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# SPATIAL ANALYSIS AND EVALUATION OF DISPARITIES IN THE DETERMINANTS OF HAPPINESS AND QUALITY OF LIFE INDICATORS IN AL JUBAIL CITY USING GIS

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## ABSTRACT

*An international report is published annually to monitor global happiness indicators based on six key variables: GDP per capita, healthy life expectancy, social support, freedom to make life decisions, generosity, and the absence of corruption. Some of these variables are associated with health, education, cultural, and recreational components available across different regions. Saudi Vision 2030 and its initiatives have focused on enhancing the performance of happiness and quality of life indicators in Saudi cities, due to the importance of these indicators in measuring the well-being of the population and their satisfaction with urban services, based on the availability of elements that facilitate people's lives and reflect on their overall quality of life and happiness. However, the distribution of these elements varies and sometimes demonstrates a lack of spatial justice within the urban fabric of cities, where spatial disparities exist between residential neighborhoods in terms of available services, which may negatively affect happiness. Al Jubail is one of the most important industrial and urban cities in the Kingdom, to which the State attaches great importance, as it combines major economic activities (Al Jubail Industrial Area) and various residential areas (Al Jubail Al-Balad). Therefore, the analysis of spatial inequalities in happiness and quality of life using GIS tools represents a scientific approach to understanding the spatial patterns of these inequalities, analyzing the efficiency of distribution, and identifying areas of deficit and surplus, thus contributing to supporting decision-makers in achieving sustainable urban development. Urban happiness indicators serve as a key framework for measuring and analyzing the quality of life within cities, as a city's economic, environmental, social, and service dimensions intertwine to shape patterns of well-being and, consequently, enhance residents' happiness and quality of life. Considering the Kingdom of Saudi Arabia's efforts to improve happiness indicators and the quality of life in Saudi cities through several initiatives, this study employed GIS-based spatial analysis tools to examine spatial variations in the determinants of happiness indicators among Al Jubail's residents. This was achieved by analyzing the distribution of green spaces and their per capita share, as well as healthcare, educational, and cultural services, and by evaluating the efficiency of their distribution to identify areas of deficit and adequacy, thereby assessing their impact on happiness indicators and quality of life across Al Jubail's neighborhoods. The results revealed notable spatial variations among Al Jubail's neighborhoods in the distribution of happiness determinants. The highest concentration of environmental, service, and social determinants was observed in the northern and central neighborhoods, compared to a lower concentration in the southern neighborhoods. The study, through its spatial processing and analysis of urban service*

*distribution efficiency, generated a spatial gap map illustrating disparities in the determinants of happiness and quality of life in Al Jubail, and proposed several recommendations expected to positively influence residents' happiness and enhance their quality of life.*

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**KEYWORDS:** Spatial variations, happiness indicators, quality of life, service efficiency, coverage gaps, Al Jubail City.

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## 1. INTRODUCTION

Happiness indicators, such as the Happy Planet Index (HPI), have become one of the most critical quantitative methods for measuring urban quality of life in recent decades, constituting a core foundation in the literature of Human Geography and Development-Oriented Urban Planning. The development and evolution of cities are no longer measured solely by their economic growth or urban expansion, but rather by elements of quality of life, well-being, and resident happiness, which have become essential criteria for assessing the efficiency and success of urban development policies. Urban happiness is achieved through residents' equitable and fair access to essential services, public facilities, and the availability of environmental and social opportunities that foster life satisfaction and high levels of community belonging and harmony. This concept led to the publication of the first World Happiness Report in 2012, based on a set of quantitatively measured variables (Jaswal et al., 2020, P.4827).

Spatial disparities in the distribution of services and resources within cities is one of the most prominent factors leading to spatial inequalities in happiness indicators. In some neighborhoods, there is a high concentration of health, educational, and cultural facilities, as well as green spaces, while other neighborhoods experience a lack of access to these facilities and services. This negatively affects the quality of life, the residents' sense of social justice, and consequently, their happiness indicators. Research indicates that well-being, service availability, and related concepts such as life satisfaction, happiness, and optimism have numerous positive impacts on residents' health, education, success, and other aspects of their lives (Almeqren et al., 2025, P.1). Therefore, geographic studies focus on the spatial analysis of the components correlating with resident satisfaction and happiness, analyzing their patterns, underlying causes, and deficiencies. These studies propose immediate and future solutions to support planners and decision-makers in formulating Sustainable Development programs across the cities and regions of the Kingdom of Saudi Arabia in general, and the city of Al Jubail in the Eastern Province in particular.

The city of Al Jubail in the Eastern Province of Saudi Arabia is considered a unique urban model, starting from its establishment as a petrochemical industrial center, and encompassing the rapid urban and demographic developmental transformations it has witnessed subsequently, under the ambitious national directives of Saudi Vision 2030, which places

special emphasis on improving the quality of life and enhancing citizen well-being. Therefore, studying the determinants of happiness indicators in Al Jubail and analyzing their spatial variation provides a scientific framework for understanding the relationship between the geographic distribution of urban services - which are essential components for residents' lives - and their levels of satisfaction and happiness, reflecting on quality-of-life indicators. Accordingly, the study methodology is structured around two main axes: The first axis will focus on conducting a Spatial Analysis of the urban components that enhance residents' satisfaction, happiness indicators, and quality of life. The second axis aims to carry out a quantitative field survey to monitor these indicators, distributed across the different levels and neighborhoods of the city of Al Jubail.

## 2. RESEARCH PROBLEM

Despite ongoing developmental efforts to advance the city of Al Jubail and enhance its quality of life, presumed spatial disparities persist in the accessibility levels of essential urban services for its residents. These services are crucial determinants of their well-being and, consequently, their sense of satisfaction and happiness. Geographic and planning literature suggest that the uneven distribution of public facilities (such as parks, green spaces, health centers, and educational and cultural institutions) across residential neighborhoods leads to urban gaps in happiness indicators, thereby negatively impacting the principle of spatial justice and overall urban quality of life.

knowledge gap lies in the lack of applied studies that quantitatively and spatially examine the relationship between the distributive equity of urban services and residents' happiness and satisfaction indicators in Al Jubail. Consequently, the primary objective of this study (Phase I) is to analyze the spatial extent of disparities in essential urban services relative to per capita and planning standards, leading to the subsequent quantification of how this spatial variation impacts urban happiness and quality of life metrics.

## 3. STUDY AREA

Al Jubail City is located between latitudes (26°45' N - 27°40' N) and longitudes (49°37' E - 49°49' E). Geographically, the city is part of the Eastern Province of the Kingdom of Saudi Arabia, overlooking the Arabian Gulf to the east. Administratively, it belongs to the greater Al Jubail Governorate, which covers a total area of



levels of accessibility to these services across the city's various neighborhoods.

- Analyze the spatial gaps resulting from variations in happiness determinants and quality-of-life components, and to provide actionable recommendations that align with the goals of Saudi Vision 2030 for enhancing well-being and happiness in Al Jubail.

## 5. METHODOLOGY

The study employed several research approaches, including the analytical method, the quantitative applied approach, and the spatial approach. A comprehensive Geographic Database (Geodatabase) was constructed, encompassing various spatial and attribute data relevant to the social and service components of happiness indicators and quality of life in Al Jubail City.

The data construction process involved developing updated digital data layers for the distribution of essential facilities (such as public parks, health centers, cultural centers, and schools) across the city's neighborhoods in 2025. Furthermore, the green cover layer was extracted from high-resolution Sentinel satellite imagery for 2025. Initial image processing was performed within the ENVI environment, followed by supervised spectral classification techniques to delineate and map green spaces with high accuracy.

Data processing and analysis were conducted using ArcGIS Pro within the Geographic Information Systems (GIS) environment. Service locations were represented as Point Features linked to precise attribute data, enabling accurate spatial distribution analysis. Spatial Statistical Analysis included calculating geographic distribution indices such as the Mean Center, Standard Distance, and Directional Distribution, to reveal spatial patterns of clustering and dispersion of urban services and assess the equity of their spatial allocation.

Density analysis was implemented using the Kernel Density Estimation method to identify areas of high and low concentrations of urban services. Additionally, Service Accessibility Analysis was conducted by generating Service Areas (or spatial buffers) for key facilities. This involved calculating the actual distance to the nearest school for each neighborhood, for example, to estimate ease of access and expose areas suffering from service deficiency. These analyses were integrated with the neighborhood population data to calculate the average per capita provision for certain services, such as green spaces.

This integrated methodology facilitated the

production of a comprehensive Spatial Model to evaluate the gaps in happiness indicators in Al Jubail, based on the available per capita welfare components utilizing advanced spatial analysis techniques.

### 5.1. Previous studies

Several studies have examined the relationship between service components and environmental resources on the one hand, and happiness and well-being indicators on the other, with a focus on the use of spatial analysis and remote sensing techniques. The following is a review of the most significant studies in this field:

**Brereton et al. (2008)** demonstrated that the quality of local environmental resources such as proximity to coastlines and green spaces positively influences life satisfaction, emphasizing the role of spatial dimensions in explaining happiness. Similarly, **Ballas (2011)** employed social geography approaches and tools to produce "happiness maps," analyzing spatial disparities between different regions. **Lin et al. (2016)** also utilized spatial data to show that access to green spaces contributes to improved mental health and higher satisfaction levels among urban residents.

**Majeed and Mumtaz (2017)** found that environmental degradation and CO<sub>2</sub> emissions decrease happiness levels, while environmental protection enhances residents' well-being. **Almalki and Al-Namazi (2019)** focused on Al Jubail City, using Landsat 8 satellite imagery to analyze the industrial sector's effect on land surface temperature. Their results indicated that industrial activities contributed to the formation of urban heat islands in Al Jubail, highlighting the importance of integrating environmental indicators in the analysis of quality of life and happiness disparities. **Benita (2019)** investigated spatial justice gaps in access to public spaces in Tel Aviv and their impact on residents' satisfaction.

Recent studies have reaffirmed the importance of urban environments and the availability of services and green spaces in enhancing happiness and quality of life. **Kwon et al. (2021)** analyzed the relationship between urban green spaces and happiness levels in 60 developed countries, concluding that the presence of green areas is positively associated with happiness through the enhancement of physical and mental health and social support. **Cheng et al. (2021)** found that access to high-quality urban parks is positively correlated with self-reported happiness, particularly during crisis periods such as the COVID-19 pandemic. Finally, **Bakir et al. (2024)** conducted a global spatial analysis demonstrating that economic

freedom and GDP per capita are positively associated with happiness, whereas unemployment and inflation have negative effects, emphasizing the geographical dimension in shaping global happiness patterns.

The World Happiness Report issued by the Sustainable Development Solutions Network for the United Nations (Helliwell et al., 2024) also highlights that several components such as the availability of public facilities and green spaces contribute to social support, thereby enhancing satisfaction, happiness, and quality of life indicators. At the local level, Almeqren et al. (2025) found that overall well-being among the Saudi sample was generally high, despite variations in perceived happiness and well-being due to demographic factors such as age differences.

This review underscores the existing research gap, represented by the scarcity of quantitative GIS-based studies that link the spatially inequitable distribution of services and environmental resources with happiness and satisfaction indicators among Al Jubail City residents at the neighborhood level.

## 5.2. Study Terminology

- **The World Happiness Report (WHR)** is an annual report that measures and ranks the levels of happiness and well-being across more than 150 countries worldwide. This report diverges from traditional economic indicators such as Gross Domestic Product (GDP) by focusing on citizens' subjective well-being.

The report measures happiness based on individuals' life evaluations, analyzing six key variables that help explain cross-national differences in happiness: GDP per capita, social support, healthy life expectancy, freedom to make life choices, generosity, and the absence of corruption (Helliwell et al., 2024). Countries with high happiness scores are generally those that prioritize the well-being of their citizens. The inaugural World Happiness Report was published on April 1, 2012.

## 5.3. Happiness Determinants in Al Jubail

Recent studies indicate that the values of urban happiness indicators and quality of life are significantly influenced by a city's spatial, environmental, social, and service components, rather than by economic factors alone (Brereton et al., 2008; Ballas, 2011). Several research efforts have demonstrated that proximity to green spaces and an increased per capita provision of these spaces have a direct and positive impact on enhancing mental

health and life satisfaction (Lin et al., 2016; Cheng et al., 2021). Furthermore, spatial justice in the distribution of essential service facilities (health, educational, cultural, and recreational) contributes to reducing welfare gaps between neighborhoods (Benita, 2019).

The importance of integrating these dimensions is particularly evident in Al Jubail City, where economic determinants, represented by the industrial area, interact with the urban environment. This necessitates the inclusion of the environmental, service, and social dimensions in the spatial analysis of happiness indicator gaps and disparities (Almalki & Al-Namazi, 2019).

Consequently, the study relied on the spatial analysis of the determinants influencing resident happiness and satisfaction, which include:

- Environmental Determinants: Analyzing the area of Green Cover and measuring its per capita provision.
- Service and Social Determinants: Analyzing the adequacy and efficiency of health, educational, cultural, and recreational service facilities, and their compliance with national planning standards.
- Accessibility Factor: Studying proximity and ease of access to certain essential services, such as schools.

## 1-Environmental Determinants

Environmental determinants in Al Jubail City are considered crucial components of urban quality of life. The availability of green spaces and a high per capita provision are linked to numerous environmental, health, and psychological benefits for residents. Studies identify five key beneficial effects of green spaces on residents: stress reduction, physical activity stimulation, facilitating social interactions, generating aesthetic pleasure, and enhancing feelings of satisfaction and happiness (Kwon et al., 2021, P.1). Several studies confirm that boosting vegetation cover, facilitating access to parks, and increasing the per capita share of green space contribute to raising residents' satisfaction and happiness levels in cities like Al Jubail.

## A- Spatial Distribution of Green Cover and Parks in Al Jubail City

Green cover and parks constitute an essential element of Al Jubail's urban structure, contributing to environmental improvement and quality of life enhancement by providing natural recreational spaces. The spatial analysis of their locations reveals

a clear spatial variation ,reflecting the impact of planning patterns and land uses across different neighborhoods.

Analysis of Figure (2) shows that parks and green spaces are notably concentrated in the Northern and Western neighborhoods (such as Al Dana and Al Waha). This part of the city is characterized by relatively modern urban planning and the availability of prepared spaces for park development near the waterfront. Proximity to the Arabian Gulf coast and open areas facilitated the allocation of large plots for recreational activities and public parks, reflecting the urban planner’s attention to creating an attractive urban environment that promotes healthy quality of life patterns in these areas.

In contrast, the Central neighborhoods (such as Al Salam and Al Hamra) exhibit less green cover and fewer public parks, while some Southern neighborhoods are entirely devoid of parks and green spaces (such as Al Aziziyah, Ashbilih, Qurtuba, and Gharnata). This disparity is attributed to several factors, primarily the age of the urban

structure in some of these areas, the lack of available open spaces for allocation, and the priority given to residential and commercial land use due to population growth and economic expansion. This issue is compounded by the fact that these neighborhoods have reached a state of maximum urban expansion ,covering of their total area (Nasif et al., 2022, P.669).

This distributional imbalance reflects historical planning challenges and varying land-use patterns. Areas near the Arabian Gulf and main streets typically have greater opportunities for creating open spaces, while high-density neighborhoods face challenges in planning new green areas within their urban fabric. Achieving balance in park distribution therefore requires strategic plans focusing on land reclamation and innovative solutions to provide recreational spaces in underserved neighborhoods, ultimately contributing to the improvement of the urban environment and the enhancement of resident satisfaction, happiness, and quality of life indicators in the city.

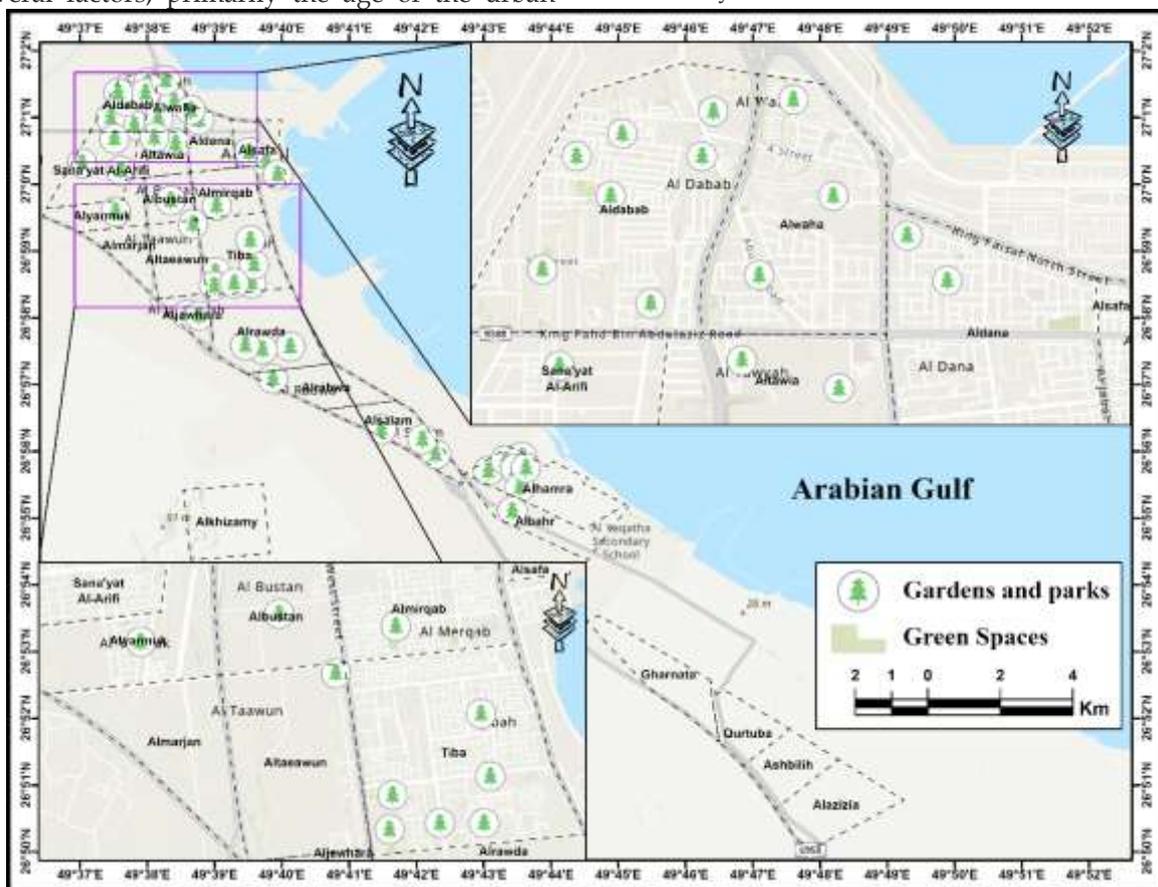


Figure (2): Spatial Distribution of Parks and Gardens in Al Jubail City in 2025.

**B- Spatial Analysis of Parks and Green Spaces Distribution using GIS**

**5.4. Mean Center Analysis**

The analysis of the Mean Center for parks and

green spaces in Al Jubail City showed its location at coordinates X = 367000.4 and Y = 2985335.6 (Figure 3), approximately situated in the center of Taibah neighborhood. This position reflects the concentration of most green cover and public parks within the central and northern neighborhoods, placing them close to the main, more densely populated urban core. This pattern facilitates access for most of the population. However, it indicates that while the distribution serves high-density areas, it does not necessarily ensure equitable coverage for peripheral neighborhoods.

**5.5. Standard Distance Analysis**

The spatial analysis of parks and green spaces using the Standard Distance tool (Figure 3) revealed a radius value of approximately 4.9 km from the Mean Center. This value suggests that the average spread of parks is primarily concentrated in the central neighborhoods. Consequently, neighborhoods located on the urban periphery have a lower share of these recreational facilities. This disparity in distribution leads to unequal recreational benefits, which are higher for residents in central areas compared to those on the urban edge, such as Al Aziziyah, Qurtuba, and Ashbilih, confirming a lack of Spatial Justice in the allocation of happiness and recreation determinants (parks and green spaces).

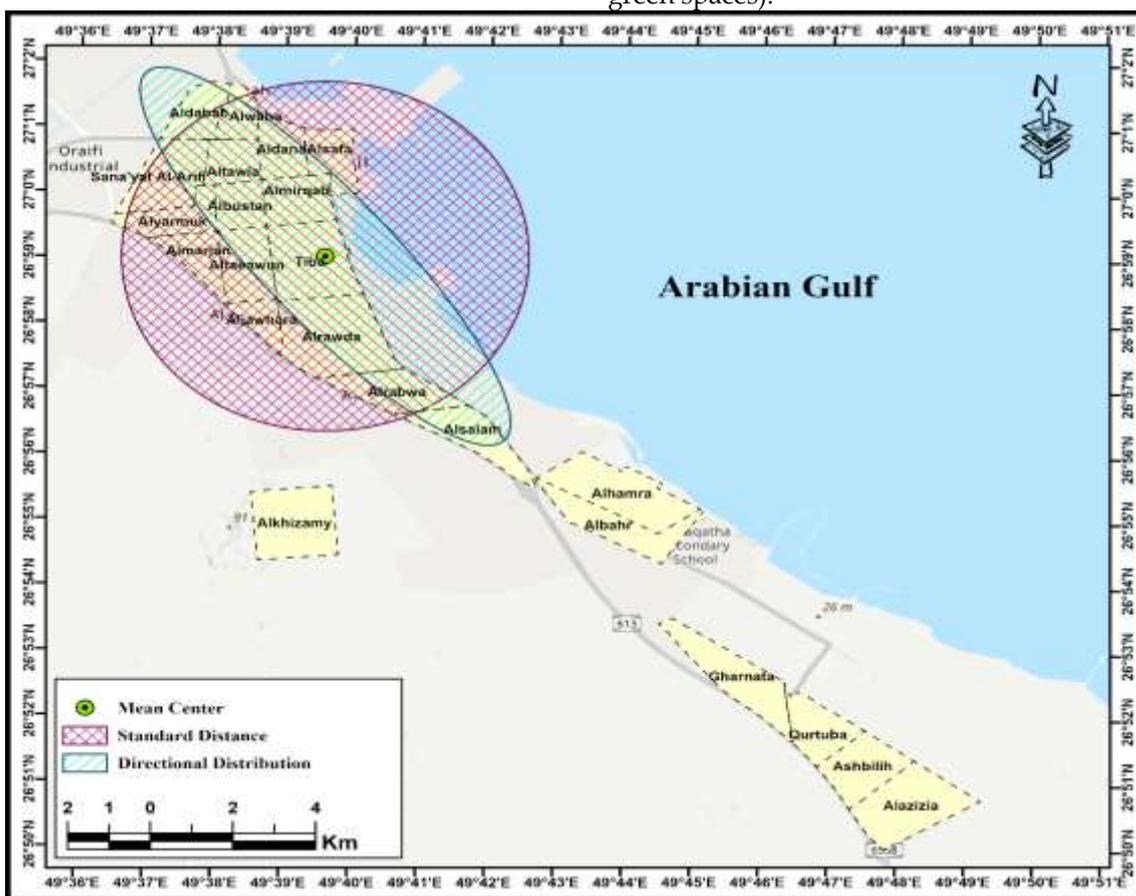


Figure (3): Spatial Analysis of The Distribution of Parks and Green Spaces in Al Jubail City.

**5.6. Directional Distribution (Standard Deviational Ellipse) Analysis**

The spatial analysis using the Directional Distribution (Standard Deviational Ellipse) method (Figure 3) showed that the spatial distribution pattern of parks takes an elongated, elliptical shape, tilted at an angle of 140.6° and extending along the Northwest-Southeast (NW-SE) axis. The standard deviation value along the Major Axis is approximately 6.7 km, while it is only about 1.7 km

along the Minor Axis. This confirms that the pattern of park distribution aligns with the linear extension of the main urban block along the city’s eastern coast. This orientation is explained by the fact that urban growth and economic/residential activities in Al Jubail are localized on the coastal plain, forcing the planning of parks and green spaces to follow this established linear sprawl.

**5.7. Kernel Density Analysis of Parks and Green Spaces Distribution in Al Jubail City**

## Neighborhoods

### 5.7.1. Spatial Distribution Pattern

The study of park and green space density in Al Jubail City using Kernel Density Estimation (KDE) (Figure 4) revealed a varied spatial pattern, indicating high density in some neighborhoods versus low density in others.

- **Very High Density:** The analysis shows that the Northern neighborhoods (such as Al Waha, Al Dana, and Al Dhubab) record the highest density levels (Very High), owing to a high number of parks within close spatial proximity. This concentration is attributed to modern urban planning and the initial inclusion of green spaces as a fundamental element in their schemes, alongside high population density driving greater demand for these facilities.
- **High to Medium Density:** Neighborhoods with high to medium density (such as Sana'yat Alarifi, Al Yarmouk, Al Mirqab, Al Ta'awun, and Al Rawdah) are characterized by the relative proximity of parks to residential areas. This reflects a planning policy aimed at ensuring the availability of recreational services at appropriate

distances.

- **Low Density:** The Central and Southern neighborhoods (such as Al Rabwah, Al Hamra, and Al Bahr) record low levels of park and green area density, resulting from the low number and dispersion of park locations. Alternatively, some areas may rely on major central green spaces that serve a cluster of adjacent neighborhoods.
- **Very Low Density:** This pattern is evident in the neighborhoods on the urban periphery (such as Al Aziziyah, Ashbilih, Qurtuba, and Gharnata, as well as Al Khuzami). This is attributed to the low concentration of parks despite their large area and lower population in some parts (Table 1). Furthermore, large tracts of land are being allocated to industrial and commercial projects at the expense of recreational and environmental services.

Consequently, the Kernel Density Analysis of parks and green spaces in Al Jubail City reveals a spatial pattern characterized by a high concentration of density in the Northern and Northwestern neighborhoods, contrasted by a low density in the Southern and Eastern neighborhoods. This variation highlights the Spatial Gaps in the distribution of green spaces among the city's neighborhoods.

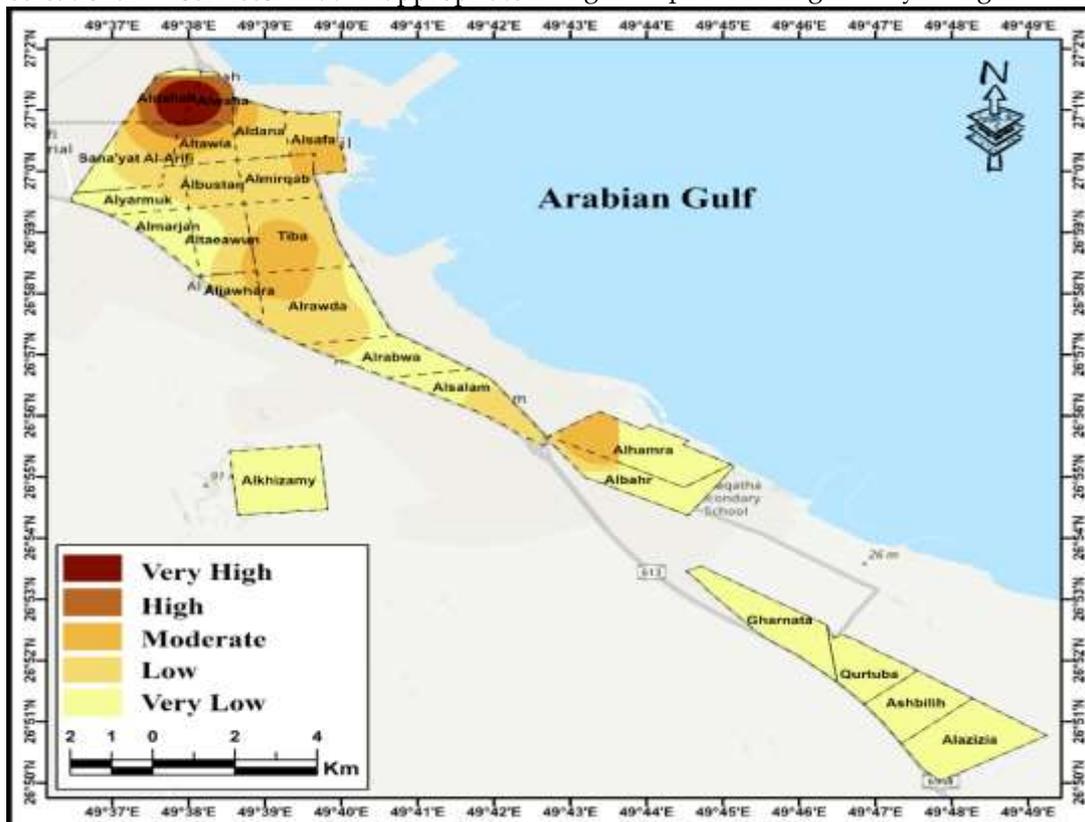


Figure (4): Density Patterns of Parks and Green Spaces Using the Kernel Density Analysis in Al Jubail City Neighborhoods.

**5.8. Service Area Coverage of Parks and Green Spaces in Al Jubail City Neighborhoods**

The Service Areas (Coverage Zones) of parks and green spaces in Al Jubail City neighborhoods were delineated, as illustrated in Figure (5), based on a

spatial standard. This standard utilizes a minimum required park area of approximately 25,000 m<sup>2</sup> to serve the recreational needs of a population group ranging from 25,000 to 40,000 residents within a single neighborhood (UN, 2025, P.116).

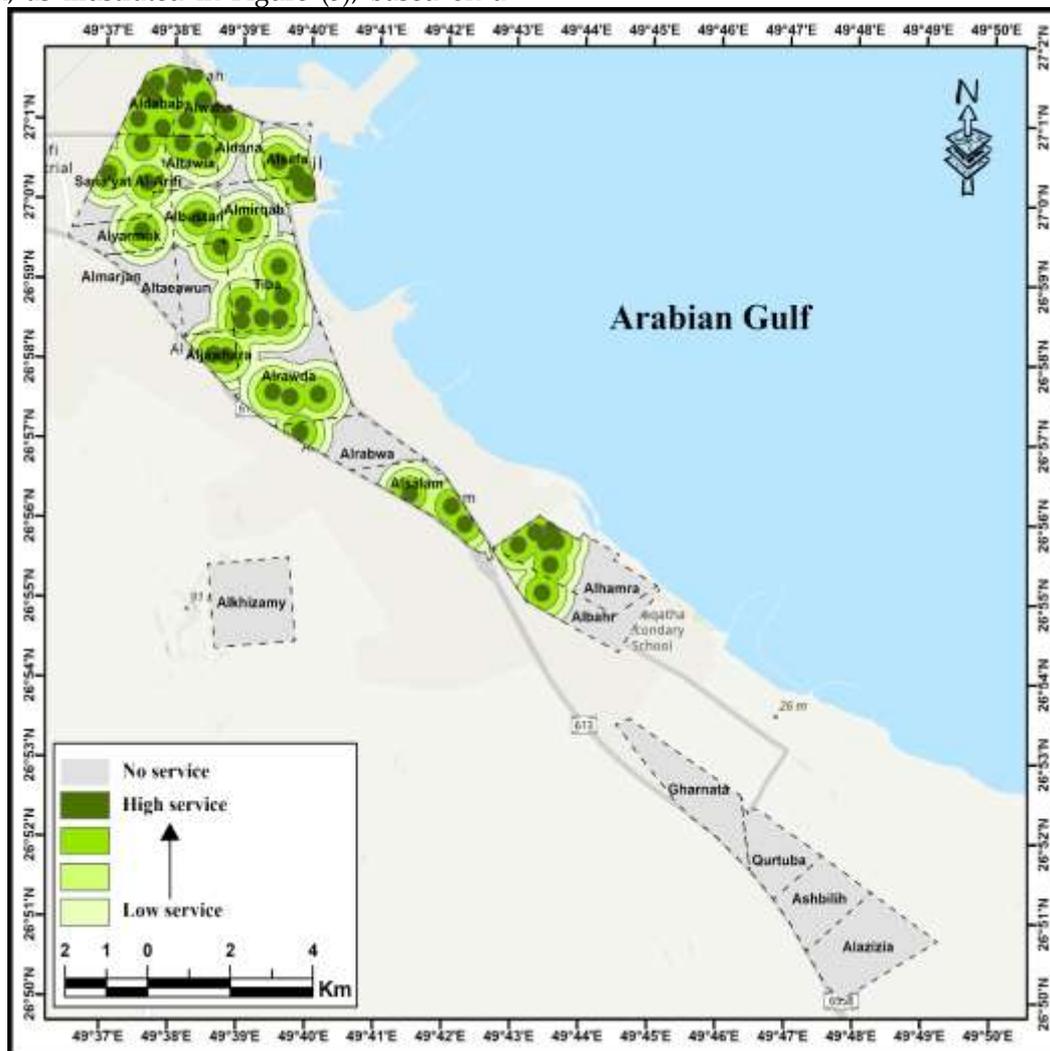


Figure (5): Spatial Service Zones of Parks and Gardens Across Al Jubail City Neighborhoods.

Analysis of the figure reveals that the neighborhoods with the highest coverage of park and green space services are the Northern and Western areas (such as Al Wahab, Al Dana, Al Ta'awun, Al Yarmouk, Al Rawdah, and Neighborhood Sana'yat Alarifi). In these areas, the service zones overlap, indicating high service efficiency and excellent accessibility for residents. This distribution pattern reflects the success of urban planning in these sectors, where parks were integrated into the modern residential fabric, thereby enhancing resident happiness, urban quality of life, and contributing to environmental balance within the neighborhoods (Quality of Life Program Annual Report 2023).

Conversely, service coverage zones progressively

decrease towards the Southern and Eastern neighborhoods (including Al Aziziyah, Ashbilih, Qurtuba, Gharnata, and Al Khuzami), which fall under low-coverage zones or those that entirely lack the service. This points to the existence of clear spatial gaps in the distribution of parks and green areas, which negatively impacts the happiness and quality of life of residents in those neighborhoods. This coverage deficit is attributed to the limited availability of vacant land and the concentration of industrial and commercial uses in those regions.

This disparity confirms that future urban planning for the city requires policies directed toward enhancing spatial justice in the distribution of green cover. This should be achieved through the

establishment of new Pocket Parks and the development of green corridors connecting peripheral neighborhoods with existing service areas, thereby ensuring comprehensive coverage and supporting sustainable urban development goals.

**5.9. Per Capita Green Space in the Neighborhoods of Al Jubail City:**

The per capita green space is a key indicator for assessing urban planning efficiency and serves as a proxy for quality of life, satisfaction, and consequently, happiness. This indicator helps determine the adequacy of parks and green areas and guides policy decisions toward achieving equitable and sustainable spatial distribution of these

resources within the urban fabric in cases of deficiency or inefficiency.

Analysis of Table (1) and Figure (6) revealed a relationship between the population size of Al Jubail’s neighborhoods and the per capita green space. In low-density neighborhoods such as Albahr, the average per capita green space reached 15.8 m<sup>2</sup>, exceeding the international and national planning standard of 15 m<sup>2</sup> per person (UN-Habitat, 2025, p.116). In Alrawda, the value was 8.37 m<sup>2</sup>, and in Al-Rabwa, 5.72 m<sup>2</sup>, due to the smaller population size, which increases per capita share and enhances environmental service availability. A similar pattern was observed in Aljawhara (5.23 m<sup>2</sup>) and Alsalam (5.11 m<sup>2</sup>), which achieved acceptable results despite their moderate total green areas.

**Table (1): Spatial Distribution of Parks and Green Spaces and Residents’ Per Capita Share in Al Jubail City Neighborhoods.**

Neighborhoods	Number of Parks	Green Areas (m <sup>2</sup> )	Average Per Capita Green Area (m <sup>2</sup> /person)	Neighborhoods	Number of Parks	Green Areas (m <sup>2</sup> )	Average Per Capita Green Area (m <sup>2</sup> /person)
Ashbilih	0	0	0	Aldabab	7	50843	1.97
Albahr	1	5183	15.80	Altawia	2	2160	1.33
Albustan	1	723	0.40	Alazizia	0	0	0
Altawun	1	2718	0.72	Almarjan	0	0	0
Aljawhara	2	50124	5.23	Almirqab	1	37214	0.89
Alhamra	6	55537	3.62	Alwaha	3	35777	2.45
Alkhizamy	0	0	0	Alyarmuk	1	13110	1.64
Aldana	2	2841	0.1	Sana'yat Al-Arifi	3	23830	2.92
Alrabwa	1	3510	5.73	Tiba	6	94154	1.97
Alrawda	3	95888	8.38	Gharnata	0	0	0
Alsalam	3	4051	5.11	Qurtuba	0	0	0
Alsafa	5	78822	1.36				

\*Prepared by the researcher through field study and land use maps in the city of Al Jubail. The overall average per capita green space in Al Jubail City was 2.59 m<sup>2</sup>, which is lower than that of Greater Dammam (3.52 m<sup>2</sup>) (Abdulkarim, 2022, p.255). A noticeable decline in per capita green space was recorded in high-density residential neighborhoods such as Alhamra, Alsafa, and Taybah, despite their large total green areas and higher number of parks. For instance, Alhamra contained more than 55,000 m<sup>2</sup> of green areas and six parks, yet the per capita share was only 3.61 m<sup>2</sup>. Similarly, Alsafa had 78,000 m<sup>2</sup> of green space but only 1.36 m<sup>2</sup> per person, and Taybah recorded 1.97 m<sup>2</sup> per person. This pattern reflects the pressure of large populations on environmental

resources, which negatively affects residents’ satisfaction and happiness.

Data from Table (1) and Figure (6) indicate that evaluating the efficiency of green space distribution requires consideration of demographic characteristics alongside environmental indicators. Peripheral low-density neighborhoods exceed the planning benchmark for per capita green space, whereas central high-density areas suffer from spatial inequity due to the high demand for environmental services. This imbalance can be attributed to traditional planning approaches that focus on total green areas rather than integrating population density into environmental justice criteria.



Figure (6): Spatial Distribution of Per Capita Green Space in Al Jubail City.

Therefore, high-density neighborhoods should be prioritized through the utilization of undeveloped lands to establish new parks or through innovative solutions such as vertical gardens and multi-use open spaces to enhance per capita green space. Furthermore, urban planning policies should be linked to dynamic standards that consider actual population size and environmental needs rather than relying on static indicators that may overlook demographic disparities. Such an approach contributes to improving quality of life and achieving the goals of Saudi Vision 2030 ([Kingdom's vision 2030](#)).

## 2-Social and Service Determinants.

### A- Population Density

Population density affects the per capita provision of various services, which, in turn, influences the indicators of happiness and quality of life in Al Jubail City. It has been observed that there

is a variation in population distribution across Al Jubail's neighborhoods, with some areas experiencing high population density while others suffer from a relative population scarcity. Table (2) and Figure (7) illustrate the population density patterns in Al Jubail's neighborhoods and the potential resulting pressure on certain services and their per capita share.

- **Very High Density (exceeding 19,000 Person/km<sup>2</sup>):**

The Very High population density pattern (exceeding 19,000 Person/km<sup>2</sup>) dominates both Al Safat and Al Mirqab neighborhoods, which are located to the north on the Arabian Gulf and close to Al Jubail Port. This is further attributed to the modern urban planning, the availability of essential services, and proximity to employment centers, economic activities, and the waterfront. These factors grant them a high residential appeal, enhancing their capacity to attract many residents within limited

urban scopes.

- **High Density (12,000 to 15,000 Person/km<sup>2</sup>):**

Neighborhoods falling into the High-Density category include Al Dana, Al Dhubab, Taibah, and Al Waha. These are Northern neighborhoods located near the Al Jubail Industrial Area, where economic activities are concentrated and job opportunities abound. They are also characterized by the quality of transport networks and the availability of educational and health services, which elevates residential demand and maintains their attractiveness.

- **Medium Density (2,000 to 9,000 Person/km<sup>2</sup>):**

Neighborhoods like Al Jawharah, Al Hamra, Al Rawdah, Al Yarmouk, Sana'yat Alarifi, and Al Marjan belong to the medium population density category. These neighborhoods function as transitional zones between the central urban mass and the periphery. This is attributed to the availability of some service components and relative proximity to work centers, lower rents, and affordable land prices for residential construction, along with more spacious residential areas that allow the population to be distributed at a lower density compared to the central neighborhoods.

*Table (2): Distribution of Population, Health Facilities, And Educational Institutions in The Neighborhoods of Al Jubail City\*.*

Neighborhoods	Population	Area Km <sup>2</sup>	Population Density Person/km <sup>2</sup>	Number of Health Centers	Average Per Capita Provision of Health Centers	Number of Schools
Ashbilih	598	2.54612	234.8671	0	0	0
Albahr	328	2.687875	122.0295	0	0	0
Albustan	1831	1.547527	1183.178	0	0	0
Altawun	3770	2.514827	1499.109	0	0	0
Aljawhara	9576	1.082121	8849.291	0	0	2
Alhamra	15356	3.915542	3921.807	1	8000	1
Alkhizamy	139	3.805356	36.52747	0	0	0
Aldana	27927	1.845242	15134.6	3	9309	0
Alrabwa	613	2.456963	249.495	0	0	0
Alrawda	11446	5.20935	2197.203	0	0	0
Alsalam	792	2.457824	322.2363	0	0	0
Alsafa	57941	1.808287	32041.93	3	19314	0
Aldabab	25868	1.754476	14744.01	1	25868	0
Altawia	1628	1.572478	1035.309	0	0	0
Alazizia	1540	3.920076	392.8495	0	0	0
Almarjan	3527	1.625982	2169.15	0	0	0
Almirqab	41834	2.158826	19378.12	1	41834	0
Alwaha	14597	1.224306	11922.67	1	14597	2
Alyarmuk	7975	1.938415	4114.185	0	0	1
Sana'yat Al-Arifi	8148	3.087237	2639.253	0	0	0
Tiba	47687	3.969316	12013.91	2	23844	1
Gharnata	440	3.329511	132.1515	0	0	0
Qurtuba	318	2.14242	148.4303	0	0	0

\*Prepared by the researcher through field study and land use maps in the city of Al Jubail. Number of Population from: [population census 2022](#)).

- **Low Density (<1,500 inhabitants/km<sup>2</sup>):**

Population density drops to its lowest levels (less than 1,500 inhabitants/km<sup>2</sup>) in the peripheral neighborhoods such as Al Aziziyah, Ashbilih, Qurtuba, Gharnata, Al Khuzami, and Al Bahr. The low population density here is explained by their

distance from employment centers in the north (Industrial Area) and the main services concentrated in the northern and central neighborhoods, along with the absence of major economic activities. This is compounded by the vast undeveloped land areas, which currently limit their ability to attract residents.



Figure (7): Spatial Patterns of Population Density in Al Jubail City Neighborhoods.

**B-Health Determinants**

Health services are considered one of the most significant determinants that directly influence the Happiness Index, due to the reflection of their adequacy and efficiency on residents' health and their Healthy Life Expectancy (HLE), the latter being

a crucial measure of the global Happiness Index.

The spatial distribution of health service centers across Al Jubail City's neighborhoods varies, as evidenced by Table (2) and Figure (8). The Northern and Central areas (including neighborhoods such as Al Safat, Al Dhubbab, Al Mirqab, Al



Figure (8): Spatial Density of Health Service Coverage (Kernel Density Estimation) In Al Jubail City Neighborhoods.

Dana, and Al Waha) enjoy the highest health service coverage, classified within the High to Very High Coverage category. This is attributed to the concentration of most health centers in these areas and integrated transport networks that enhance accessibility. This is also due to the high population density, which prompted governmental planning to increase the number of health centers to meet the growing demand for the service.

In contrast, neighborhoods such as Taibah, Sana'yat Alarifi, Al Tuwaiyah, and Al Bahr recorded Medium to Low health service coverage. This is due to their transitional location between the center and the periphery, resulting in a lower density of health centers compared to the central neighborhoods. This disparity is also linked to the allocation of land for residential and commercial purposes without establishing adequate health facilities, which creates a relative gap in coverage.

Health service coverage drops to its lowest levels in the Southern and Eastern neighborhoods of Al Jubail (such as Al Aziziyah, Ashbilih, Qurtuba, Gharnata, and Al Khuzami), which fall under the Very Low Coverage category. This is attributed to their distance from the health centers concentrated in the city center, the complete absence of health centers within their boundaries, and the predominance of industrial or low-density residential land use, which limits health investment in those areas.

This spatial pattern of health center distribution reflects an urgent need for planning policies targeting neighborhoods with Very Low coverage by establishing new health centers and improving the network connectivity between peripheral areas and the central health centers. It further highlights the importance of

integrating Spatial Justice into development plans to ensure balanced access to health services for all city residents, in line with sustainable development standards and Saudi Vision 2030.

### 5.10. Spatial Analysis of Health Centers in Al Jubail City Neighborhoods (2025)

#### 5.11. Mean Center Analysis

Processing the health center distribution data in Al Jubail City using spatial analysis tools showed that the Mean Center for these health centers is located at coordinates: X: 49.659338°E and Y: 26.997628° N. This location is situated in the center of the Taibah neighborhood in the central region of Al Jubail City (Figure 9). This Mean Center indicates that most health centers are a key determinant of happiness and quality of life are concentrated within the city's Northern and Central neighborhoods, where population density and the intensity of urban and service activities are high, making it a primary focal point for service localization.

#### 5.11. Standard Distance Analysis

Spatial analysis using the Standard Distance tool (Figure 9) showed that it covered an area with a circular radius of approximately 4 km from the Mean Center point. This value indicates that the average spatial coverage of health services extends within an 8 km diameter, concentrating in the North and Center. Conversely, some peripheral neighborhoods, such as Al Aziziyah and Ashbilih, fall outside this effective health coverage range, indicating the existence of spatial disparities and gaps in service coverage.



Figure (9): Spatial Analysis of The Distribution of Health Service Centers in Al Jubail City (2025).

### 5.12. Directional Distribution Analysis

The spatial analysis of health service centers in Al Jubail City using the Directional Distribution (Standard Deviational Ellipse) tool (Figure 9) revealed that the health service centers take on an obliquely shaped ellipse with a rotation angle of approximately 135.7°, extending towards the Northwest-Southeast (NW-SE) axis. The standard deviation along the Major Axis is approximately 5627.45 meters, while the Minor Axis measures 1073.35 meters. This pattern confirms that the spatial distribution of health services aligns with the linear extension of the main urban block, characterized by high population density, particularly in the Northern neighborhoods. This is a consequence of the concentration of development, economic, and population activities along this coastal axis of the Arabian Gulf. In contrast, the Southern neighborhoods, which have lower population density, have fewer health centers due to relatively lower demand and the presence of vast areas that are currently not urbanized.

### C- Educational Determinants

Educational determinants in the Kingdom of Saudi Arabia are considered one of the most fundamental tools for achieving Saudi Vision 2030, as they contribute to building a prosperous knowledge-based society that enhances happiness indicators and quality of life. Education equips individuals with skills and values that enable them to contribute to sustainable development goals and achieve social welfare. The Kingdom has established planning standards to regulate the distribution of educational services in Al Jubail City to ensure coverage for all target population groups across different neighborhoods. Consequently, a spatial analysis was conducted to evaluate the educational service distribution, assessing its alignment with planning standards and its impact on residents' happiness and quality of life indicators in Al Jubail.

### 5.13. Spatial Influence Zones of Schools in

### Al Jubail Neighborhoods (2025)

The planning influence zone for school's ranges from (400 - 600Mm) for primary schools, (800 - 1000 m) for intermediate schools, and (1000 - 2000 m) for secondary schools (Ministry of Municipal Rural Affairs and Housing, 2015). For this evaluation, school coverage was assessed based on an average distance of 1.5 km.

### 5.14. High Coverage

Analysis of Table (2) data and Figure (10) results show a spatial pattern reflecting an inverse relationship between the level of service and the distance from school locations. Neighborhoods located within the 1.5 km radius of school sites enjoy the highest level of educational service due to their direct proximity and easy accessibility (by foot or via the local road network). This category includes most Northern and Central neighborhoods, such as Al Waha, Al Dana, Al Tuwaiyah, Al Mirqab, Al Ta'awun, Al Rawdah, and Al Bahr, where service zones overlap and clearly cover the main urban core.

### 5.15. Medium to Low Coverage

Neighborhoods located in the further zones, ranging from 1.5 km up to 3 km, are classified as having medium to low educational coverage, as is the case in parts of Al Salam, Al Rabwah, and Al Hamra neighborhoods. Here, the density of schools is lower, and reliance on transport means to access educational services is higher.

### 5.16. Low or No Coverage

This category includes neighborhoods situated in the Southern peripheral edges such as Gharnata, Qurtuba, Ashbilih, and Al Aziziyah. This indicates low or zero direct educational coverage within these neighborhoods, meaning they fail to meet the target planning standard set by the Ministry of Municipal Rural Affairs and Housing. This imposes challenges on residents in these areas, affecting their happiness, satisfaction, and quality of life.

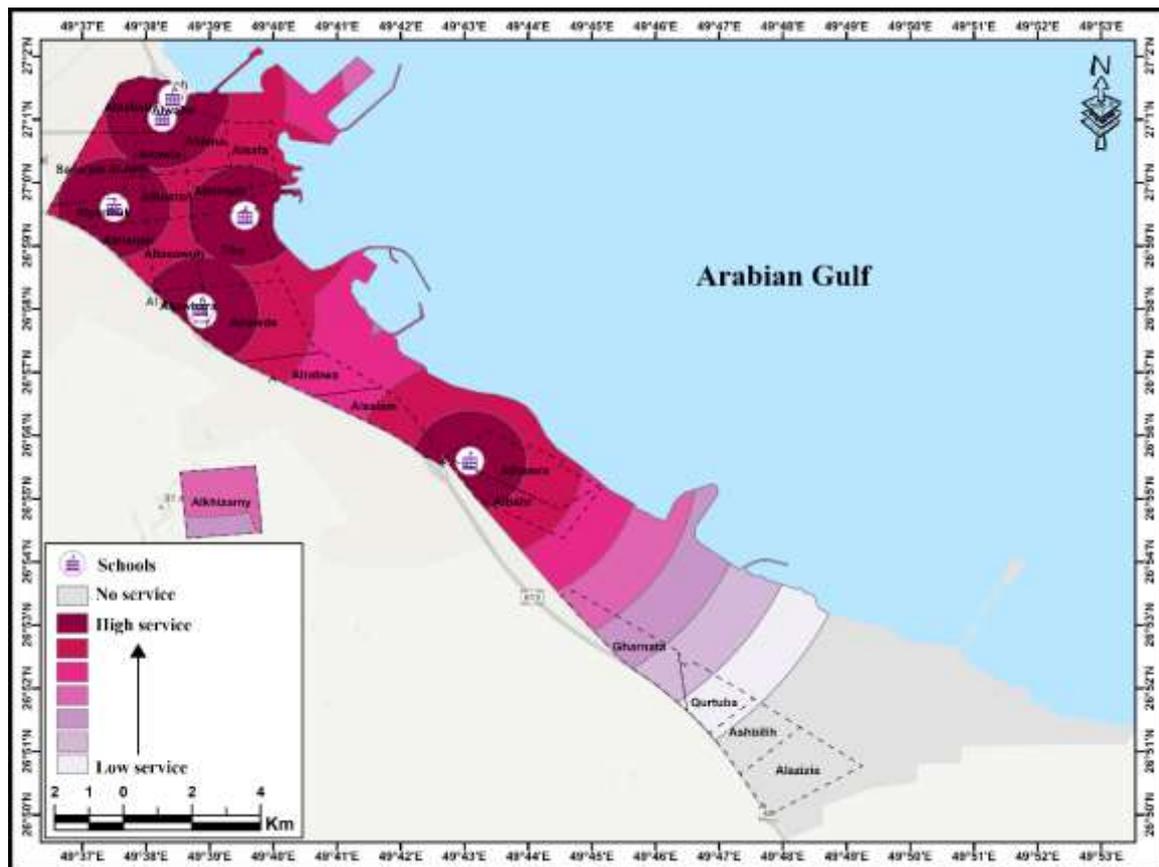


Figure (10): Distribution of Schools and Their Spatial Influence Zones in Al Jubail City.

The concentration of educational services (schools) in the Northern and Central neighborhoods of Al Jubail City is primarily due to the requisite population density. Conversely, the peripheral neighborhoods suffering from low educational coverage are subject to several spatial factors, including the linear coastal urban sprawl and a land-use distribution that allocates large areas in the south to industrial and commercial activities, reducing opportunities for school site allocation. Furthermore, the relatively low population density in the Southern neighborhoods does not meet the necessary population criteria for establishing new schools.

To achieve spatial justice and comprehensiveness, the geographical distribution of schools must be re-evaluated. This should involve establishing new schools or improving educational transport options in peripheral neighborhoods to ensure spatial equity in access to educational services and reduce gaps between different zones. Enhancing connectivity through internal roads and providing safe pedestrian paths could also raise the level of service, even in neighborhoods located outside the direct 1.5 km radius.

#### D- Cultural Determinants

Cultural determinants are considered one of the most vital elements of social support for residents and a key factor influencing residents' awareness, their ability to make life decisions, and their capacity to combat corruption, which is a significant metric in the global Happiness Index. Hence, the importance of studying their spatial distribution across Al Jubail City's neighborhoods.

Distribution Analysis and Coverage Zone: Figure (11) analysis revealed the existence of one cultural center (Category D) based on planning standards (Ministry of Municipal Rural Affairs and Housing, 2015) located within the residential area of Al Jubail (Al Jubail Balad), and two other centers (Category D) situated within the Al Jubail Industrial Area outside the residential neighborhoods. The coverage of these centers and their provision of cultural services were assessed based on a 5 km influence zone (Buffer) to ensure easy accessibility.

Spatial Coverage Pattern: The analysis demonstrated a graduated spatial pattern regarding the adequacy of service coverage across the city's neighborhoods. The Northern and Western neighborhoods, which are closest to the Al Jubail Industrial Area, receive the highest degree of coverage, while the service decreases as one move

South and East. The highest service areas align around the urban connection hub in the North, then diminish towards the Southern neighborhoods (Gharnata, Qurtuba, Ashbilih, and Al Aziziyah), where the distance from the centers increases and access to organized cultural activities decreases. Verification Against Planning Standard: Planning standards require the provision of one cultural center (Category D) for every 30,000 to 100,000 inhabitants

(Ministry of Municipal Rural Affairs and Housing, 2015, P.3-15). Applying this standard to the three available centers in Al Jubail City showed that the population size served by a single cultural center reached 95,000 inhabitants, which is close to the upper limit set by the planning standard. This situation indicates stress planning and necessitates an increase in the number of cultural centers to meet the growing population demand.

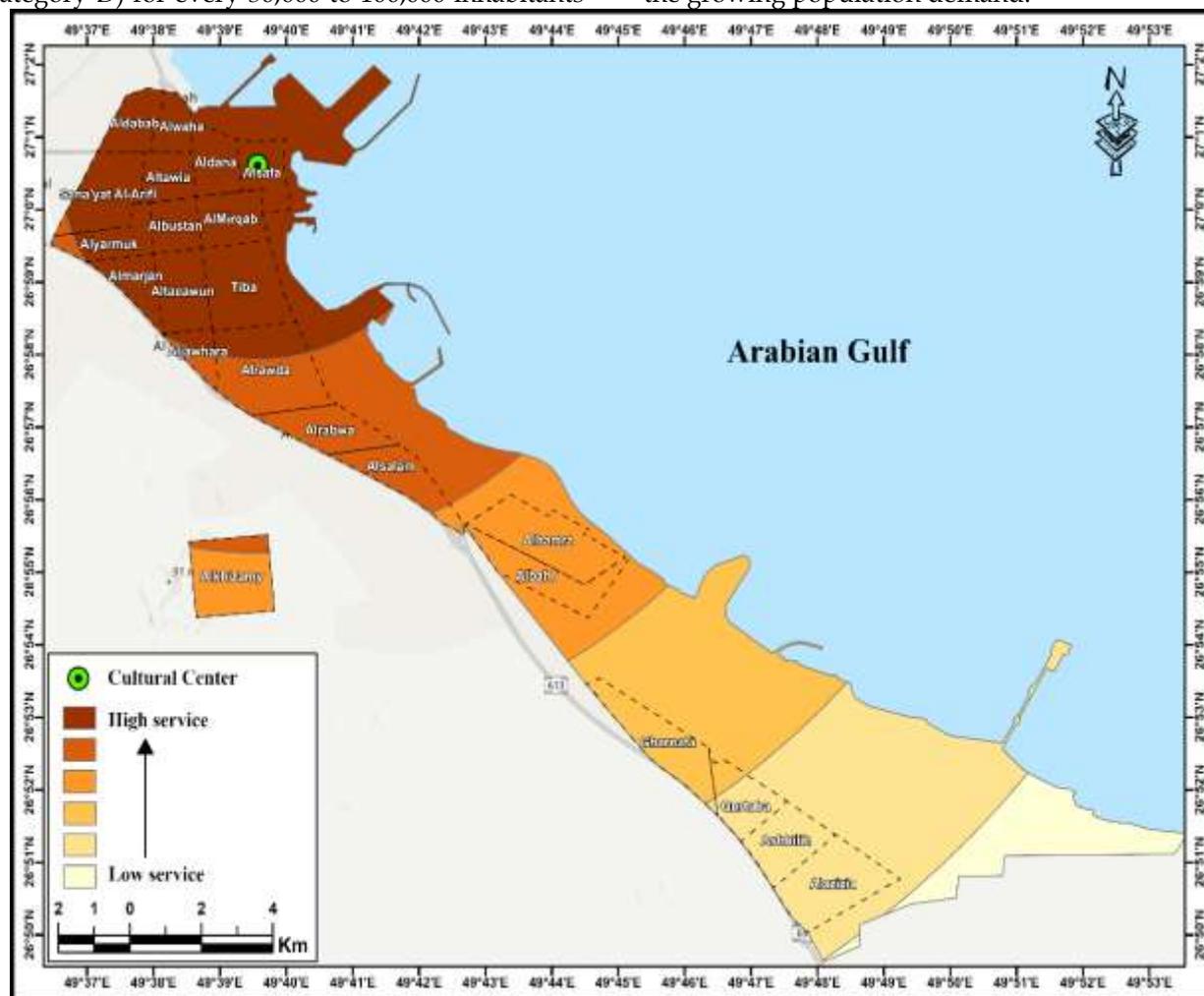


Figure (11): Distribution of Cultural Centers and Their Spatial Influence Zones in Al Jubail City Neighborhoods (2025).

### 3-Analysis of Spatial Efficiency in Urban Service Distribution across Al Jubail City Neighborhoods

The results of the spatial analysis of happiness and quality of life determinants in Al Jubail City represented by essential services (educational, health, cultural, and recreational)—revealed a spatial surplus in the Northern and Central neighborhoods, such as Al Waha, Al Dana, Al Safat, Al Mirqab, and Al Yarmouk. In these areas, green spaces are integrated, and the service

coverage zones for essential facilities (educational and health services) overlap within effective access distances. This is due to the modern urban planning in these neighborhoods, their integrated infrastructure, and their proximity to the coastal extension axis, which represents the city's main development artery, consequently reflecting a spatial imbalance in service distribution.

Conversely, there is spatial inadequacy of services in some Southern neighborhoods,

especially the peripheral ones, such as Al Aziziyah, Ashbilih, Qurtuba, Gharnata, and Al Khuzami. These areas suffer from a clear deficiency in green spaces and poor coverage of schools, health centers, and cultural facilities. This is attributed to their distance from the main urban core and their lower population density, coupled with the land-use orientation towards industrial and commercial activities at the expense of residential and service functions, which leads to a decline in their investment appeal for essential services.

This analysis underscores the need for planning interventions based on precise spatial data to correct the development trajectory and achieve a balance between surplus and deficit areas, thereby realizing Spatial Justice in the distribution of happiness and quality of life determinants across the city's neighborhoods. Achieving spatial justice requires a package of integrated planning solutions aligned with Sustainable Development Goals and Saudi Vision 2030, which includes:

- Establishing new parks and recreational areas in neighborhoods experiencing a deficit.
- Localizing multi-functional schools, health, and cultural centers in peripheral locations according to optimal distance standards.
- Improving internal transport and public transit networks to reduce travel time to central services .

**\*Spatial Analysis of Gaps in the Determinants of Happiness and Quality of Life in Jubail City:**

The Happiness Index Gaps in Al Jubail City refer to the spatial disparities among neighborhoods in the availability and quality of environmental, social, and service amenities. This concept highlights the extent to which the distribution of parks, health centers, and educational/cultural facilities impacts quality of life and community well-being. Analyzing these gaps is crucial for formulating equitable development plans aimed at achieving spatial balance and improving happiness indicators for all city residents.

A precise statistical spatial analysis model was applied to measure the gaps in happiness and quality of life determinants in Al Jubail. This

involved converting each service indicator into a normalized value ranging between (0 and 1). Zero (0) represents the lowest level of adequacy or spatial availability (Spatial Gap), while one (1) represents the highest level of service sufficiency and coverage. These indicators included per capita provision of green spaces and the level of proximity to schools, health centers, and cultural/other service facilities at the neighborhood level.

Subsequently, a relative weight was assigned to each indicator based on its methodological importance (as per literature), and the resulting values were integrated into a unified composite index. The index values were then divided into five graduated spatial categories, ranging from deficit to surplus in service level. This methodology allowed for the construction of a quantitative model that accurately illustrates the true spatial disparities, revealing areas of sufficiency and gap (Figure 12), and reflecting the level of Spatial Justice in the distribution of happiness determinants.

**Figure (12) shows notable spatial disparities in the adequacy of urban services that constitute determinants of happiness and quality of life across Al Jubail's neighborhoods, which can be categorized as follows:**

**Neighborhoods with Very High Service Spatial Gap (Very High Gap):**

This category includes the Southern and Southwestern neighborhoods, such as Al Khuzami, Qurtuba, and Al Azizia. These neighborhoods record the highest levels of service spatial gap, indicating a clear spatial deficit in essential service coverage. This is often associated with the peripheral location of these neighborhoods, their low urban density, geographical distance from central service hubs, lack of green spaces and parks, and poor connectivity to effective access zones for schools, cultural, and health centers.

**Neighborhoods with Medium and Low Service Spatial Gap:**

The Central and Northeastern neighborhoods (such as Al Ta'awun and Al Rabwah) show medium to low levels of spatial gap in service adequacy. This reflects relatively better service coverage and higher spatial efficiency due to the concentration of certain vital facilities and service institutions within these areas.

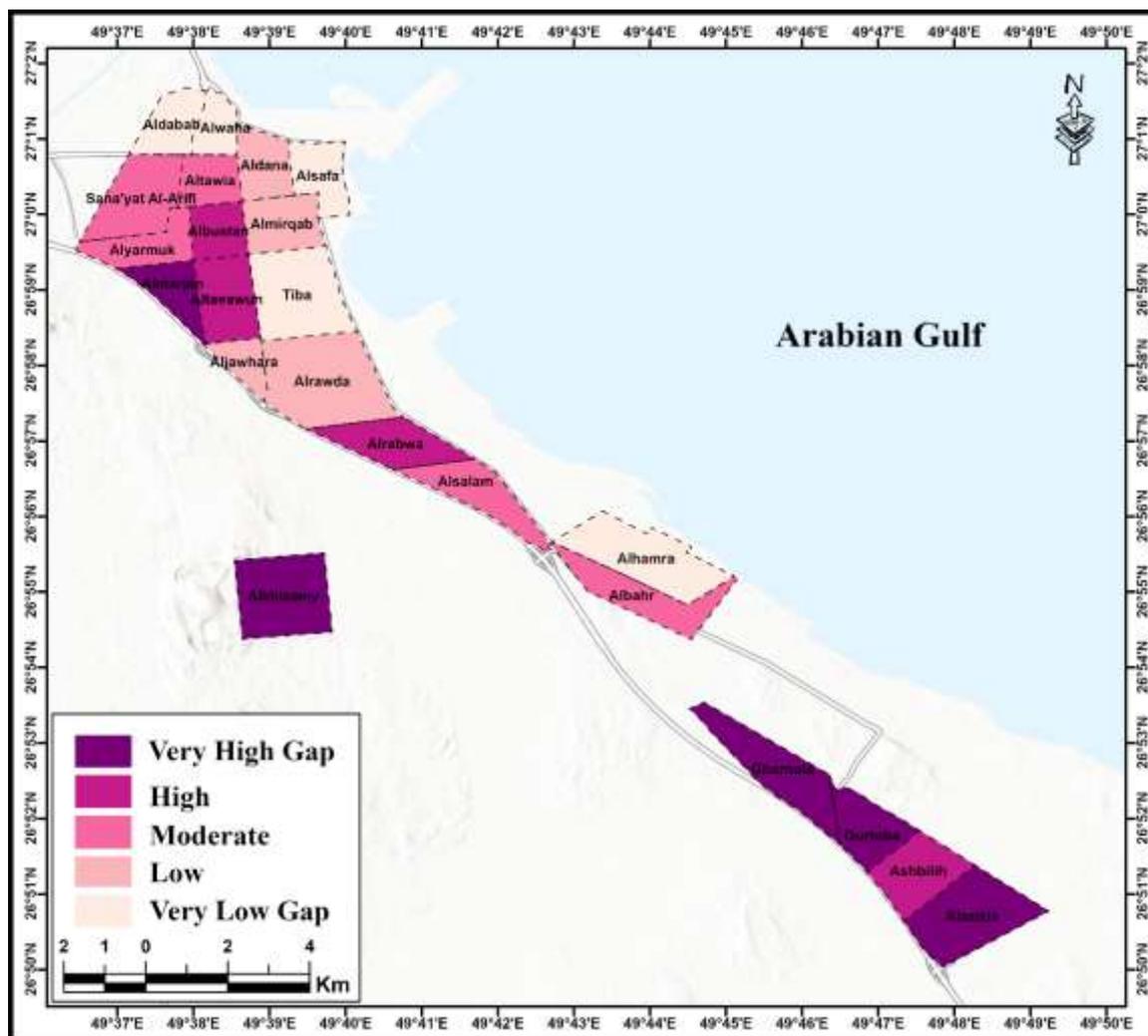


Figure (12): Spatial Disparities in Happiness Indicators Gaps Across Al Jubail City Neighborhoods (2025).

#### Nearhoods with Very Low Service Spatial Gap (Very Low Gap):

This category includes the Al Rawdah, Al Waha, Al Safat, and Taibah neighborhoods. These are in the north, close to the Al Jubail Industrial Area, and possess high service adequacy for most essential services due to their modern planning.

These spatial patterns in the determinants of happiness and quality of life in Al Jubail City reflect a lack of Spatial Justice in the distribution of essential services. Sufficiency tends to be concentrated in the Northern and Eastern sectors, contrasted by a noticeable deficit in the Southern and Western peripheries. This situation necessitates directing future policies and planning efforts toward achieving spatial justice in urban service distribution and enhancing service adequacy in high-gap neighborhoods, particularly those located on the Southern and Western edges of the city. This will contribute to improving the overall quality of life and urban happiness and fostering spatial integration

across all parts of Al Jubail City within a sustainable and comprehensive framework.

## 6. RESULTS

- Recreational service components in Al Jubail, represented by parks and green spaces, are notably concentrated in the Northern and Western neighborhoods, while decreasing in the Central neighborhoods, and are absent in most Southern neighborhoods located on the urban periphery of the city. The per capita provision of green space in only one neighborhood approximated the national planning standard of 15 m<sup>2</sup>/person, while it sharply decreased across the remaining neighborhoods.
- Population density exceeds 19000 person /km<sup>2</sup> in the planned Northern neighborhoods with high service coverage, contrasting sharply with the Southern neighborhoods,

where density falls below 1500 person /km<sup>2</sup> and service coverage is lower.

- The spatial gap analysis results concerning the sufficiency and coverage of essential services (which are social support determinants linked to the Happiness Index) showed a clear disparity in the distribution of environmental, social, and service amenities among the city's neighborhoods. The Northern and Central neighborhoods (such as Al Waha, Al Mirqab, Al Safat, Al Rawdah, and Al Bahr) are characterized by a relative integration of green spaces and overlapping coverage zones for educational, health, and cultural services. This reflects their association with higher population density areas and the modern urban planning structure extending along the coast.
- High to Very High Spatial Gaps emerged in the peripheral and Southern neighborhoods (such as Al Aziziyah, Ashbilih, Qurtuba, Gharnata, and Al Khuzamy). This is due to their distance from the main service centers, their low per capita share of green spaces, and poor coverage of educational, cultural, and health services within effective access ranges.
- Other neighborhoods (such as Al Rabwah, Al Salam, and Al Jawharah) showed transitional levels of service adequacy, possessing acceptable provision in some services while suffering from deficiencies in others. This highlights the impact of varying population density patterns and land uses in shaping this disparity. The analysis clearly demonstrates that the coastal extension axis played a primary role in the concentration of services in the North and Center at the expense of the peripheries, which still exhibit tangible spatial gaps in happiness indicators.

## 7. RECOMMENDATIONS

**Based on the results of the spatial analysis of the disparities in happiness determinants and quality**

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**of life in Al Jubail City, the study presents the following recommendations:**

- Directing investments in essential services towards urban periphery neighborhoods, particularly in Southern Al Jubail, by establishing new parks and recreational areas, and founding schools, health, and cultural centers in strategically planned locations that achieve spatial balance and equity.
- Elevating the efficiency of internal and public transport networks to reduce travel time and enhance connectivity between the periphery and the main urban core, thereby mitigating the impact of spatial coverage gaps for certain services.
- Reallocating urban services according to spatial needs priorities, focusing on core services (education, health, and public spaces). This includes launching programs to encourage the private sector to utilize vacant land in underserved areas, channeling urban investments toward infrastructure enhancement in low sufficiency neighborhoods and promoting balanced development over the medium to long term to support the provision of integrated environmental and service activities.
- Activating the role of Geographic Information Systems in monitoring service gaps and updating urban databases periodically to support evidence-based planning decision-making.
- Enhancing the participation of the local community in Al Jubail City in determining service development priorities, ensuring that plans align with actual needs and elevating the level of social satisfaction.
- Conducting a field survey to record the quantitative values of happiness and quality of life indicators across Al Jubail City's neighborhoods as a subsequent phase, allowing behavioral data to integrate with the spatial analysis of this study.

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