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Assessing Quality of urban life in Egyptian Cities: Developing a Comprehensive Evaluation Framework Using 6-October City as a Case Study.

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ABSTRACT

This study introduces an extensive evaluation framework aimed at assessing the quality of urban life (QOUL) in Egyptian cities, with a specific focus on 6-October City. The framework encompasses both objective QOUL (OQOUL) and subjective QOUL (SQOUL) indicators, providing a comprehensive understanding of QOUL. Objective measurements are derived through Geographic Information System (GIS) modeling, while subjective data is collected via surveys utilizing the SPSS program. By integrating these approaches, the research endeavors to generate valuable insights for urban planners and policymakers, facilitating the improvement of QOUL in Egyptian cities. The proposed multimodal approach takes into account the distinctive characteristics of Egyptian cities and the diverse needs of their populations. It enables evidence-based interventions and targeted enhancements across various aspects of urban life. Methodological and practical considerations are thoroughly examined, emphasizing the advantages of the multimodal approach in assessing QOUL. Additionally, an approach for the development of 6-October City is presented. This research holds significant potential in informing future urban development initiatives and decision-making processes in Egypt. Its findings can guide policymakers and urban planners in implementing effective strategies to enhance QOUL and contribute to the overall well-being of Egyptian cities and their residents.

Introduction

Evaluating the Quality of Urban Life (QOUL) is vital for urban planning, benefiting policymakers, planners, and stakeholders (Kaklauskas et al., 2018). This research aims to link social perception with urban features (Węziak-Białowolska, 2016). Experts agree that QOUL encompasses both subjective impressions and objective reality, necessitating a dual-index assessment system (Felce & Perry, 1995; Kerce, 1992; Tiran, 2016) (von Wirth et al., 2015). Egypt faces complex urban challenges like other nations due to rapid urbanization and demographic shifts (Marans & Stimson, 2011). Urban expansion has transformed Egypt's socio-economic, environmental, and economic landscape, with cities now housing over a million people (Discoli et al., 2014). This has led to concerns about urban planning, air pollution, and well-being, highlighting the need for socioeconomic stability, sustainable services, and a healthier environment (Mohamed et al., 2017).

Previous research has focused on economic, community, and environmental aspects, neglecting personal and temporal variance factors such as smartness and sustainability as significant predictors of life satisfaction (Bovkir et al., 2023; Le et al., 2023; Wesz et al., 2023). Some environmental indicators, like pollution and thermal comfort, were ignored due to data limitations (Bolzan Wesz et al., 2023). We categorized variables into seven groups: subjective (psychological, social, political, and economic) and objective (environment, physical, and mobility). To implement this approach, we'll use a mix of research methods. Objective QOUL (OQOUL) data will come from official sources and spatial data analysis. Subjective QOUL (SQOUL) data will be gathered through surveys, interviews, and qualitative assessments, providing a holistic view of urban life.

In the literature, numerous works have been conducted to estimate QOUL, including global and regional studies, reports, surveys, and tools that focus on various themes such as livability, sustainability, prosperity, and development (Marans, 2003). Researchers have employed two fundamental strategies to assess QOUL (Liu et al., 2020):

a) OQOUL Approach: This approach involves analyzing secondary data obtained from official governmental sources, often related to spatial indicators research, at different geographic or spatial scales.
b) SQOUL Approach: This approach collects primary data through social survey methods, focusing on individual behaviors and assessments related to certain aspects of QOUL.

To assess the OQOUL, indicators related to transportation systems, housing affordability, public safety access, environmental quality, and infrastructure development must be considered (Kubiszewski et al., 2018). These indicators provide quantifiable data for benchmarking and informed decision-making. For example: (i) Evaluating transportation systems, housing affordability, and availability helps determine mobility and social equity (von Wirth et al., 2015). (ii) Evaluating public safety ensures a safe urban environment. Assessing environmental quality promotes clean and healthy environments. (iii) Infrastructure development assessment identifies areas for improvement and investment (Ardestani et al., 2022).

On the other hand, SQOUL considers various factors including personal well-being, happiness, sense of community, social connections, cultural opportunities, and overall QOUL.

It recognizes that urban life is not solely defined by physical infrastructure or economic indicators but also by the intangible aspects that shape people's daily experiences and emotional well-being. Qualitative research methods, such as surveys, interviews, focus groups, and ethnographic studies, are commonly utilized in the evaluation of SQOUL. These methodologies enable researchers to explore the subjective experiences of individuals and comprehend the factors that influence their overall satisfaction with urban life (Discoli et al., 2010; Rezvani et al., 2013).

For evaluating QOUL, a multimodal approach of SPSS and GIS are effective tools. SPSS aids in data collection, management, and statistical analysis, whereas GIS assists in capturing, managing, and analyzing spatial data. SPSS analyzes factors influencing QOUL using various statistical techniques, whereas GIS visualizes and maps spatial patterns and relationships (Yeh, 1999)(Nicoară-Farcău et al., 2020). Integrating SPSS and GIS provides a comprehensive understanding of QOUL, which aids decision-making and urban planning.

Integrating both subjective and objective indicators in QOUL assessment has emerged as a comprehensive approach for identifying a city's strengths and weaknesses (Le et al., 2023), but how can a multimodal approach, combining objective OQOUL indicators derived from GIS modeling and SQOUL indicators collected through surveys using the SPSS program, be utilized to assess and improve the QOUL in Egyptian cities, with a specific focus on 6-October City. There are many efforts in the integration of SQOUL and OQOUL in QOUL assessment. For example, Smith et al. (2018) conducted research in the United Kingdom that combined objective variables such as air quality and green space accessibility with subjective indicators such as inhabitants' views of aesthetics and neighborhood satisfaction (Ma et al., 2018). The results revealed disparities between objective and subjective assessments, emphasizing the importance of considering both perspectives for a comprehensive understanding of QOUL (Mouratidis, 2021). In 2018, Saudi Arabia launched the "Quality of Life Program, Life and Humanization of Cities" to enhance various sectors that directly impact citizens, including sports, culture, and entertainment (Al-Qawasmi et al., 2021). The program used both objective and subjective indices of sustainable development to assess QOUL in Saudi cities (Mostafa, 2021) . Semi-annual surveys were employed to evaluate general satisfaction with moral indicators, while physical indicators were assessed using GIS programs and the results were analyzed to establish a municipal development strategy (Annual Report on Quality of Life in the Kingdom of Saudi Arabia,2023, n.d.). Several studies have explored different approaches to evaluating the QOUL as demonstrated in Table 1.

While many studies have explored various approaches to QOUL assessment, some have relied solely on questionnaires to measure both objective and subjective indicators, missing the potential benefits of integrating GIS technology (Elkawy & Ahmed, 2023; Gomaa & Fouad, 2022). Additionally, most of the research has focused on either objective or subjective markers individually, overlooking the potential synergistic effects that can be achieved by combining them (Hegazy, 2020).

Table 1- Quality and relevance assessment previous studies.

Studies	Focus	Statistical Analysis Method
Mohammad et al. (Rezvani et al., 2013)	Subjective indicators _ Objective indicators of QOUL.	SPSS (Linear regression).
Carlos et al. (Discoli et al., 2014)	Subjective indicators	GIS Model (suitability analysis).
Chiara et al. (Garau & Pavan, 2018)	urban sustainability; smart indicators	Multiple linear regression model.
Alina et al.(Popescu, 2020)	Sustainability, QOUL indicators	GIS spatial distribution analysis.
Rabia et al. (Bovkir et al., 2023)	Composite indicators and Multicriteria decision analysis	AHP +BWM +Entropy+ PCA.
Thuy et al. (Le et al., 2023)	QOUL land price	GIS analysis + ANP.
Abeer (Elkawy & Ahmed, 2023)	Urban sustainability and green indicators.	GIS and EBRD Green Cities Program.
Gomaa (Gomaa & Fouad, 2022)	Subjective and Objective indicators.	Survey and SPSS (Linear regression) analysis.

In line with the goals set forth in Egypt Vision 2030 and the Ministry of Housing's efforts to implement smart sustainable urbanism, this research aims to enhance the strategic urban planning process in 6-October City. The objective is to investigate the characteristics of QOUL by utilizing QOUL indicators. By aligning with the city's future vision, this study introduces a comprehensive measurement approach that combines SPSS and GIS technologies. This multi-model approach assigns average weighted satisfaction scores to each indicator, simplifying the prioritization of urban development projects.

The key contributions of this study can be summarized as follows:

i. To analyze OQOUL indicators such as infrastructure, accessibility, land use, green areas, transportation, etc. in 6-October city using GIS technology;
ii. To gather SQOUL data from a survey of residents regarding their views and experiences related to QOUL in the city;
iii. To assess SQOUL indicators, statistical analysis using SPSS is employed to analyze the collected data;
iv. To thoroughly understand the QOUL in the 6-October city by combining objective and subjective indicators;
v. To present a clear conclusion, highlight important metrics significantly contributing to the overall QOUL. Based on the findings, recommendations will be made to enhance urban living conditions in the city.

By incorporating both objective and subjective indicators, this approach aims to provide a comprehensive view of the city's strengths, challenges, and opportunities for QOUL improvement. The ultimate objective is to create cities that are sustainable, inclusive, and responsive to the needs and aspirations of their residents.

This paper is structured as follows: The objective and subjective data validations are detailed in section 2. The results and discussion in both objective and subjective indicators for developing the city of 6 October in section 3. Finally, the conclusion is demonstrated in section 4.

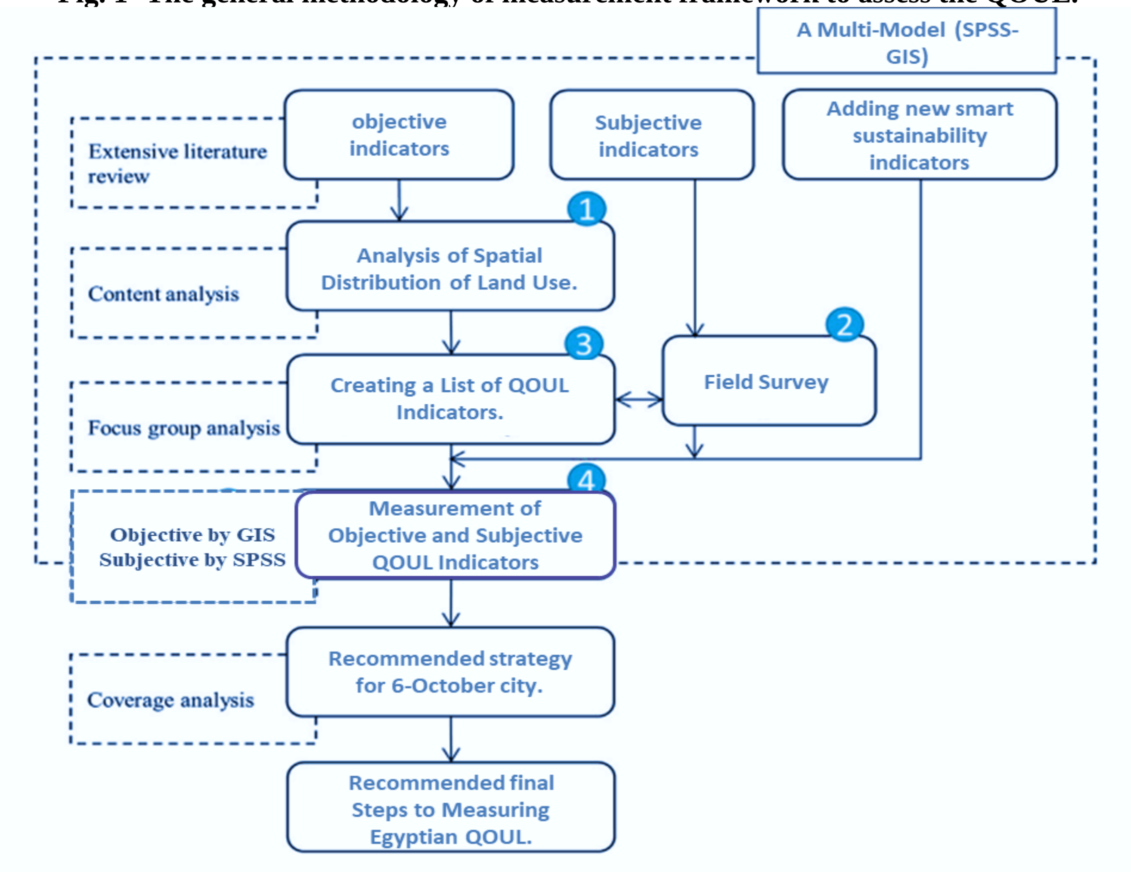
Materials and Methods

As pointed out by Dotti [27], the main goal of QOUL is to create ways to measure and evaluate different aspects of urban life and their impact. To evaluate QOUL, the general structured methodology approach is shown in Figure 1. The aim was to assess the city's QOUL and monitor progress towards the goal of becoming a smart and sustainable urban center. City-level indicators were used to compare different districts and identify areas with significant differences in service quality and environmental factors (Li & Weng, 2007). Therefore, a comprehensive QOUL assessment should encompass both subjective and objective considerations.

SPSS and GIS are valuable tools for assessing QOUL. SPSS helps with data collection, management, and statistical analysis, while GIS aids in capturing, managing, and analyzing spatial data. SPSS allows you to analyze factors influencing QOUL using various statistical techniques, while GIS enables you to visualize and map spatial patterns and relationships. Integrating SPSS and GIS provides a comprehensive understanding of QOUL, aiding in decision-making and urban planning.

The methodology involves considering the satisfaction levels that match the collective needs and demands of diverse population groups when selecting and assessing the OQOUL and SQOUL indicators. This methodology is structured into four distinct phases, as depicted in Figure 1.

Fig. 1- The general methodology of measurement framework to assess the QOUL.



Source: Authors.

Phase 1: Analysis of Spatial Distribution of Land Use:

This phase focuses on analyzing the spatial distribution of land use within the study area. This analysis helps identify specific locations or regions where data collection is necessary to assess QOUL. By understanding the spatial patterns of land use, researchers can determine areas that may have different characteristics or experiences related to QOUL.

Phase 2: Field Survey

The second phase of the study will involve a field survey to collect subjective data on QOUL from residents and stakeholders within the study area. The survey will be administered in person to capture their perceptions and experiences of various aspects of QOUL, such as safety, amenities, and community satisfaction. This direct engagement with the target population will provide valuable insights and opinions that will be essential to informing the study's findings.

Phase 3: Creating a List of QOUL Indicators

In this phase, a list of QOUL indicators is created, incorporating the concept of smart sustainable criteria. Sustainability principles and the goals of smart city initiatives are considered when selecting indicators. Factors like energy efficiency, environmental impact, and technological advancements are considered, making the QOUL assessment comprehensive and relevant to contemporary urban development priorities.

Phase 4: Measurement QOUL Indicators

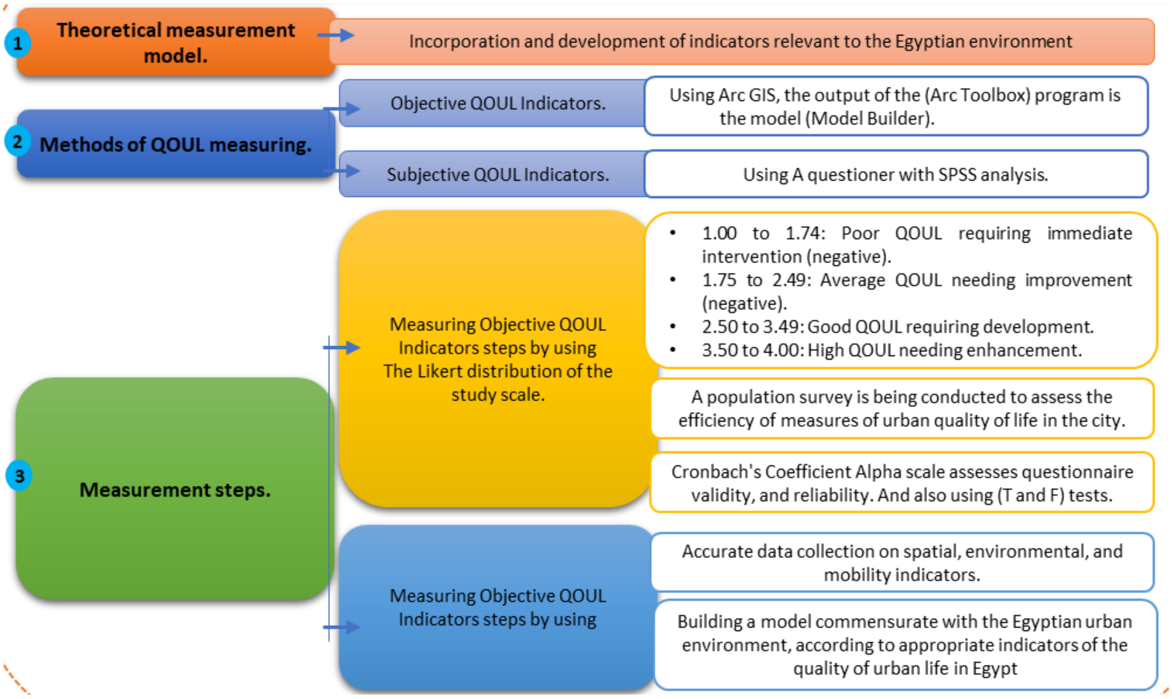
This phase consists of two sub-phases for measuring QOUL indicators:

i. Measurement of OQOUL Indicators: GIS tools are used to measure OQOUL indicators. GIS (spatial distribution of land use analysis) for measuring OQOUL indicators, aiding in data collection, spatial analysis, and evidence-based decision-making in urban planning. Enables the collection, analysis, and visualization of spatial data related to QOUL. For example, proximity to key amenities, transportation networks, and green spaces can be objectively measured using GIS, providing insights into accessibility and infrastructure quality. Objective indicators from previous GIS-based QOUL investigations, as described in the literature, are employed. These indicators have already been empirically demonstrated to forecast SQOUL or specific components of it, such as housing quality and sustainable transportation.

ii. Measurement of SQOUL Indicators: SQOUL indicators are measured using simple regression and linear regression analysis of SPSS software is essential for providing insights into subjective urban well-being and aiding in the development of strategies for improving urban life. Psychological, social, political, and economic factors are considered as SQOUL indicators and are measured through the survey proposed by the researcher. The survey questions are derived from the standard indicators themselves, and the results are analyzed using SPSS, providing accurate results. The primary data from a household survey conducted in the Egyptian city of 6-October city form the foundation of this empirical study.

In this study, Figure 2 presents the proposed framework for evaluating the QOUL by analyzing objective and subjective indicators. The framework aims to comprehensively measure various aspects of urban life and can be applied to assess cities at different levels. The integration of these indicators into city statistics facilitates effective urban planning. The process begins with identifying relevant indicators specific to Egypt's characteristics, forming the foundation for a theoretical measurement model. Objective and subjective indicators are used to assess QOUL comprehensively. Spatial relationships among these indicators are analyzed using a multi-model approach incorporating GIS analysis. Objective QOUL indicators are measured using a Likert scale, allowing participants to express their agreement or disagreement with statements related to QOUL. This standardized method quantifies the objective indicators. Data analysis is performed using SPSS software, which provides various statistical tools for processing, exploring, and interpreting the data. A customized model for analyzing QOUL trends in Egypt can be developed by following these steps, offering valuable insights for urban planning and policymaking.

Figure 2- Steps of multi-model (GIS-SPSS) to Measuring Egyptian QOUL.



Source: Authors.

Objective Data Validation (Phase 1: Analysis of Spatial Distribution of Land Use)

One of the first-generation cities, located in Giza Governorate west of Cairo, is the 6th of October City, covering 53,744 acres, including industrial, residential, tourism, and entertainment areas as shown in Fig. 2. The study focuses on the spatial analysis of the city and aims to identify the physical elements related to the measurement model indicators in the urban environment. The research methodology includes monitoring, observation, analysis, interviews, and studying human behavior in relation to the physical environment. The indicators that can be observed and measured include mobility, environment, and spatial indicators.

Figure 3. Spatial distribution for 6-October city.

Source: (Elkawy & Ahmed, 2023), and Authors.

The GIS technology is used along with a modeling approach to accurately measure spatial, mobility, and environmental factors. We transformed various components from the geographic database into a Shapefile format to create a measuring model, as depicted in Figure 3. To facilitate the interaction between the program and the indicators, we employed the model builder tool within the Arc Toolbox program, and we organized the indicator strategies in Table 2 with digital orders. The model builder plays a crucial role in generating equations or commands that produce the results. It can be applied to any database that contains similar elements, such as water quality, land quality, local environment quality, and energy use quality. We formulated equations for each element in the database, allowing us to:

i. Include one or more services and environmental elements.
ii. Analyze and evaluate each service and available space.
iii. Assess environmental aspects.
iv. Specify optimal/acceptable levels for spatial and mobility indicators and low-impact levels for environmental indicators within existing urban systems.
v. The resulting maps help identify quality standards for the urban components under investigation.
vi. Overall, the GIS model and the modeling approach provide a systematic method for assessing and visualizing the quality standards of different urban components.

Table 2- Assessment the OQOUL indicators (Ardestani et al., 2022; Bovkir et al., 2023; Cummins, 2000; Lotfi & Koohsari, 2009; Walter-Busch, 1983).

<table>
<tr><th>Dimension</th><th>feature(classes) Sub-Dimension.</th><th>Indicators Code</th><th>(Attribute Table) Indicators.</th><th>Evaluation method | source of data</th></tr>
<tr><td rowspan="11">Mobility (E)</td><td>Public Transport.</td><td>E1</td><td>Road lanes for public transport.</td><td rowspan="11">ArcGIS’s Network analysis | cadastral maps.</td></tr>
<tr><td rowspan="3">Roads.</td><td>E2</td><td>Road view.</td></tr>
<tr><td>E3</td><td>Sidewalk type.</td></tr>
<tr><td>E4</td><td>Main roads.</td></tr>
<tr><td>Pedestrians.</td><td>E5</td><td>Adequate pedestrian network.</td></tr>
<tr><td rowspan="2">Accessibility.</td><td>E6</td><td>Bike lanes available.</td></tr>
<tr><td>E7</td><td>Pedestrian assembly areas.</td></tr>
<tr><td rowspan="2">Smart Transport.</td><td>E8</td><td>Efficient and intelligent transmission systems.</td></tr>
<tr><td>E9</td><td>Technological infrastructure.</td></tr>
<tr><td rowspan="2">Sustainable Transport.</td><td>E10</td><td>Pedestrians, cycle paths and green spaces around.</td></tr>
<tr><td>E11</td><td>Use clean fuel.</td></tr>
<tr><td rowspan="13">Environment (F)</td><td rowspan="2">Quality of energy Use.</td><td>F1</td><td>Energy efficiency in cities.</td><td rowspan="13">ArcGIS’s IDW interpolation | official reports.</td></tr>
<tr><td>F2</td><td>% of total supply that is renewable.</td></tr>
<tr><td rowspan="3">Regional environmental condition.</td><td>F3</td><td>Citywide green spaces.</td></tr>
<tr><td>F4</td><td>Resurface the roads.</td></tr>
<tr><td>F5</td><td>Thermal comfort and surface treatment.</td></tr>
<tr><td rowspan="4">Urban Quality.</td><td>F6</td><td>The city's environmental footprint.</td></tr>
<tr><td>F7</td><td>The number of reclaimed lands.</td></tr>
<tr><td>F8</td><td>City's smart infrastructure.</td></tr>
<tr><td>F9</td><td>City's sustainable infrastructure.</td></tr>
<tr><td rowspan="4">Water Quality.</td><td>F10</td><td>The watercourse's name.</td></tr>
<tr><td>F11</td><td>The type of watercourse.</td></tr>
<tr><td>F12</td><td>Water Consumption.</td></tr>
<tr><td>F13</td><td>Wastewater treatment.</td></tr>
<tr><td rowspan="12">Spatial (G)</td><td rowspan="3">Housing and construction quality.</td><td>G1</td><td>Building codes fulfillment.</td><td rowspan="3">ArcGIS’s Statistics | cadastral maps.</td></tr>
<tr><td>G2</td><td>Congestion.</td></tr>
<tr><td>G3</td><td>Infrastructure.</td></tr>
<tr><td rowspan="3">Construction Line.</td><td>G4</td><td>Pedestrian streets.</td><td rowspan="3">ArcGIS’s Select by location | cadastral maps</td></tr>
<tr><td>G5</td><td>Automated ways.</td></tr>
<tr><td>G6</td><td>The ratio of building height to width.</td></tr>
<tr><td rowspan="2">Compressed City.</td><td>G7</td><td>population area ratio.</td><td rowspan="2">ArcGIS’s Network analysis | cadastral maps</td></tr>
<tr><td>G8</td><td>Gradient density available.</td></tr>
<tr><td rowspan="4">Land use.</td><td>G9</td><td>current land uses.</td><td rowspan="2">ArcGIS’s Field calculator | field survey data.</td></tr>
<tr><td>G10</td><td>Inside and outside the city.</td></tr>
<tr><td>G11</td><td>Area.</td><td rowspan="2">Space Syntax | cadastral maps.</td></tr>
<tr><td>G12</td><td>Measurement of land diversity.</td></tr>
</table>

	G13	Services.	
Smart Urbanism.	G14 G15	Smart spaces. Smart infrastructure.	ArcGIS's Statistics | cadastral maps.
Sustainable Urbanism.	G16	Designed for a pollution-free environment.	ArcGIS's Statistics | cadastral maps.
	G17	Utilizing green components on building facades.	

Subjective Data Validation (Phase 2: Field Survey).

Subjective indicators are measured through a survey, like other models. The models are constructed using aggregated data to assess population satisfaction with QOUL. In May 2023, we conducted a closed-ended survey with a random sample of 300 individuals from various districts within the 6th of October City. The survey provided specific answer options. We assessed the survey's validity, reliability, and relevance using Cronbach's Coefficient Alpha scale (Christmann & Van Aelst, 2006), which indicated a high reliability rate of 95%. To measure the QOUL, we employed a quadruple Likert scale (Wu & Leung, 2017). The quadruple Likert scale of this study is demonstrated in Table 3. For statistical analysis, we calculated the weighted arithmetic mean and standard deviations as follows (Nicoară-Farcău et al., 2020):

- 1.00 to 1.74: Indicates poor QOUL requiring immediate intervention (negative).
- 1.75 to 2.49: Signifies average QOUL in need of improvement (negative).
- 2.50 to 3.49: Suggests good QOUL requiring development.
- 3.50 to 4.00: Indicates high QOUL in need of enhancement.

The survey includes questions derived from standard subjective indicators that align with the research hypothesis. Statistical tests, such as correlation, simple regression (Lichtenberg & Şimşek, 2017), and T-F tests (Carvalho et al., 2012), are conducted to analyze the data and evaluate its significance. The assessment of the SQOUL indicators is listed in Table 4.

Table 3- A quadruple Likert scale (Nicoară-Farcău et al., 2020).

Very Good	Good	Average	Poor
High QOUL.	Good (Acceptable) QOUL.	Average QOUL.	Poor QOUL.
4	3	2	1
3.25- 4	2.50 - 3.24	1.75 - 2.49	1.74 -1

Table 4- Assessment the SQOUL indicators (Ardestani et al., 2022).

Dimension	Sub-Dimension	Indicator Code	Indicator	Evaluation method source of data
Economic (A)	Employment	A1	Create employment opportunities.	**Surveying Data.**
	Local business	A2	Considering housing costs and travel time to work	
		A3	The hybrid approach to mortgage finance	
	Cost of living	A4	Index of housing prices	
	Cost of living	A5	Utility and service prices	

Social (B)	Participation in Society	B1	Awareness of the QOUL in cities
		B2	Equal access to facilities and services
	Social Justice	B3	Access to affordable housing for everybody
	Social Integration	B4	Take part in the planning process
	Social Network	B5	Accessibility for those with special needs
Political (C)	Urban Policies and Strategies.	C1	Participation of women in local government decision-making
		C2	Council decisions prioritize city welfare.
		C3	The city device's total impact
	Civil and Political Rights	C4	Understanding urban political life standards.
		C5	Comprehensive urban governance
Psychological (D)	Community Identification.	D1	Urban and architectural quality
		D2	Individual recognition
		D3	Urban and architectural quality
	Pleasing Milieu.	D4	Individual recognition
		D5	Landscape excellence

Results and Discussion

In his study, GIS technology to analyze the spatial distribution of land use in 6-October city is used. Data was collected from land use maps, satellite imagery, and cadastral information. GIS analysis techniques, including overlay analysis, proximity analysis, and spatial statistics, were employed to understand patterns, clustering, and distances between different land use categories. Also, simple regression and linear regression analysis of SPSS software is essential for providing insights into subjective urban well-being and aiding in the development of strategies for improving urban life.

Subjective indicators Estimation and findings.

The assessment of QOUL uses a weighted satisfaction measure, with a threshold score of 2.5. Scores below 2.5 indicate a negative QOUL, necessitating immediate intervention or development, while scores above 2.5 indicate a high QOUL that requires strengthening or further development. Deficiencies in spatial QOUL, encompassing environmental, physical, and mobility aspects, impact overall population satisfaction, especially in psychological QOUL. These deficiencies also influence subjective indicators. However, there is a portion of the population satisfied with social life quality, suggesting development potential. Addressing human needs is vital for enhancing residents' general satisfaction. SPSS analysis assesses various QOUL factors, revealing the following:

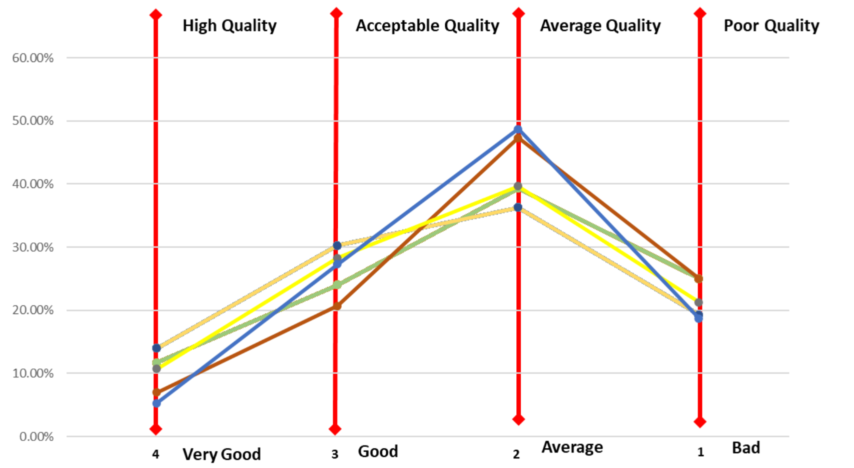
- Among the average quality areas requiring improvement, job opportunities (A1) has the highest percentage frequency of 48.7%. On the other hand, in terms of acceptable quality areas requiring development, the city's housing prices (A4) have the highest percentage frequency at 30.3% (Figure 4-A).

- In terms of public awareness about the Quality of Urban Life (QOUL) in the city, the general awareness of the population (B1) has the highest percentage frequency of 37% as an average quality requiring improvement. However, the accessibility of services for people with special needs (B5) has the highest frequency at 36.3% as an acceptable quality requiring development (Figure 4-B).
- When considering women's participation in civic decision-making (C1), it has the highest percentage frequency of 47.7% as an average quality requiring improvement. On the other hand, integrated urban governance (C3) has the highest percentage frequency at 35.7%, indicating that it needs improvement but is at an acceptable level (Figure 4-C).
- All dimensions (D1, D2, D3, D4, and D5) have the highest percentage frequency in the average quality category, indicating they require immediate intervention (Figure 4-D).
- Figure 4-F illustrates the statistical analysis of the economic (A), social (B), political (C), and psychological (D) dimensions of 6-October City. It also shows the hypothetical probability of the population's degree of significance and level of satisfaction using the "Quadruple Likert" scale.

The provided information highlights the areas in need of improvement and development across various dimensions of 6-October City's Quality of Urban Life. These findings can guide policymakers and urban planners in implementing targeted interventions to enhance the overall quality of life in the city.

Figure 4. Statistical of 6-October City's (A economic- B social- C political- D psychological) dimensions.

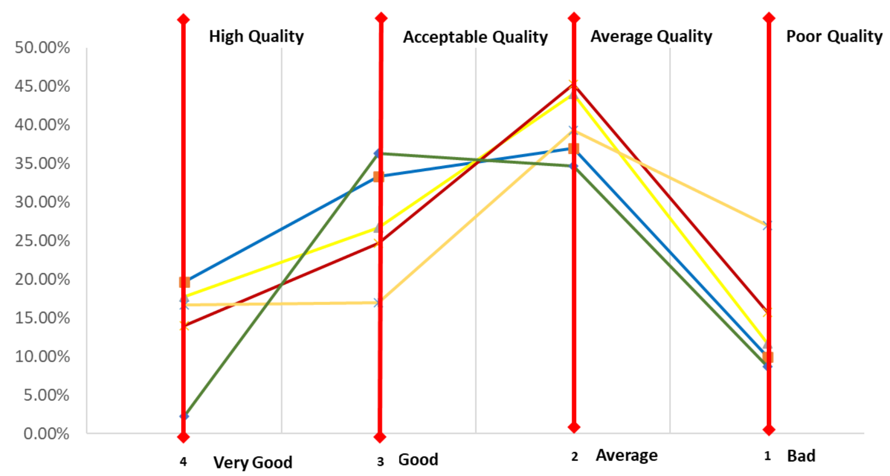
While F reflects the population's (QOUL) hypothetical probability of the degrees of significance and level of satisfaction using the "Quadruple Likert" scale.



Pearson C.	Mean	Bad		Average		Good		Very Good		Economic
		%	Freq.	%	Freq.	%	Freq.	%	Freq.	
**0.672	2.19	%18.7	56	%48.7	146	%27.3	82	%5.3	16	A1
**0.463	2.28	%21.3	64	%39.7	119	%28.3	85	%10.7	32	A2
**0.309	2.09	%25.0	75	%47.3	142	%20.7	62	%7.0	21	A3
**0.329	2.39	%19.3	58	%36.3	109	%30.3	91	%14.0	42	A4
**0.275	2.22	%25.0	75	%39.3	118	%24.0	72	%11.7	35	A5

A5		A4		A3		A2		A1	

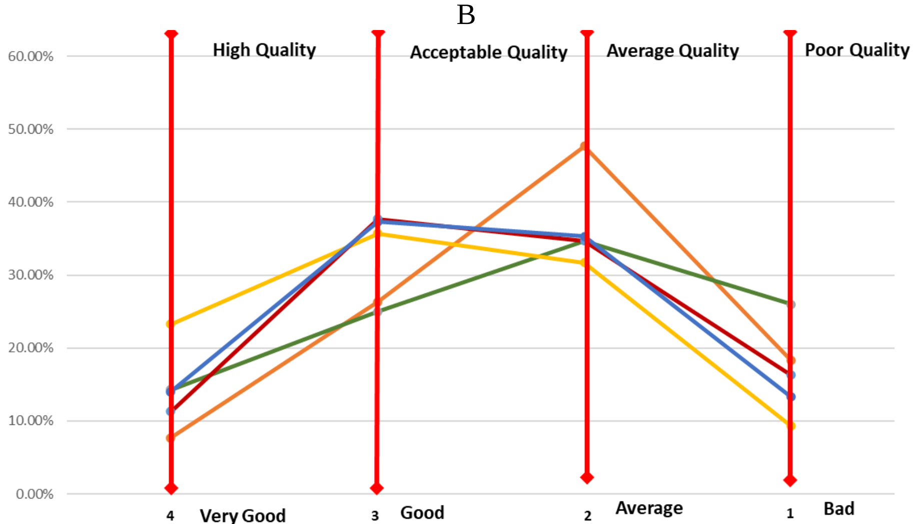
A



Pearson C.	Mean	Bad		Average		Good		Very Good		Social
		%	Freq.	%	Freq.	%	Freq.	%	Freq.	
**0.574	2.63	%10	30	%37	111	%33.3	100	%19.7	59	B1
**0.449	2.5	%11.7	35	%44	132	%26.7	80	%17.7	53	B2
**0.158	2.37	%15.7	47	%45.3	136	%24.7	74	%14	42	B3
**0.741	2.23	%27	81	%39.3	118	%17	51	%16.7	50	B4
**0.365	2.68	%8.7	26	%34.7	104	%36.3	109	%2.3	61	B5

B5		B4		B3		B2		B1	

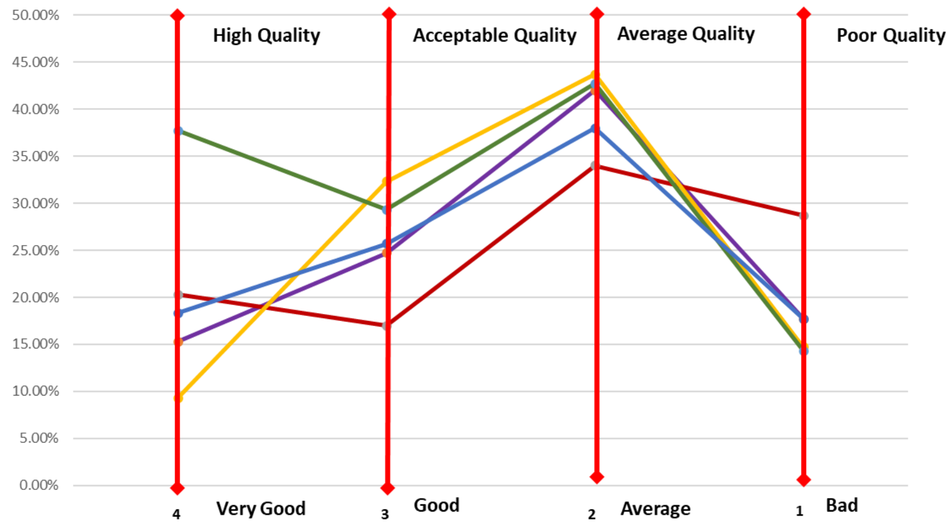
B



Pearson C.	Mean	Bad		Average		Good		Very Good		Political
		%	Freq.	%	Freq.	%	Freq.	%	Freq.	
**0.376	2.233	%18.3	55	%47.7	143	%26.3	79	%7.7	23	C1
**0.410	2.267	%26	78	%34.7	104	%25	75	%14.3	34	C2
**0.340	73.2	%9.3	28	%31.7	95	%35.7	107	%23.3	27	C3
**0.400	2.44	%16.3	49	%34.7	104	%37.7	113	%11.3	34	C4
**0.366	2.25	%13.3	40	%35.3	106	%37.3	112	%14	42	C5

C5		C4		C3		C2		C1	

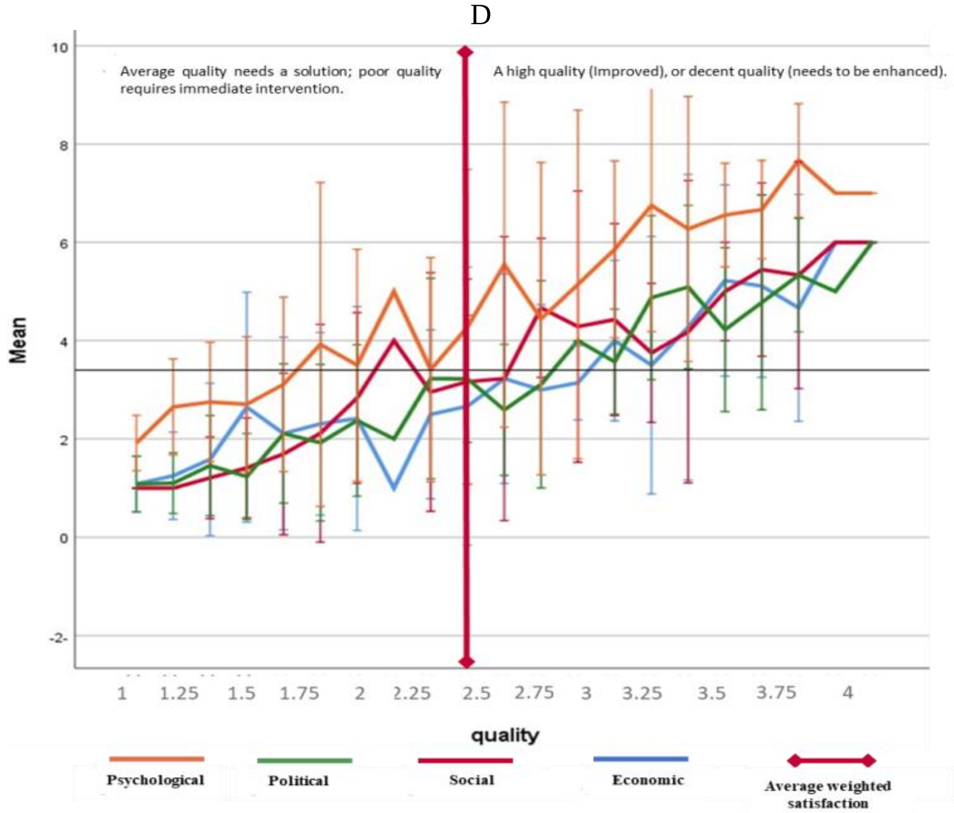
C



Pearson C.	Mean	Bad		Average		Good		Very Good		Psychological
		%	Freq.	%	Freq.	%	Freq.	%	Freq.	
**0.627	2.377	%17.7	53	%42	126	%24.7	74	%15.3	46	D1
**0.637	2.29	%28.7	86	%34	102	%17	51	%20.3	61	D2
**0.637	2.363	%14.7	44	%43.7	131	%32.3	97	%9.3	28	D3
**0.815	2.433	%14.3	43	%42.7	128	%29.3	88	%27.7	41	D4
**0.578	2.448	%17.7	53	%38	114	%25.7	77	%18.3	55	D5

D5		D4		D3		D2		D1	

D



F.

Source: Authors.

A simple regression analysis explored the relationship between economic, social, political, and psychological variables and their impact on QOUL of 6-October City. All statistical hypotheses were examined with a 99% confidence level, signifying that significance levels (e.g., 0.000 Sig.), with a 1% probable error rate accounting for changing conditions or additional elements not initially considered correspond to a p-value less than 0.01(Nicoară-Farcău et al., 2020).
The obtained results from Table 5 were evaluated using a weighted satisfaction approach, focusing on the hypothetical arithmetic mean. The political (-0.397) and social (0.546) aspects received the lowest average weighted satisfaction scores, indicating a need for urgent intervention. Efforts should be made to promote civic engagement, foster inclusive governance, empower marginalized groups, and encourage active participation in community decision-making processes to enhance the social and political aspects. Additionally, the average weighted psychological satisfaction score is (3.410), suggesting the need to improve factors such as a sense of belonging, urban perception, and architectural and urban quality. The economic satisfaction score is (2.278), indicating room for development in areas such as job opportunities, proximity between work and housing, and housing diversity (economic, medium, and luxury) within the city.

Table 5- Linking the questions to QOUL subjective indicators and displaying the findings' mean value.

Dimension	Indicator Code	Questions	Mean Value of Results.
Economic (A)	**A1**	How satisfied are you with the job opportunities and their diversity in the city?	2.19
	A2	How satisfied are you the distance between work and housing in the city?	2.28
	A3	In your opinion, the diversity of housing (economic / medium / luxury) available in the city?	2.09
	A4	Housing price index for you?	-2.39
	A5	The cost of public services (entertainment/commercial services/...) in the city for you?	2.22
		Average weighted Economic satisfaction score.	**2.278**
Social (B)	**B1**	How highly do you rate the general awareness of the population about the QOUL in the city?	2.63
	B2	How satisfied are you with the fair distribution of services in the city?	2.50
	B3	How satisfied are you with the equal access to affordable housing in the city?	-2.37
	B4	How satisfied are you with community participation in city planning decisions?	2.23
	B5	How satisfied are you with the accessibility of services for people with special needs in the city?	-2.26
		Average weighted social satisfaction score.	**0.546**
Political (C)	**C1**	How highly do you consider women's participation in civic decision-making?	2.23
	C2	How efficiently do you rate the implementation of stated planning decisions?	-2.26

	C3	In your opinion, the planning decisions of the city's decision makers serve the city in a way.	2.73
	C4	How general is your awareness of the city's urban-political quality of life?	-2.44
	C5	How satisfied are you with integrated urban governance (which encourages city decision-makers to be transparent and effective)?	-2.25
		Average weighted Political satisfaction score.	**-0.397**
Psychological (D)	**D1**	How satisfied are you with the architectural and urban quality of the city?	2.38
	D2	How satisfied are you with feeling a sense of belonging to the city?	2.29
	D3	How satisfied are you with the city's urban perception (urban beauty)?	2.36
	D4	How satisfied are you with the methods of preserving the personal identity (cultural and social heritage...) of the city?	-2.43
	D5	How satisfied are you with the quality of landscaping in the city?	2.45
		Average weighted psychological satisfaction score.	**3.410**

Objective indicators Estimation and findings.

The analysis of Figure 5 reveals significant patterns and trends in the city's characteristics. The central areas of the city exhibit consistently high values across multiple dimensional indices, encompassing environmental, physical, and mobility aspects. This indicates a strong presence of well-developed infrastructure, efficient transportation networks, and easy accessibility to urban amenities. However, it is important to acknowledge the environmental challenges within the city, particularly in the industrial area. This region demonstrates the lowest environmental index, primarily due to elevated levels of air pollution resulting from industrial activities. Addressing this issue requires targeted interventions and stringent regulations to mitigate the adverse environmental impacts associated with industrial operations and ensure the well-being of both residents and the surrounding ecosystems. Conversely, the western and northern parts of the city exhibit the highest environmental index, indicating a more favorable environmental profile. This suggests successful environmental conservation efforts and the presence of more sustainable practices in these areas.

To comprehensively assess the city's environmental status, it is crucial to evaluate key indicators such as air quality, water quality, land use, energy consumption, and regional environmental conditions. However, the availability of comprehensive data and information regarding these indicators remains limited within many city authorities. To address this data gap and facilitate effective environmental management, the establishment of a comprehensive and integrated database encompassing various environmental factors is imperative. Such a database would serve as a valuable resource for assessing the city's environmental performance, identifying areas of concern, and formulating evidence-based strategies to address existing challenges, as depicted in Figure 5 (a, b, and c).

In addition to the environmental aspects, the spatial GIS analysis provides valuable insights into land use, density, housing, and construction characteristics within the city. These findings offer guidance for optimizing urban development and ensuring organized and sustainable growth.

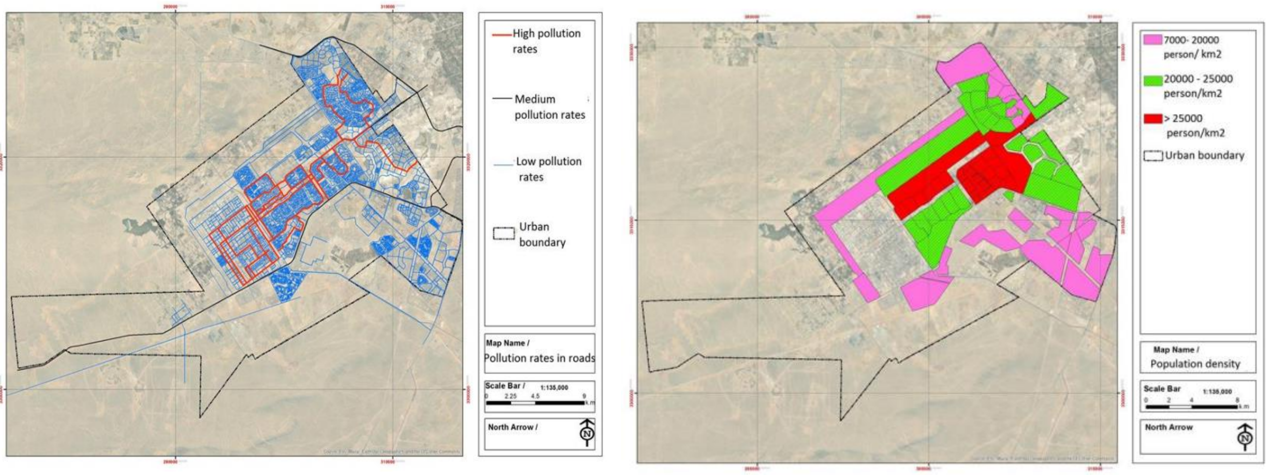
Disparities across different dimensions, such as the distribution, accessibility, and functionality of land uses, as well as the overall density of the city, highlight areas that require targeted attention and improvement, as illustrated in Figure 5 (a, b, and e).

The evaluation of housing and construction quality is crucial for ensuring the safety and well-being of the city's residents. Factors such as building integrity, adherence to regulations, and overall livability are important considerations. Identifying areas that need improvement allows proactive measures to be taken to create safe and comfortable living environments that meet residents' needs.

Furthermore, it is important to note that 6th October city currently lacks the implementation of smart urbanism principles. Smart urbanism involves using technology and data-driven solutions to improve a city's efficiency, sustainability, and livability. In the case of 6th October City, the adoption of these approaches has been limited, which hinders the city's potential to optimize resource usage, improve connectivity, and provide advanced services to its residents.

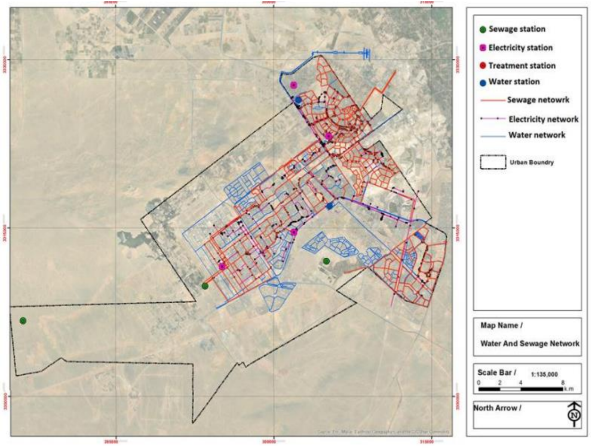
To address mobility challenges in the 6th of October city, it is necessary to enhance public transportation efficiency by increasing service frequency and coverage. Implementing smart transportation solutions like real-time information systems and mobile applications can also be beneficial. Improving infrastructure for pedestrian safety, such as dedicated pathways and traffic calming measures, is essential. Promoting sustainable transportation options like cycling infrastructure, electric vehicles, and carpooling is important as well. Strategies to reduce traffic congestion, such as intelligent traffic signals and congestion pricing, should be considered. These comprehensive transportation policies can lead to a more efficient and environmentally friendly system, resulting in improved mobility, reduced emissions, and better air quality, as shown in Figure 5 (d and f).

Figure 5- GIS-based OQOUL study maps for the 6th of October City.

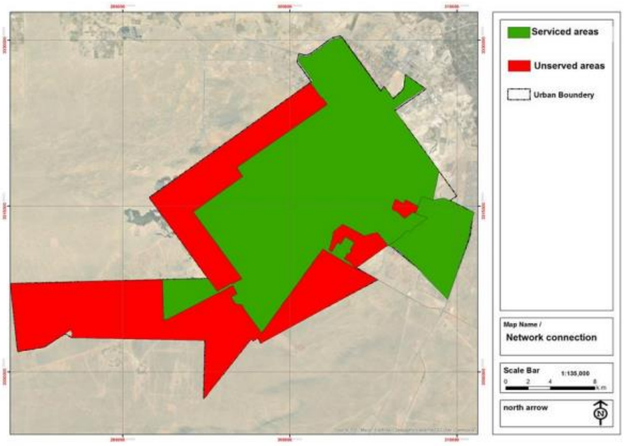


a) Fuel pollution rates on 6-October's roads.

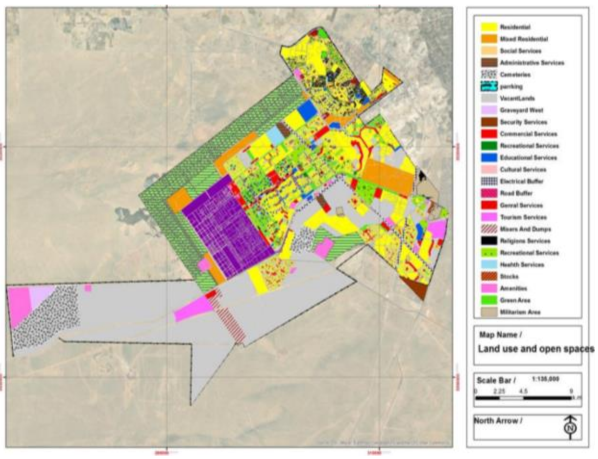
b) 6-October City's population density.



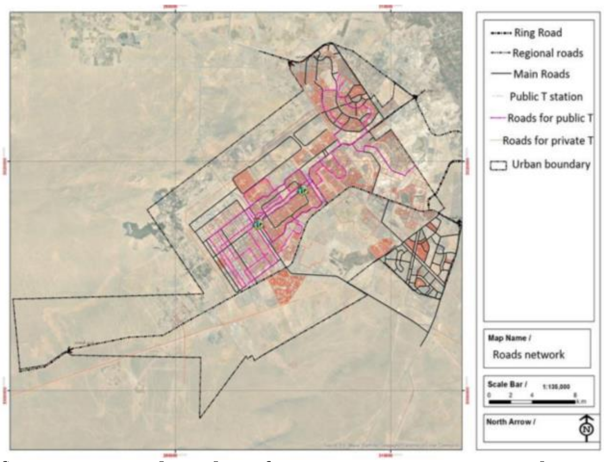
c) Water network characteristics in 6-October city



d) Rates of network connectivity in 6-October city.



e) 6-October city land use.



f) Routes and modes of transportation on 6-October.

Source: (Ramadan et al., 2017).

Integrating SPSS and GIS analysis provides valuable insights into residents' satisfaction with different aspects of the city. Psychological satisfaction influences residents' perception of service quality, particularly in the central areas. Satisfaction with architectural and urban quality is higher in the eastern and northern extension areas, increasing loyalty towards the city. Job opportunities, commuting distance, transportation quality, and service affordability also impact satisfaction. However, the industrial area's environmental situation and certain public transportation services negatively affect overall satisfaction. The social and political dimensions exhibit the lowest satisfaction levels, attributed to inadequate development policies and limited resident involvement in decision-making processes.

To improve resident satisfaction and enhance the city's overall quality, addressing psychological well-being, improving service quality, prioritizing job opportunities and transportation, and fostering inclusive planning and decision-making processes is essential. Policymakers and urban planners can use these findings to develop strategies that meet residents' needs and aspirations, ultimately creating a more satisfactory urban environment.

The suggested approach for developing the city of 6-October.

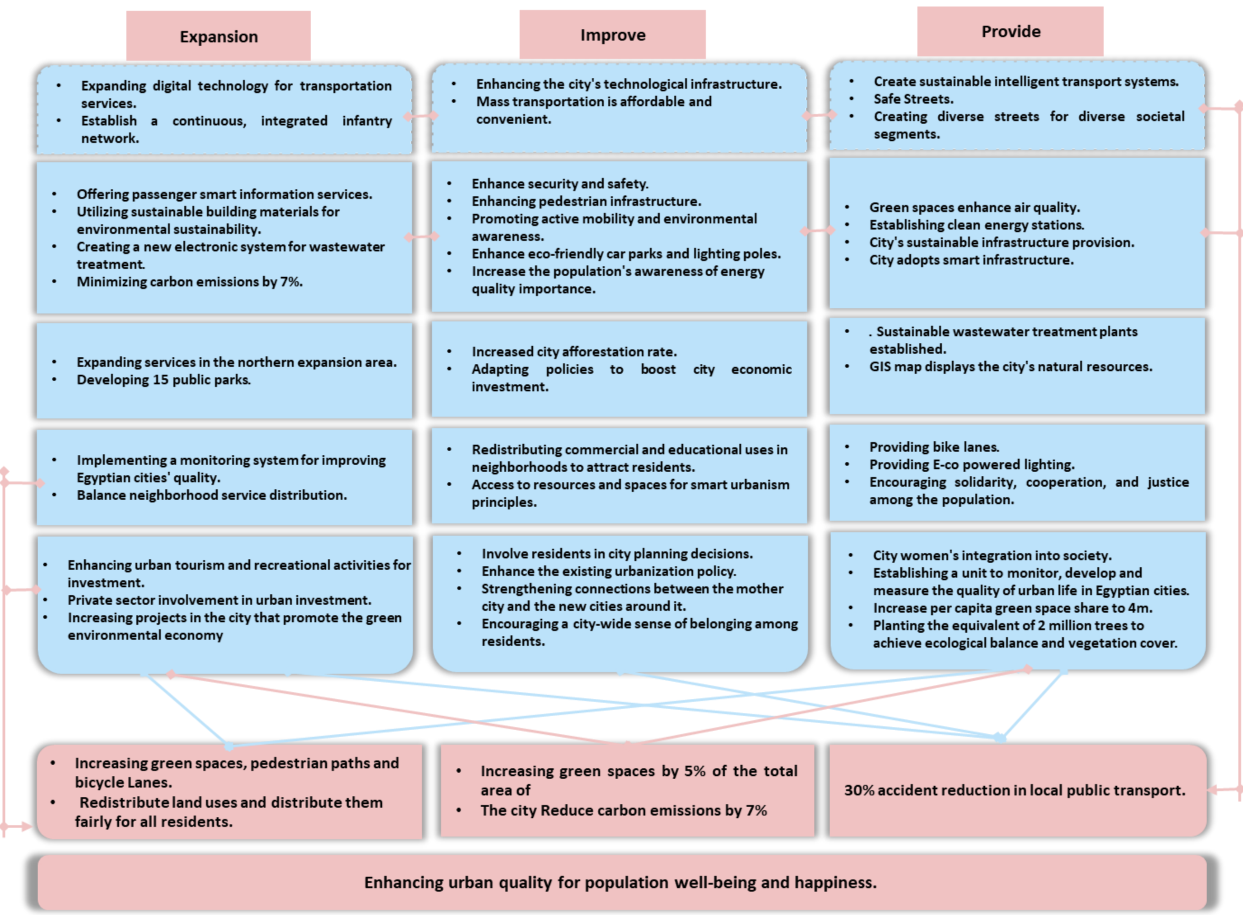
Another contribution of this study, the strategy for 6-October city is structured into three distinct phases, each designed to address specific challenges and contribute to the city's growth and development as illustrated in Figure 6. These three phases together form a comprehensive strategy that not only addresses current challenges but also sets the stage for the city's continued growth and development. The strategy's components and progression are:

i. Saving Phase: In this initial phase, the primary objective is to address immediate deficiencies and provide the resources that are currently lacking. The focus is on rectifying critical issues and ensuring that the city's fundamental needs are met.

ii. Development Phase: Following the Saving Phase, the Development Phase concentrates on enhancing the city's existing resources and optimizing their efficiency. This involves making improvements and upgrades to various aspects of the city's infrastructure and services, ultimately raising the overall quality of life for its residents.

iii. Expansion Phase: The final phase emphasizes expanding the scope of services and fostering technological development within the city. It looks ahead to future initiatives aimed at propelling the city forward and enhancing the well-being of its residents.

Figure 6- The recommended strategy for the 6-October city's development.



Source: Authors.

Conclusions

The study conducted a scientific assessment of the Quality of Urban Life (QOUL) in 6th-October, Egypt, employing a comprehensive SPSS-GIS model. By integrating OQOUL and SQOUL indicators, the research aimed to provide a rigorous understanding of QOUL. Objective measurements were obtained using Geographic Information System (GIS) modeling, while subjective data was gathered through surveys and analyzed using the SPSS program. The analysis revealed varying satisfaction and dissatisfaction levels among residents, with environmental pollution identified as a significant negative factor affecting QOUL, particularly in the central and surrounding areas. Additionally, the study highlighted the impact of limited-service availability in the northern and western regions on low residential occupancy rates. The SPSS analysis emphasized the influence of independent variables, including political, economic, social, and psychological factors, on QOUL, thereby identifying opportunities for improvement. This scientifically conducted research provides valuable insights for urban governance decisions, offering recommendations such as including subjective indicators, adaptation of measures to the local context, exploration of the relationship between objective and subjective factors, and prioritization of urban life quality in development plans. Integrating GIS and SPSS allowed for comprehensive analysis, revealing patterns, and informing evidence-based decision-making. Overall, this scientific study contributes to urban planning by presenting a robust methodology for assessing and enhancing QOUL, with implications for guiding urban development initiatives in Egypt.

Abbreviations	
QOUL	Quality of Urban Life.
GIS	Geographic Information System.
SPSS	Statistical Package for the Social Sciences.
SQOUL	Subjective QOUL
OQOUL	Objective QOUL
AHP	The Analytic Hierarchy Process.
BWM	Best Worst Method | A multi-criteria decision-making method
Entropy	“The measure of disorder/randomness of a system.”
PCA	Principal Component Analysis.
ANP	The analytic network processes.
EBRD	European Bank for Reconstruction and Development.

Declarations

Ethics approval and consent to participate
The authors have approved all data collection on Understanding Society main study.
Consent for publication
Not applicable.
Competing interests
The authors declare no competing interests.
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