalqiliya, is depicted on an ArcGIS-generated map (v10.7) (Data from the Palestinian Ministry of Local Government Geospatial Portal).

In the context of Hajjah, a local center with services extending to neighboring villages, certain services like the fire station possess a broader, regional significance, denoted as a global value. Conversely, other services within Hajjah, like specific schools, cater solely to the local populace, thus holding a localized value. Hajjah's services are categorized into three primary groups: (1) essential governmental services, covering healthcare, education, and civil defense; (2) commercial services, including shops and filling stations; and (3) community amenities, such as mosques and parks.

To thoroughly examine the spatial configuration and effectiveness of various urban services in the research area, a detailed description was compiled for each kind of service, encompassing its categorization, description, and pertinent metrics for examination. Table 1 highlights the range of services available in Hajjah alongside their respective metrics earmarked for analysis.

Moreover, the edge effect can significantly impact the understanding of spatial configurations, and it is essential to address it effectively [54–56]. Various approaches are proposed in the literature, such as using different centrality measures and carefully defining the boundary of the study area, offering avenues to address this challenge [23,55,56]. In essence, designing the study area boundary requires consideration of the research context and its relevance to the problem at hand [55].

In our study, we carefully considered the unique characteristics of the road network and its context, particularly its centralization around the main road and our utilization of axial lines. This method aligns with empirical studies of space syntax, known for its effectiveness in analyzing social behavior, which constitutes our primary focus. However, eliminating the edge effect entirely remains a complex task.

Table 1. Services type and description in Hajjah and their corresponding values.

Service Categories	Service Type	Service Description	Value Type	Needed Values *
Basic governmental services	Health Clinic	Serving town residents and neighboring villages.	Global	Integration
	Schools	Serving residents across various town parts and some nearby villages.	Global and Local	Integration and Connectivity
	Fire station	Serving the town and neighboring villages	Global	Integration and Choice
Community services	Park	Serving all communities' inhabitants.	Global	Integration
	Mosques	Serving the population across different town sections.	Local	Connectivity
Commercial services	Filling station	Catering to passersby	Global	Integration and Choice
	Commercial facilities	Providing services to town residents and passersby.	Global	Integration and Choice

* The needed values were established by considering the service scope and description.

3.2. Spatial Mapping

When analyzing space syntax, a common technique is to map the computed values of integration, choice, and connectivity to visually depict the spatial attributes of the urban network. These mappings aid in discerning the interrelations between different segments of the city and the distribution of services across the area. By showcasing how each service location performs on these maps, it becomes feasible to evaluate the efficacy of their current placements and how they relate to the metrics of integration, choice, and connectivity. Additionally, these mappings afford a holistic perspective of the urban milieu, spotlighting areas potentially lacking in service coverage and those seamlessly integrated and interconnected with the broader network.

Applying the formulas and executing spatial analyses utilizing DEPTHMAP software generated the maps in Figure 3, delineating each value type pertinent to the community of Hajjah. These maps exhibit a discernible pattern in the distribution of integration, choice, and connectivity values across the town. The central area and its peripheries showcase the greatest concentration of the values of integration, with a gradual decline noted as one moves away from this area as shown in Figure 3a. Furthermore, the main streets within the town display elevated choice values, indicative of heightened demand for commercial services and other amenities situated along these routes, rendering them more accessible to a broader population as presented in Figure 3b. Additionally, connectivity values peak in the intersections adjoining the main roads, underscoring the strategic significance of situating public services to guarantee seamless connectivity and accessibility as shown in Figure 3c.

3.3. Performance Index Outcomes

A performance index was devised to assess the effectiveness of different urban services, drawing upon integration, choice, and connectivity metrics. This index delineates the optimal values for each category of services, pinpointing areas spatially with the highest potential for top performance. Calculations for the index were based on the highest and lowest values, with integration values spanning from 0.030 to 0.082, choice values from 3836 to 1818171, and connectivity values ranging from 1 to 5. It is imperative to recognize that the ideal value would fall below the maximum, contingent upon the availability of prime locations. For example, commercial services thrive in areas boasting the maximum integration values, whereas schools are ideally situated in areas with robust connectivity. Subsequently, each service's current value was compared to the ideal value utilizing the index. The mean value for each service type was computed and contrasted with its ideal value as shown in Figure 4a–c. These findings were then spatially depicted on maps, depicting each service's performance in its ideal state.

Figures 4 and 5 delineate the mean values for various services compared to their ideal benchmarks. This comparison facilitates a clear comprehension of how each service's current location aligns with its possibility to achieve optimal performance. The maps and charts serve as invaluable instruments for evaluating the appropriateness and efficacy of each service's existing location within the study area, thereby aiding future decision-making processes for service delivery and urban planning.

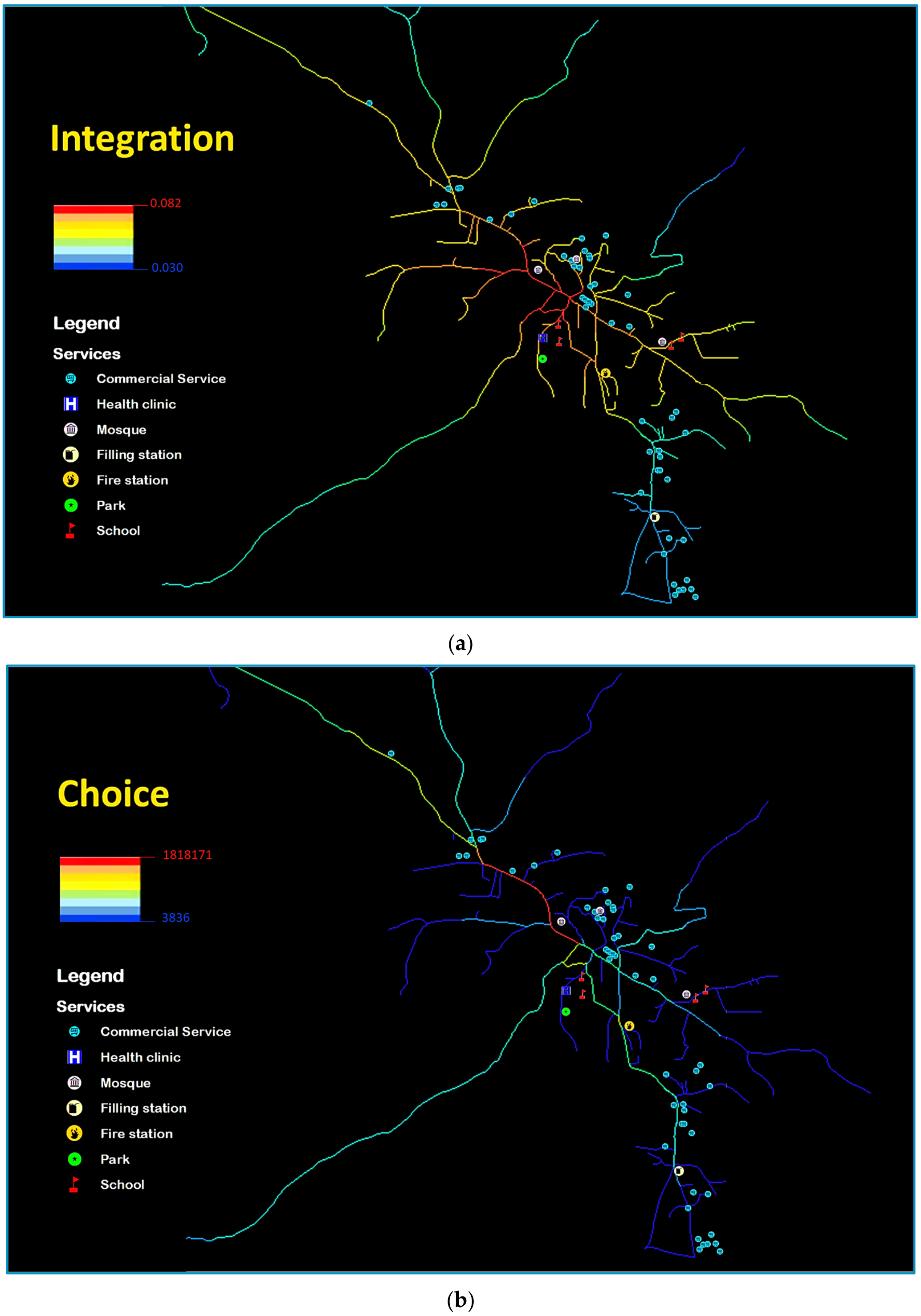
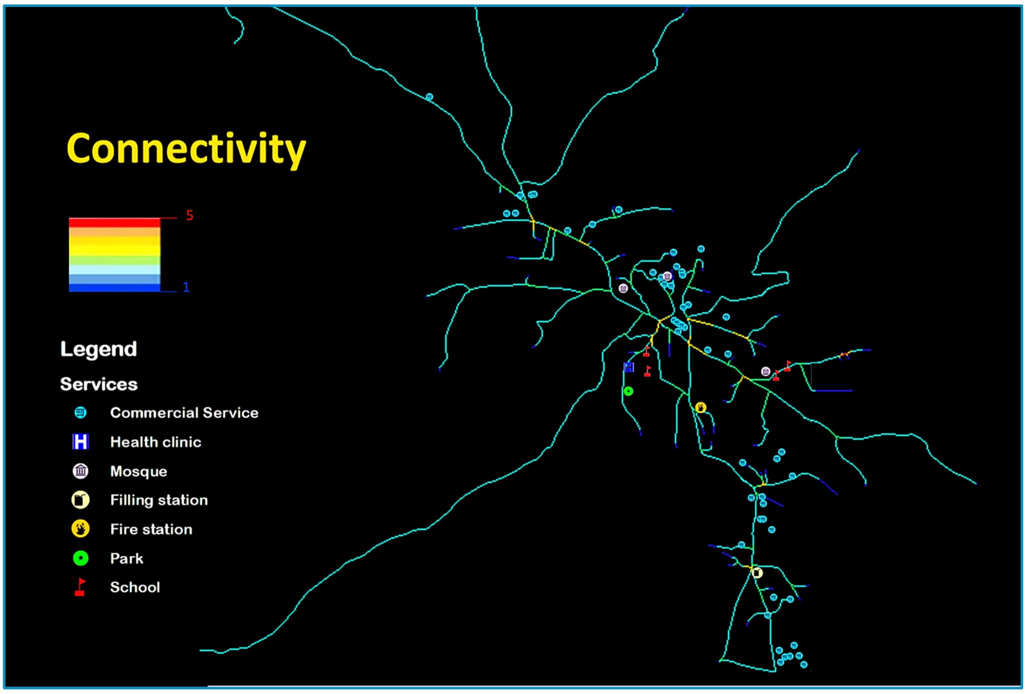
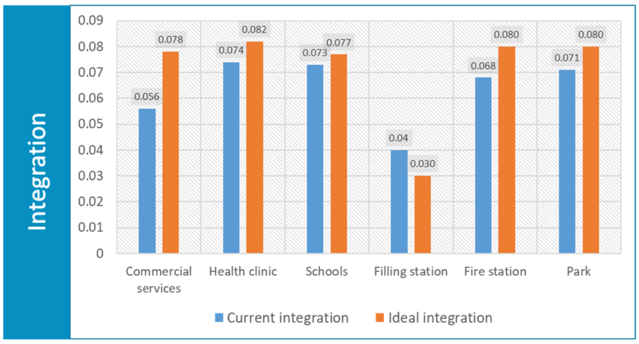


Figure 3. *Cont.*

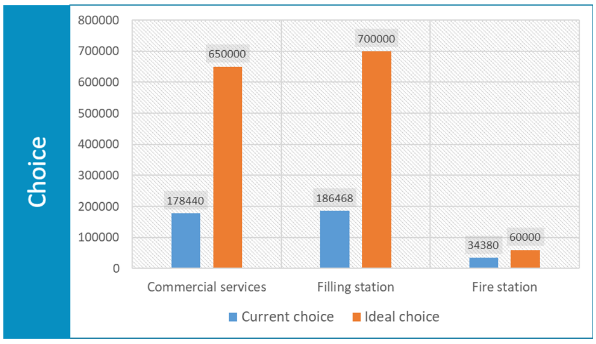


(**c**)

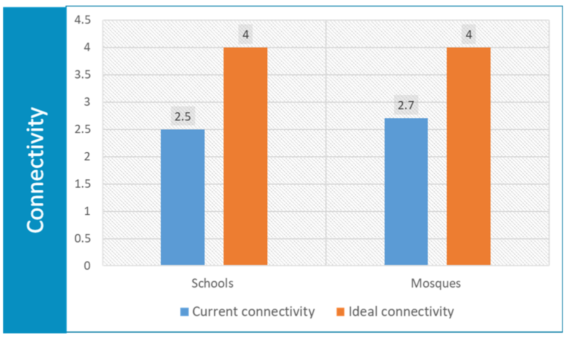
Figure 3. Spatial configuration of urban services in Hajjah depending on the different metrics. The metrics include the following: (**a**) integration; (**b**) choice; (**c**) connectivity. Note. The map exhibits a discernible pattern in the distribution of metrics across the town. It was created using the integration between DEPTHMAP and ArcGIS (v10.7).



(**a**)



(**b**)



(**c**)

Figure 4. Comparison between the average metrics and their corresponding ideal metrics. The metrics include the following: (**a**) integration; (**b**) choice; (**c**) connectivity.

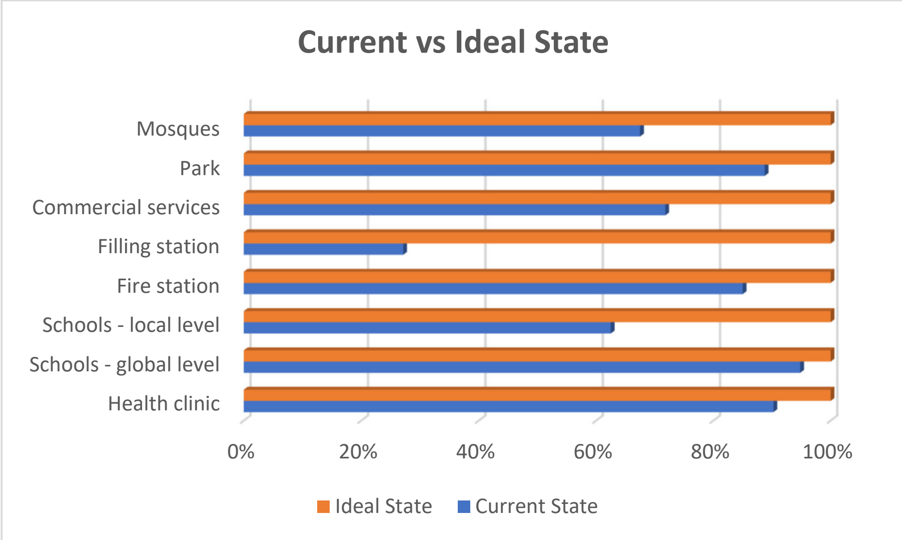


Figure 5. Comparison between the average values of different urban services and their corresponding ideal values. Note: the graph serves to summarize the evaluation of the effectiveness of each service's current location.

4. Discussion

Through a deep examination of how different urban services are spread out and how well they work in Hajjah using space syntax theory, this research has produced a comprehensive array of maps and graphs (refer to Figures 3–5), offering deep insights into how services are distributed and how they meet the needs of the community. By examining metrics such as integration, choice, and connectivity for each type of service and comparing them to the ideal standards, this research has revealed a notable disparity between where services are currently located and where they would be most effective. These outcomes significantly impact urban planning and policymaking in Hajjah and similar communities, underscoring the necessity for more thorough and evidence-driven methods for providing services and developing spaces. Subsequent sections show the principal outcomes of research, explore their significance, and put forward suggestions for improving each category of urban services.

4.1. Essential Governmental Services (Health Clinics, Schools, and Fire Stations)

The health clinic serves town residents and surrounding areas; the health clinic demands a location with high control values and easy accessibility. Based on calculations, the clinic's location in Hajjah is ideal, with an integration value of 0.074, close to the desired optimal of 0.082, suggesting convenient accessibility for residents. Similarly, the fire station plays an important role in providing prompt responses during emergencies. Ideally, it is important for the fire station to have high integration values and easy access to the different parts of Hajjah. Nevertheless, it is also essential to position it away from areas with low choice values to avert traffic jams during the period of crises. Upon examination, the existing placement of the fire station is deemed highly favorable. The computed integration value of 0.068 closely mirrors the optimal benchmark of 0.08.

Furthermore, the low choice value, falling below 50,000, aligns well with the desired standard. Consequently, the existing placement of the fire station satisfies the requisite criteria for an appropriate location, obviating the need for relocation. Moreover, schools cater to educational needs across the town and neighboring villages; schools must have high connectivity values for effective service delivery while preserving satisfactory integration values to facilitate easy access for students from neighboring villages. Although the placement of schools in Hajjah meets global standards (with an integration index of 0.73, compared to the optimal value of 0.77) for nearby students, local optimization is needed.

Suboptimal connectivity values stemming from irregular distribution necessitate the redistribution of certain schools to better accommodate the educational needs of students across various regions.

4.2. Community Amenities (Parks and Places of Worship)

The park is essential for the town inhabitants to have universal accessibility. Presently, only one park is situated close to the center of Hajjah. Evaluation reveals the park's location to be highly favorable, with an integration index of 0.071, closely aligning with the desired optimal value of 0.08. This suggests the park is conveniently situated for all inhabitants to enjoy and access. Additionally, places of worship (mosques) serve as pivotal community hubs across various town regions; hence, strategic placement in areas with elevated connectivity values is essential. Currently, three places of worship are situated close to the center of the town, yet distribution could be enhanced to guarantee accessibility for all residents. Analysis indicates a relatively satisfactory connectivity index of 2.7 for these locations, suggesting decent distribution throughout the town. However, there remains scope for improvement, given the ideal value of 4. Therefore, redistributing them could prove advantageous in better meeting the holistic needs of the town populace.

4.3. Commercial Services (Fuel Stations and Shops)

The optimal positioning of a filling station is in areas with frequent vehicle traffic to ensure convenient accessibility while mitigating pollution and disturbances to residents in high-integration zones. However, an analysis reveals that the existing location of the filling station needs to meet this ideal standard. The integration index of 0.04 surpasses the optimal threshold of 0.03, while the choice index, registering below 190,000, falls significantly short of the preferred ideal of 700,000. Hence, reassessing the filling station's location is imperative to make sure it is located in an appropriate location that fulfills the required criteria for accessibility and reduces negative effects on the community. Furthermore, essential for fulfilling the needs of town residents and passersby, commercial services require a strategic placement to ensure convenient accessibility and optimal integration and choice values. Evaluation of commercial service distribution in Hajjah, guided by calculated metrics, reveals that the integration index is 0.056, which is close to the desired ideal of 0.078, albeit with suboptimal choice values. Consequently, an opportunity exists to enhance the distribution of commercial services, especially along main streets where choice metrics are maximal.

In summary, the analysis indicates that services distribution in Hajjah is generally satisfactory. While certain amenities like the health clinic and the park are located advantageously, others, such as the filling station and certain schools, would benefit from relocation to more optimal sites (refer to Figure 5).

4.4. Applicability of the Adopted Approach in Urban Planning Strategies

The adopted methodology can be applied to any community sharing similar characteristics, beginning with defining the network and identifying various service types based on the community's privacy concerns. In calculating the performance index, we can use the same approach if we have available prime locations that address each service type.

It is also crucial to classify areas according to their levels of control, accessibility, and connectivity. Areas with high control can be identified by integration and choice metrics, prioritizing areas with high integration values and then the regions with high choice. Global accessibility is mostly determined and evaluated through choice values, while also considering the positive relationship with integration values. Connectivity values come into play when assessing suitability at the local level.

For similar communities, essential public services should be situated in areas with high control values and easy accessibility, ensuring service effectiveness by employing pertinent metrics. Community amenities ought to prioritize universal accessibility, emphasizing integration and choice values, while other services should cater to local or neighborhood needs, necessitating high connectivity values. Commercial services should also have convenient accessibility and optimized integration and choice values, effectively meeting the daily needs of the community. In cases where these services present environmental challenges, concerted efforts should be made to maintain convenient accessibility while mitigating pollution and disturbances to residents, particularly in highly integrated zones.

These findings offer valuable insights to broader urban planning principles for communities with similar characteristics. When addressing complex human factors such as social and cultural dynamics that are hard to quantify, there is a need for policymakers and planners to base their urban planning on evidence. By integrating space syntax analysis with GIS tools to consider spatial nuances, decision-making processes can be enriched with insights derived from space syntax metrics that mirror human spatial behavior, verified through real-world experimentation. This synergy positions space syntax as a powerful instrument for predicting the impacts of architectural and urban design. For instance, it can facilitate the evaluation of existing designs or proposed plans, as well as forecast the consequences of various alternative proposals. Hence, this integrated approach empowers urban planners to refine their strategies and make informed decisions that enhance the livability and functionality of urban environments.

5. Conclusions

Current approaches to assessing urban service locations often prioritize spatial analysis based solely on physical attributes, neglecting crucial social dimensions essential for enhancing inhabitants' comfort and quality of life. This paper addressed this critical gap by integrating social factors alongside spatial analysis in assessing urban service locations. Utilizing space syntax theory, this study investigated urban service suitability rooted in inhabitants' social behavior facilitated by GIS-based technological tools. The findings guide decision-making processes and urban planning initiatives not only for Hajjah, but also for similar communities.

The results suggest that essential public services should be located at high control values with easy accessibility, considering service efficacy in defining relevant metrics. Community amenities should prioritize universal accessibility focusing on integration and choice values, while others cater to local or neighborhood needs, requiring high connectivity values. Commercial services require strategic placement to ensure convenient accessibility and optimal integration and choice values, effectively meeting the community's daily needs. If these services pose environmental challenges, efforts should be made to maintain convenient accessibility while mitigating pollution and disturbances to residents, particularly in highly integrated zones. These findings are significant for shaping future urban planning and development initiatives. By integrating social dynamics of human interaction and leveraging methodologies like space syntax theory, urban planners and policymakers can gain deeper insights into community needs and preferences. This, in turn, enables them to optimize service distribution for the collective welfare of residents.

However, a limitation arises in ensuring genuine citizen participation in the application process, as space syntax theory operates by generalizing human behavior, which may vary across different contexts. As individual preferences and behaviors vary widely, the absence of real participation can raise concerns regarding the validation of outcomes and the inclusivity of urban planning practices. Furthermore, when addressing social dimensions, the accuracy and precision of data become important, as any biases or inaccuracies in data collection can significantly impact the results. Additionally, the static nature of this analysis and its susceptibility to subjective interpretation highlight the need for greater dynamism to meet real-world demands. Similarly, methodological constraints such as limited resources, tools, techniques, time, which are compounded by specific issues like the edge effect, or the complexity of the studied problem can present additional hurdles.

Future research could focus on actively involving citizens in applying space syntax theory and refining data collection methods to ensure accuracy and impartiality. In addition, it is important to work towards overcoming the current methodological constraints identified by different researchers, in order to promote a more dynamic, inclusive, and efficient approach to urban planning. By adopting these initiatives, urban planners can improve the reliability, comprehensiveness, and fairness of their decision-making processes, hence favoring sustainable and equitable urban development.

Author Contributions: Conceptualization, S.Q.; methodology, S.Q. and I.H.H.; software, S.Q.; validation, S.Q., I.H.H., I.S. and R.E.M.; formal analysis, S.Q.; investigation, S.Q.; resources, S.Q.; data curation, S.Q. and I.H.H.; writing—original draft preparation, S.Q. and I.H.H.; writing—review and editing, S.Q., I.H.H., I.S. and R.E.M.; visualization, S.Q.; supervision, I.H.H., I.S. and R.E.M.; project administration, S.Q. and I.H.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The data used in this research are presented in this paper.

Conflicts of Interest: The authors declare no conflicts of interest.

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