

Abstract

Public open spaces are essential for residents' social interactions and recreational activities, improving wellbeing as well as offering economic and environmental benefits. Saudi Arabia is aiming to enhance the quality of life in all its cities through different national programs and projects. One of the key performance indicators is increasing public open space per capita from 3.47 m² to 3.9 m² by 2020. This study measured the current public open space per inhabitant in Jeddah by using a geographic information system to identify the types of public open spaces that make up the per capita value in the city. Jeddah is located in a rapidly developing country, and it is a re-planned city where the current status of public open spaces falls short of users' expectations and does not meet international standards. This study suggests that the Ministry of Municipal and Rural Affairs and municipalities should adopt a systematic approach to tackling the spatial distribution of open spaces in Saudi cities. In addition, there is a need for the proactive involvement of planners, landscape architects and designers in the planning process.

Keywords: quality of life, open spaces, planning, GIS, per capita, Saudi Arabia

PUBLIC OPEN SPACE PER INHABITANT IN THE CITY OF JEDDAH

Quantitative Evaluation of Public Open Space per Inhabitant in the Kingdom of Saudi Arabia: a Case Study of the City of Jeddah

The topic of public open spaces in cities has become very important globally in terms of their provision and the benefits they offer to both the cities themselves and to individuals. These spaces are considered as fundamental to cities because of the physical, mental and social benefits they offer (Burgess et al., 1988; Olwig, 2016). Public open spaces can also provide cities with environmental benefits, such as reducing the effect of urban heat islands (Dimoudi & Nikolopoulou, 2003; Norton et al., 2015).

For residents, public open spaces are important in enhancing and promoting physical activities by encouraging people to walk and exercise (Hillsdon et al., 2006; Koohsari et al., 2015). Furthermore, studies have shown that these spaces can improve users' mental wellbeing (Curtis, 2010; Wood et al., 2017). Public open spaces also contribute to social cohesion (Yung et al., 2017) and bring people from different ethnic backgrounds together (Addas & Rishbeth, 2018).

The World Health Organization (WHO) and the United Nations have identified the minimum per capita public open space in urban areas for healthy living and enhancing the quality of life of residents. These are considered as common standards and are widely used in the study of open spaces to examine whether a city is achieving adequate provision of public open spaces (Senanayake et al., 2013; Shahfahad et al., 2019).

In Saudi Arabia, various programs and initiatives are underway to enhance the quality of life in cities as part of the country's Vision 2030. The Quality of Life Program (QLP) was launched in 2018 as one of the government's twelve Vision 2030 initiatives under the National Transformation Program (NTP). The QLP aims to

improve quality of life by providing a supportive environment that is designed to enhance the lives of all citizens, facilitating their participation in various cultural, recreational and sporting activities.

One of the NTP key performance indicators is to increase public open space per capita in Saudi cities from 3.47 to 3.9 m² by 2020. This is a challenging target because of current practices of planning and urban design at the city level, as highlighted in a number of studies (Abubakar & Aina, 2018; Al-Hathloul & Mughal, 2004; Atef, 2013; Mandeli, 2008). Furthermore, consideration of the benefits and values of public open spaces have been neglected in Saudi cities until recently.

Mandeli (2011) noted that the demands of the modern economy in Saudi Arabia and planning processes that were designed to re-shape society have resulted in a sharp break from the traditional urban environment. In recent decades, economic activities have been centralized in large cities, such as Jeddah, and the Saudi economic system has been integrated with Western economies.

It was believed that the health of the economy could be maintained only by changing the nature of the built environment. Large-scale housing and transportation projects were initiated, redeveloping old cities and creating new residential areas and road networks (Al Nowaiser, 1982; Alharbi, 1989). These changes have been driven by land-use regulations put in place by central and local authorities prioritizing physical uniformity and economic productivity (Mandeli, 2011). These regulations have also focused on vehicle use which, together with the segregation of people according to their economic and social status, has led to the physical decomposition of the urban fabric and social disintegration (Akbar, 1981; Bokhari 1978).

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This prioritization and the development strategies that were employed, including the creation of single-use areas, have had damaging effects on urban public open spaces in cities across the Middle East; Sidky and Bastawisi (2010) described cities in Egypt as urban environments that demonstrably lack balance. The same could be said of cities such as Jeddah in Saudi Arabia, where outdoor spaces are widely dispersed and barely accessible and fail to provide protection from very hot weather. The absence of suitable public open spaces has undermined any sense of community or identity and discouraged people from taking part in social experiences and physical activities (Al-Hathloul and Mughal, 1999; Eben-Saleh, 2002; Mandeli, 2011).

These issues have arisen because the design and planning of public open spaces have been approached somewhat haphazardly in most Saudi cities (Addas & Rishbeth, 2018; Mandeli, 2010). In Jeddah, after the demolition of the Jeddah Wall, five master plans were prepared for the city (Table 1). Each of these master plans considered the provision of public open spaces to some extent, but to different levels and in different areas.

Master plan	Public open spaces key aspects
Dr. Makhlof (1962)	75 km ² of recreation zones Neglected public open spaces
Robert Matthew and Johnson Marshall (1973)	High distribution of recreation and public open spaces Proposed 10 m ² per capita Three main parks in the city
Sert Jackson International and Saudi Consult (1980)	Proposed 10 m ² per capita Neighborhood park 3,500 m ² District park 1,500 m ² Metropolitan park 500 m ² Children's playground
Dr. Alsummait (1986)	56 km ² of recreation zones include farms and public open spaces
Albeeah Consultants (2004)	Focus on the waterfront recreation zones

Table 1. Jeddah master plan from 1962 to 2004

These five master plans did not achieve the successful provision of public open spaces because decision-makers focused on providing residential development and there was a lack of an overall strategy or framework for public open spaces. As a result, the outcome of the planning process is seen as meaningless. The public open spaces that do exist are often poorly used and are, in some cases, in locations that are dangerous to residents, with access across busy roads.

While initiatives such as the QLP seek to increase public open space availability quantitatively, there is no clear understanding of what should be considered as usable public open space, differentiated from other visual amenity spaces. Given the benefits of public open spaces and their role in encouraging linkages and a sense of pride and belonging (Addas, 2015), the aim should not simply be to achieve a numerical target; the value of the spaces and the way they connect the city are what is important (Timperio et al., 2007). Therefore, this study aims to calculate the actual usable public open spaces per capita in Jeddah.

This study will help to highlight planning issues associated with public open spaces in the city. It will also show whether increasing the availability of public open spaces in Saudi cities would be dependent on the Ministry of Municipal and Rural Affairs (MoMRA) introducing design and planning approaches that enhance city planning.

Methodology

The methodology for this study included data collection to identify all gardens and public open spaces within the Jeddah municipality. All open spaces were then classified into one of eleven types according to their nature and location (Table 2). It is important to highlight that this study does not propose a typology for public open spaces in the city of Jeddah. However, the authors classified the current spaces in the

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city according to the geographical location, condition and spatial arrangement of each site. However, such a typology should be created to assist the provision of public open spaces and provide a framework to guide the city's decision-makers.

Code	Type	Definition
T1	Garden	All gardens that are located in the middle of neighborhoods, or at the district level and city level.
T2	Garden unbuilt	All gardens that are located in neighborhoods, or at the district level or city level, that are not yet built, but everything around them is built.
T3	Garden proposed	All gardens that are located in neighborhoods, or at the district level or city level, that are proposed (nothing built).
T4	Plaza	All public plazas at the city level, such as those in the historical area. Mosque and shopping mall entrances are not classified under this category.
T5	Roundabout	Street and road roundabouts that have been designed by the municipality as a public space or are used by residents as a public space.
T6	Walkway	Sidewalks that are used for exercising or gathering within the urban context of the city.
T7	Land use changed	Plots which were supposed to be gardens in the city master plan but where the land use has changed.
T8	Walkway central median	Exercise tracks built by the municipality.
T9	Garden central median	Gardens and public spaces built by the municipality.
T10	Waterfront space	The public waterfront spots (Corniche)
T11	Cloverleaf space	The gardens or public spaces built by the municipality in cloverleaf road junctions.

Table 2. Open space category

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There are nineteen districts in Jeddah, with a variety of land uses that include gardens. All public open spaces in these districts were drawn using a geographic information system (GIS). The creation of maps and a database depended on satellite images and the city strategic master plan. Car surveys were used to validate the situation and condition of public open spaces. Statistical analysis of each district was applied to generate the required graphs, maps and tables. The population of each district was obtained from the General Authority for Statistics and Jeddah Urban Observatory (JUO); the methods used to calculate the public open spaces per capita by JUO are presented in the findings of this study to highlight the differences.

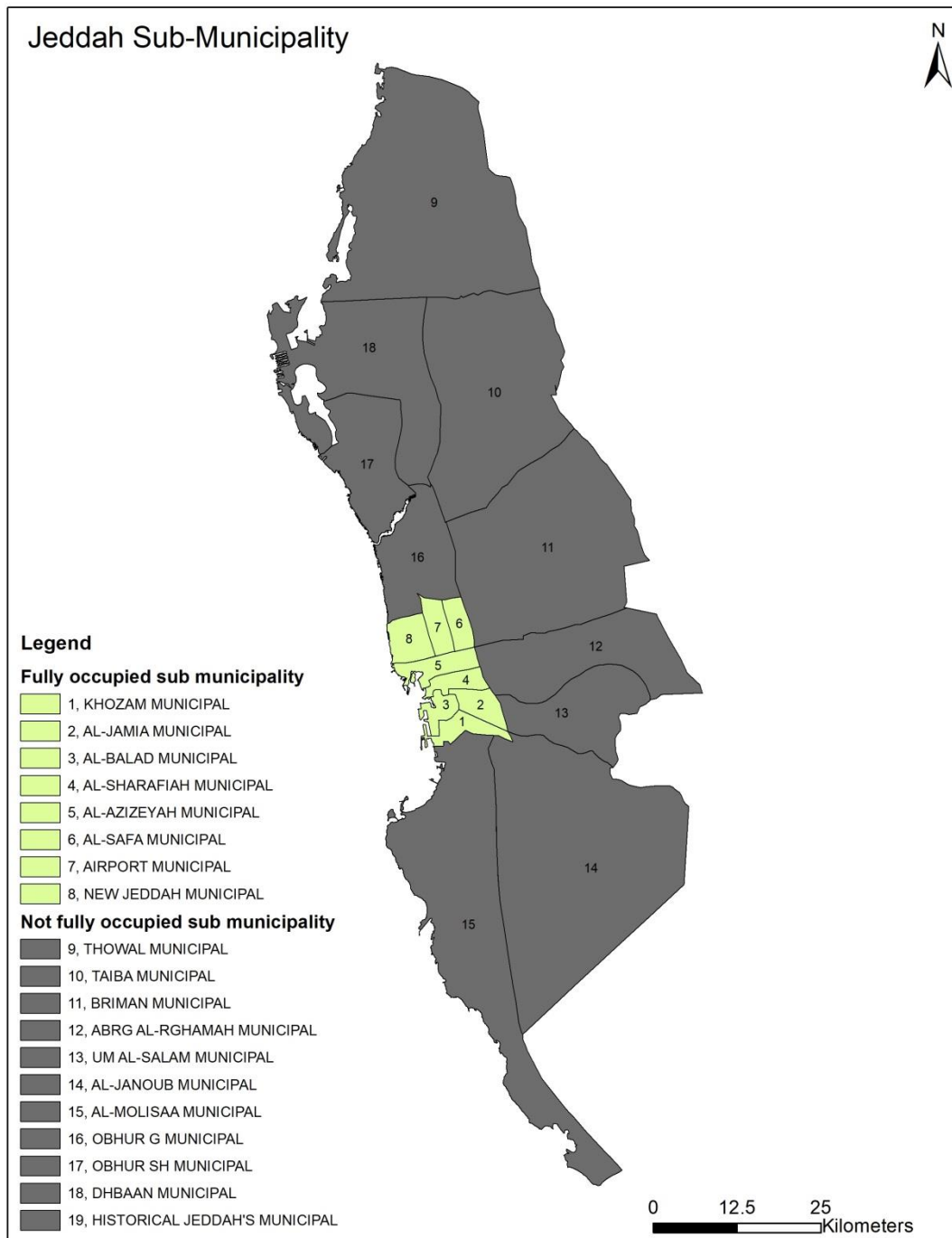
After producing the graphs and maps, the authors reviewed public open spaces against population data and identified the types of public space using four scenarios to present the findings. For Jeddah, the results of public open spaces per capita were compared to international standards produced by the WHO, the Public Health Bureau USA, the European Union, and the United Nations. In addition, the findings are compared with MoMRA guidelines and JUO findings. Additionally, particular types of space were highlighted to identify current planning practices in the city, namely garden unbuilt (T2), roundabout (traffic circle) (T5), walkway central median (T8), garden central median (T9), and cloverleaf space (T11). Changes in land use from garden to residential are also highlighted.

Findings

The population data was taken from the 2016 JUO report. In 2015, Jeddah had 4,060,591 inhabitants, which equated to 12.8% of the total population of the kingdom. The average annual growth in the population was 3.2%. Of the nineteen districts, not all are fully occupied or built; Figure 1 shows the occupied and under-development districts and their populations.

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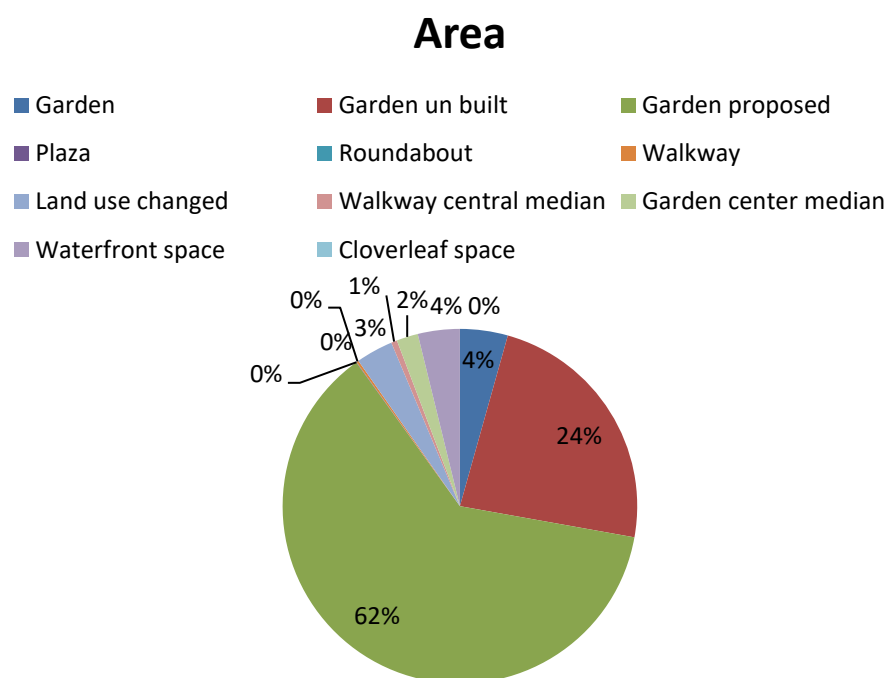
Figure 1. Occupied and under-development municipalities



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Figure 2 shows the percentage of the open space types which were generated using the GIS data. Proposed public open spaces make up 62% of the total area of the spaces in Jeddah. If all these sites were implemented effectively, the city would have a good public open spaces system, as shown in Scenarios 3 and 4; it is important to note that these spaces must be of good quality to meet users' needs and demands (Addas, 2015).

Figure 2. The Percentage of each open space according to the study category



Existing gardens and the land that is supposed to be used for gardens equate to 4% of the total public open spaces in the city. Unbuilt gardens comprise 24% of the total and indicate that governments do not have enough financial or operational resources to build these spaces.

Scenarios

The findings regarding the city are presented through four scenarios discussing the analysis according to the public space types that were identified. Each scenario investigates the data and the open spaces classification according to different

suggestions as to what should be included in the per capita value for the city. The public open space per capita was calculated in a different way in each scenario. The following equation was used:

$$P = \frac{T}{P}$$

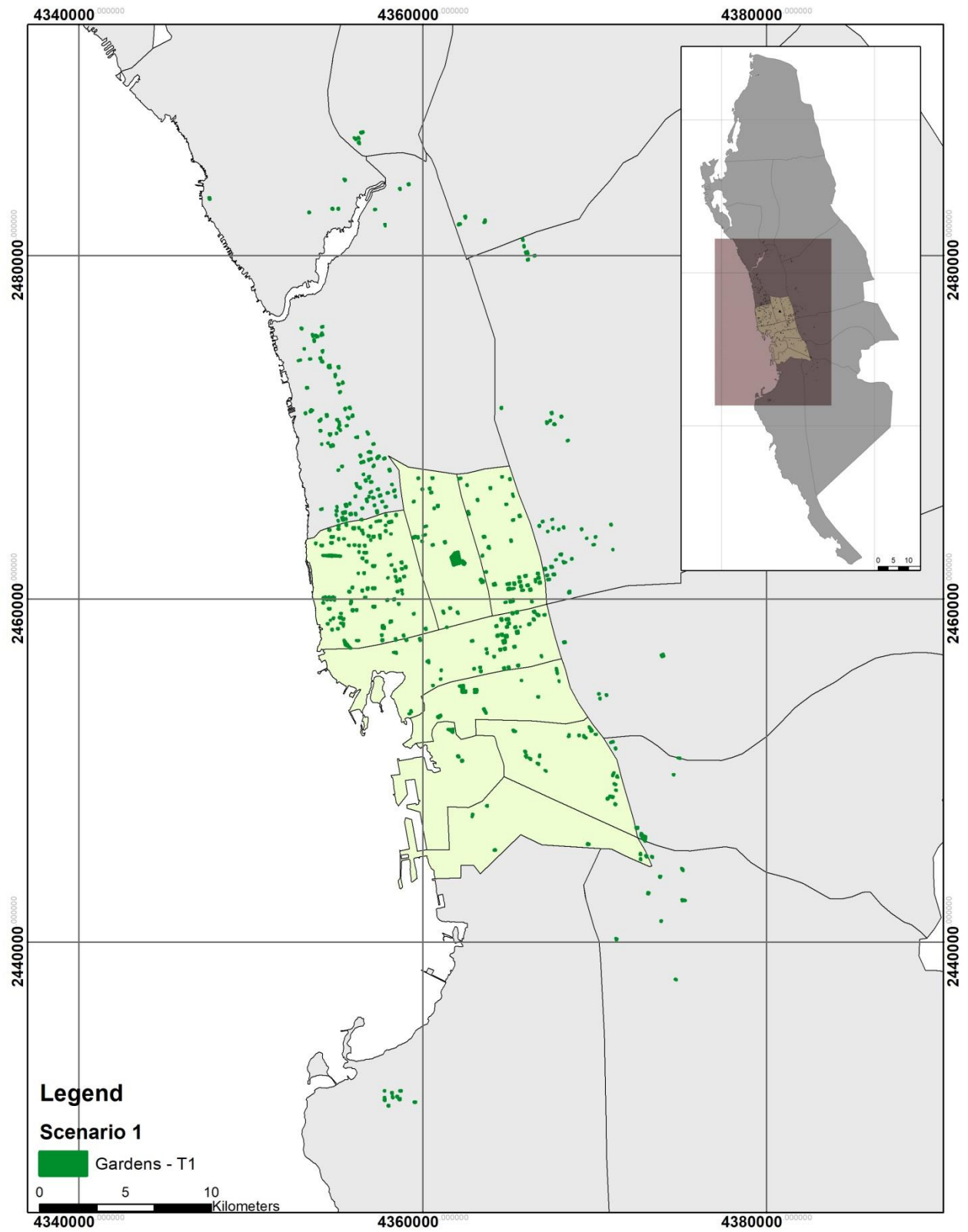
Where P = per capita, TOS = total area of T, and P = the population.

The first two scenarios examine the current and existing situation of public open spaces. The third and fourth scenarios look at the future situation taking account of the unbuilt and proposed public open spaces. The results of two of the scenarios are compared with the JUO data, which indicated that the figure for public open spaces per capita was 7.54 m² in 2014 (Jeddah Urban Indicators Report 2015, 2016).

Scenario 1. The first scenario looks at T1 public open spaces according to the above classification. This type is for all gardens that are located in neighborhoods, or at the district and city level. All other spaces, such as the waterfront, are excluded from this scenario. We argue that the per capita calculation should be based on spaces that residents pass by daily and not include those spaces they spend time traveling to visit (La Rosa, 2014; Chiesura, 2004). The relevant public open spaces are those that surround offices or houses and places where residents go for shopping or business. Jeddah has a total 2,050,493 m² of public open spaces (T1) distributed in all nineteen districts with a total of 432 public open spaces (Figure 3). This means that there is one garden for every 8,949 inhabitants.

By applying the equation, we find that public open space equates to 0.5 m² per capita. This figure is well below international standards, as shown in Table 3. To meet the minimum standard of the WHO, there is a need to plan and design a total area of 34,494,880 m². A total of 119,767,291 m² would be required to meet the United Nations' standard.

Figure 3. Distribution of gardens (T1)



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Organization	Standard m ² /capita	POS per capita m ²	Required area of POS to achieve standard m ²	Shortage m ²	Actual POS (%)
World Health Organization (WHO)	9	0.5	36,545,319.00	34,494,880.00	2.28
Public Health Bureau (PHB) USA	18		73,090,638.00	71,040,199.00	4.57
European Union	26		105,575,366.00	103,524,927.00	6.60
United Nation	30		121,817,730.00	119,767,291.00	7.61

Table 3. International standards and Scenario 1

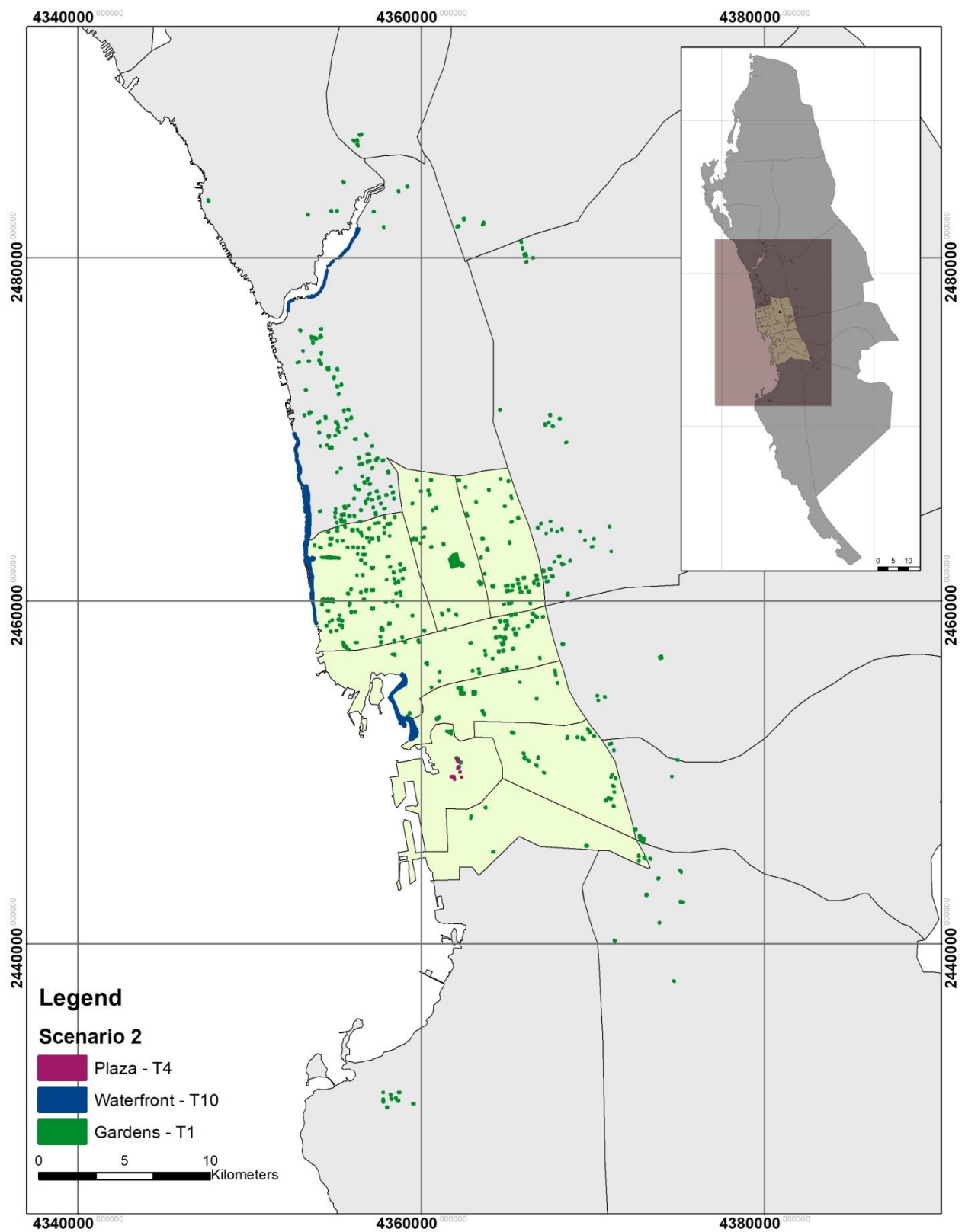
Scenario 2. In this scenario, the waterfront side (T10) in Jeddah is added to the first scenario as well as plazas (T4), of which there are few in the city. The reason for including the waterfront is because it is considered as the main recreational destination in the city for residents and visitors. When adding the total area of the waterfront spaces (T10) in Jeddah and the plazas (T4) to the total from the first scenario, the sum is 3,870,028 m² of public open spaces (Figure 4).

We find that the total area of the public open spaces (T1, T4 and T10) equates to 0.95 m² per capita. This result is still far from international norms of public open space per inhabitant. Comparing the result with the WHO minimum indicates that Jeddah municipality needs to increase the total area of public open spaces (gardens, plazas and waterfront spots) by 89.40%. Furthermore, to meet the United Nations' 30 m²/capita, there is a need for an additional 117,947,702 m² of public open spaces (Table 4).

Organization	Standard m ² /capita	POS per capita m ²	Required area of POS to achieve standard m ²	Shortage m ²	Actual POS (%)
World Health Organization (WHO)	9	0.95	36,545,319.00	32,675,291.00	2.28
Public Health Bureau (PHB) USA	18		73,090,638.00	69,220,610.00	4.57
European Union	26		105,575,366.00	101,705,338.00	6.60
United Nation	30		121,817,730.00	117,947,702.00	7.61

Table 4. International standards and Scenario 2

Figure 4. Distribution of gardens, waterfronts and plazas.



Scenario 3. This scenario presents the future and proposed total area of public open spaces according to data from the municipality of Jeddah and adds types T2 (garden unbuilt) and T3 (garden proposed) to the results of the previous analyses. This analysis helps us to estimate the future area of the public open spaces network in Jeddah if all the proposed and unbuilt spaces were implemented.

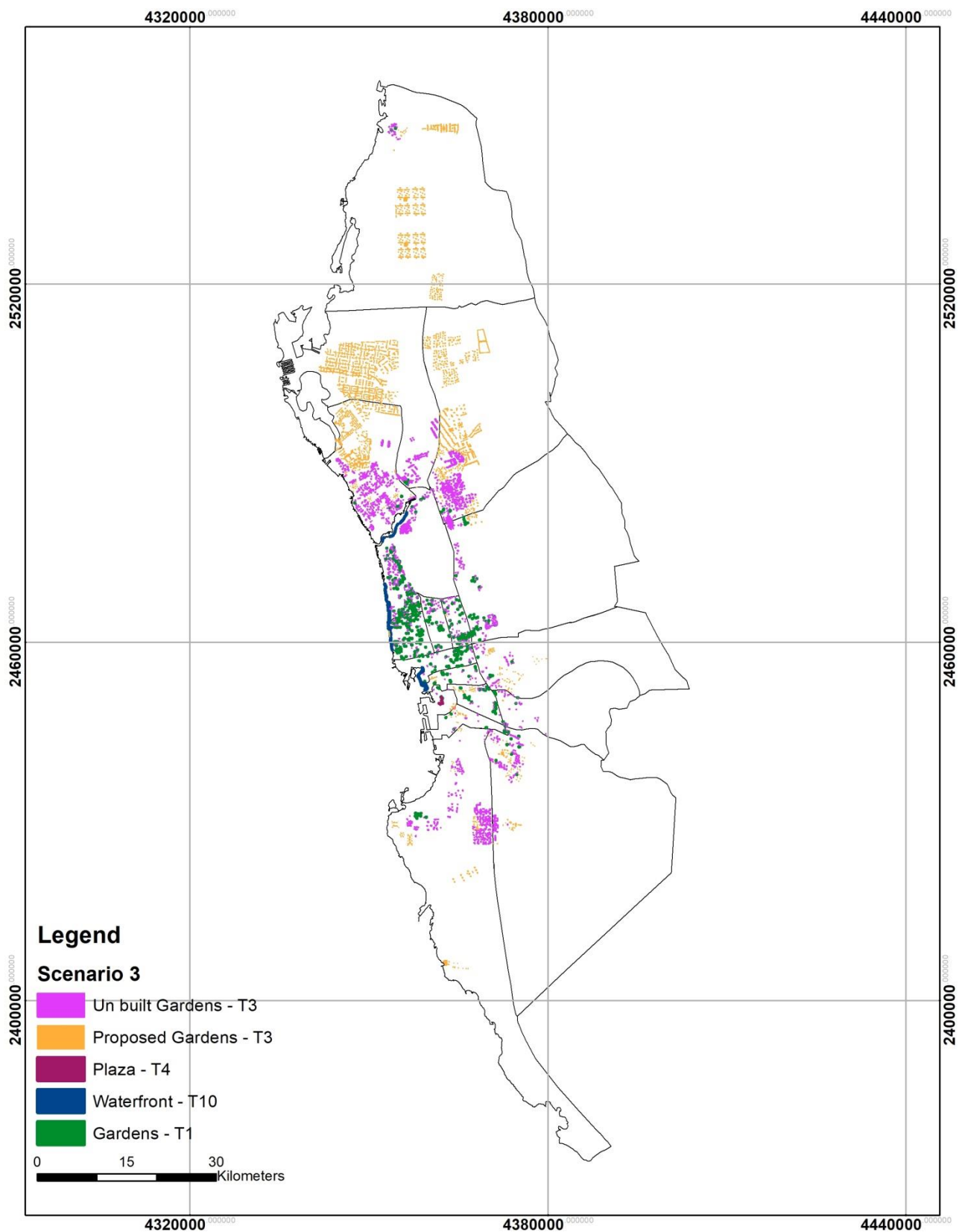
The total area of the unbuilt open spaces which are located in residential areas across the city is 11,033,829 m². In addition, the total number of the proposed public open spaces which will be built in neighborhoods is 29,281,770 m² (Figure 5).

By adding the total area of T2 and T3 to the previous scenario totals, it can be seen that Jeddah will have a total area of public open spaces of 44,185,627 m² (Table 4). This will increase the public open spaces per capita from 0.5 m² in Scenario 1 and 0.95 m² in Scenario 2 to 10.88 m². However, in this scenario, we must keep in mind that the implementation of these spaces will take time and the population of the city will also increase. It is important to note that the total area of the unplanned open spaces in fully occupied neighborhoods is 11,033,829 m². This is almost five times the current total area of public open spaces and reflects a lack of understanding of the importance of public open spaces as well as a lack of resources in the municipality, such as funds and staff capacity and knowledge, focused on the planning and design of public open spaces.

Organization	Standard m ² /capita	POS per capita m ²	Required area of POS to achieve standard m ²	Shortage m ²	Actual POS (%)
World Health Organization (WHO)	9	10.88	36,545,319.00	-7,640,308.00	2.28
Public Health Bureau (PHB) USA	18		73,090,638.00	28,905,011.00	4.57
European Union	26		105,575,366.00	61,389,739.00	6.60
United Nation	30		121,817,730.00	77,632,103.00	7.61

Table 5. International standards and Scenario 3

Figure 5. Distribution of gardens, unbuilt, proposed, waterfront and plazas



Scenario 4. The authors argue that the T8 (walkway central median) and T9 (garden central median) spaces have not been planned or designed by city planners or specialists and so should not be included in the analysis. These spaces are the walkways and public spaces in the central medians of streets. According to international standards, there are guidelines that could be applied to ensure that these spaces do not affect users' safety. By adding the area of T8 and T9, the open spaces per capita in Jeddah is 11.17 m² (Figure 6).

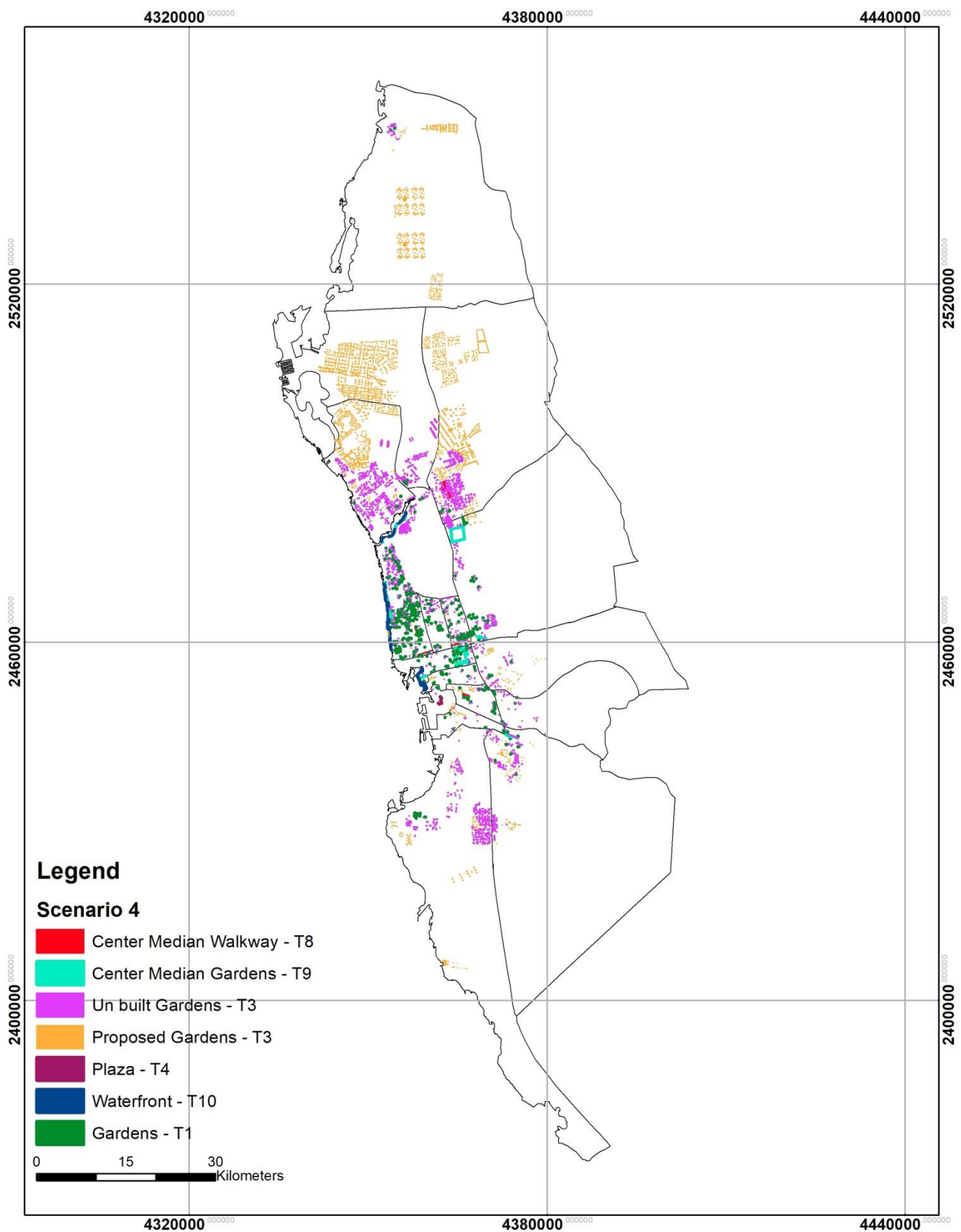
This result is similar to the third scenario, and will also be affected by the population increase in the city by the time of the implementation of these spaces. The shortage of the overall area needed is less than in the first two scenarios (Table 5).

Organization	Standard m ² /capita	POS per capita m ²	Required area of POS to achieve standard m ²	Shortage m ²	Actual POS (%)
World Health Organization (WHO)	9	11.17	36,545,319.00	-8,815,264.00	2.28
Public Health Bureau (PHB) USA	18		73,090,638.00	27,730,055.00	4.57
European Union	26		105,575,366.00	60,214,783.00	6.60
United Nation	30		121,817,730.00	76,457,147.00	7.61

Table 6. International standards and Scenario 4.

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Figure 6. Distribution including T8 and T9 spaces



Change of Land Use

The analysis of the GIS data showed that there is a current practice in Jeddah by which land use is different compared with the approved master plan. Change of use amounts to a loss of 1,591,366 m² that is supposed to be built as gardens (Figure 7). These areas have been changed to residential, governmental or religious land use. The investigation showed that the loss of this land has not been compensated for in other areas. New Jeddah district has seen the greatest loss, totaling 390,094 m². This loss reflects the construction of many new buildings in the district, with an evident lack of gardens and parks (Figure 8). However, the district also has 187,163 m² of unbuilt public open spaces, which equates to about 55 gardens. Another example is the Alnassem district, which has eleven approved open spaces but, currently, only has one public open space (Figure 9).

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Figure 7. Land use changed

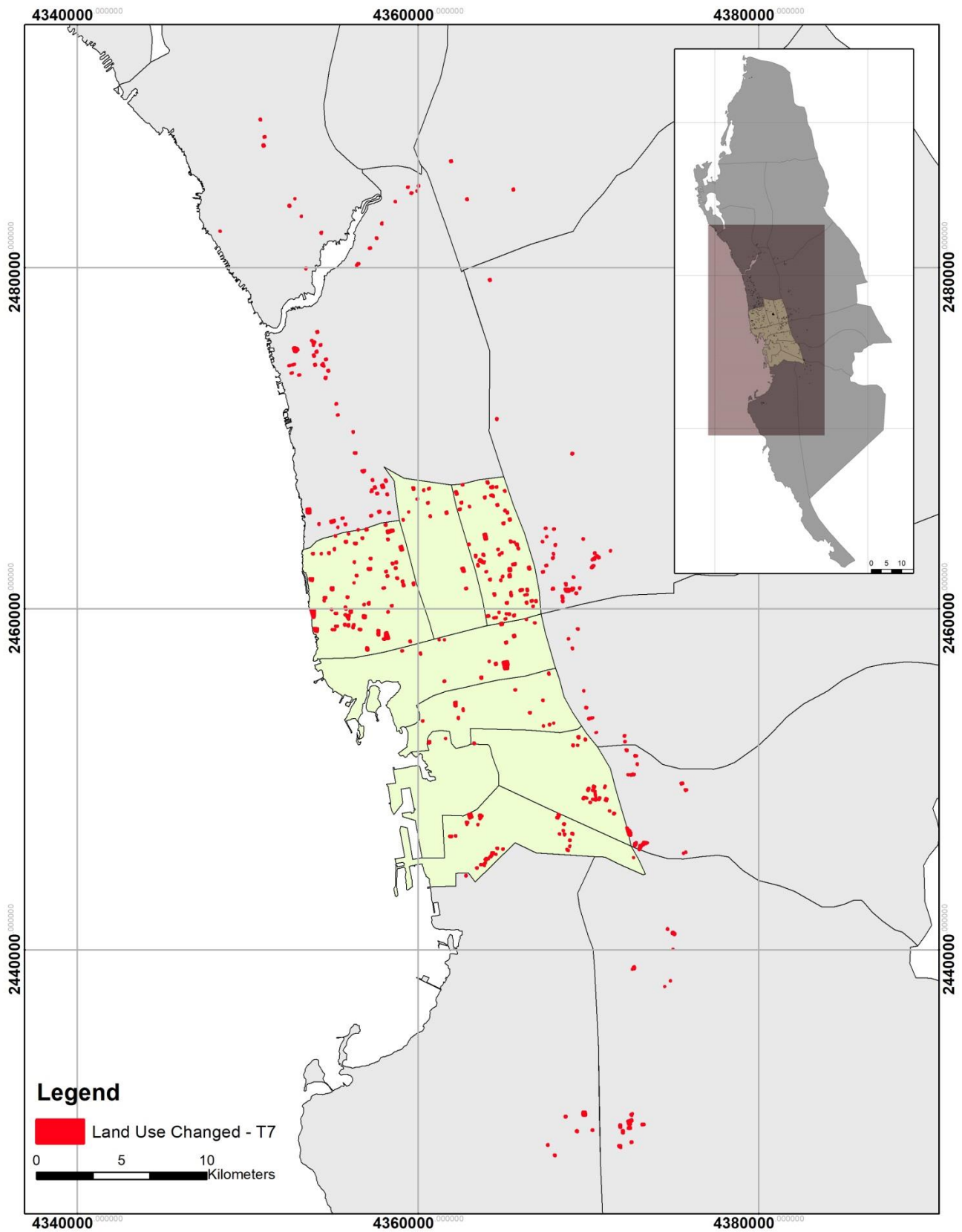


Figure 8. New Jeddah district



Figure 9. Alnassem district



Public Open Spaces in Planned Districts

This section explores the structure of the fully occupied districts in Jeddah in terms of the open spaces per capita to help identify which meet international standards according to the previous scenarios (Table 6). It is clear from the table that the majority of these districts do not meet the international standards and all of them have

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a shortfall in public open spaces except New Jeddah, which could be close to the WHO standard under the third scenario.

District	population	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Aziziyah	411,734.00	0.5	2.1	2.6	2.6
Alsharfia	287,687.00	0.37	0.4	0.9	0.8
New Jeddah	232,201.00	1.7	2.5	5.3	4.1
Almattar	497,372.00	0.7	0.7	1.1	1.1
Aljamaa	601,456.00	0.1	0.1	0.5	0.5
Alballad	354,168.00	0.05	0.06	0.3	0.24
Historical Jeddah	6,000.00	1.7	5.1	8.4	8.4
alsafa	254,692.00	0.7	0.7	2.4	1.6
Khozam	417,622.00	0.04	0.04	0.73	0.5

Table 7. Per capita in the fully occupied districts

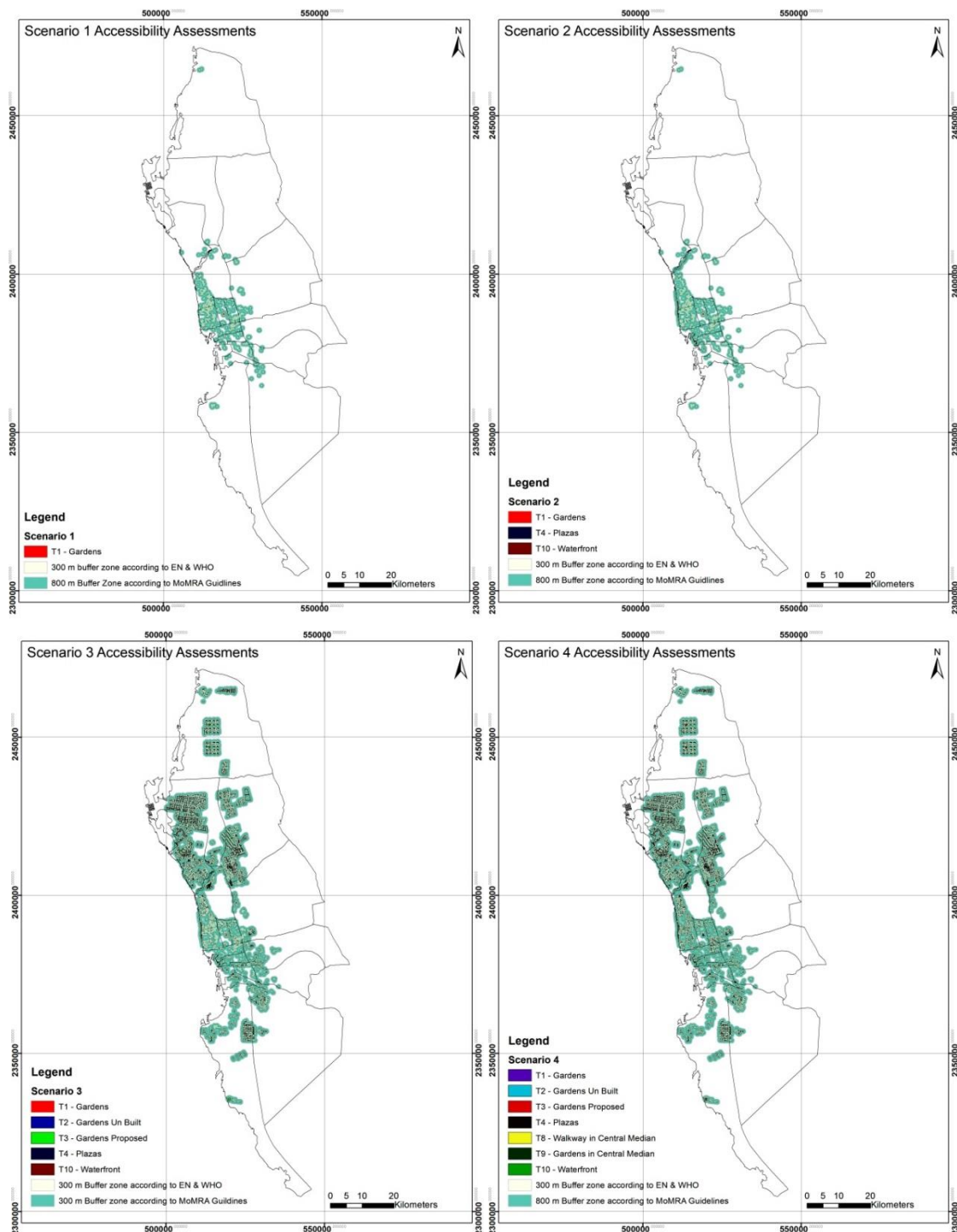
Public Open Spaces Catchment Area

The accessibility of public open spaces is very important (Fan et al., 2017) and there are available standards. Analysis against these standards can provide an effective indication of the spatial planning of public open spaces in the city. According to the Accessible Natural Greenspace Standards Model, English Nature (EN) recommends 300 m as a walking distance to a public open space (Harrison et al., 1995). Furthermore, the European Environment Agency recommends a maximum distance of 1,000 m (Giles-Corti et al., 2005). MoMRA recommends a maximum of 800 m, which is the transition point from walking to driving based on MoMRA's standards.

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The accessibility analysis shows that the spatial distribution of public open spaces in Jeddah does not reflect the location of these spaces and the various levels of accessibility. The accessibility assessment was carried out for 800 m and 300 m distances for the four scenarios using buffer tools in the GIS.

Figure 10. A. Scenario 1; B. Scenario 2; C. Scenario 3 and D. Scenario 4.



The results show that the city performs poorly regarding the catchment areas in Scenarios 1 and 2 (Figure 10A and B). The lack of strategy for allocating public open space creates gaps in the city and poor accessibility. The findings reveal that the open spaces in the city are not located within suitable walking or driving distance from users' residences and workplaces. However, by applying the 300 m and 800 m buffer to the third and fourth scenarios, it can be seen that the majority of the districts could have sufficient coverage of public open spaces when compared to the existing situation (Figure 10C and D). Table 7 shows the coverage percentages for 300 m and 800 m buffers for the existing and proposed public open spaces in Jeddah.

Overall, public open spaces comprise a very small area in terms of the land use of each district under each of the scenarios. The analysis of the collected data shows that, when applying Scenario 4, the public open space area will amount to 2.42 % of the total area (Table 8); this is a very low figure given the area and population. In addition, the area of open spaces in seventeen of the districts is below 1%, with the exceptions of Almattar and New Jeddah at 1.26 and 1.01, respectively. This is clear evidence of a lack of understanding of the importance of public open spaces, and the planning process does not consider these spaces as important land use by the city.

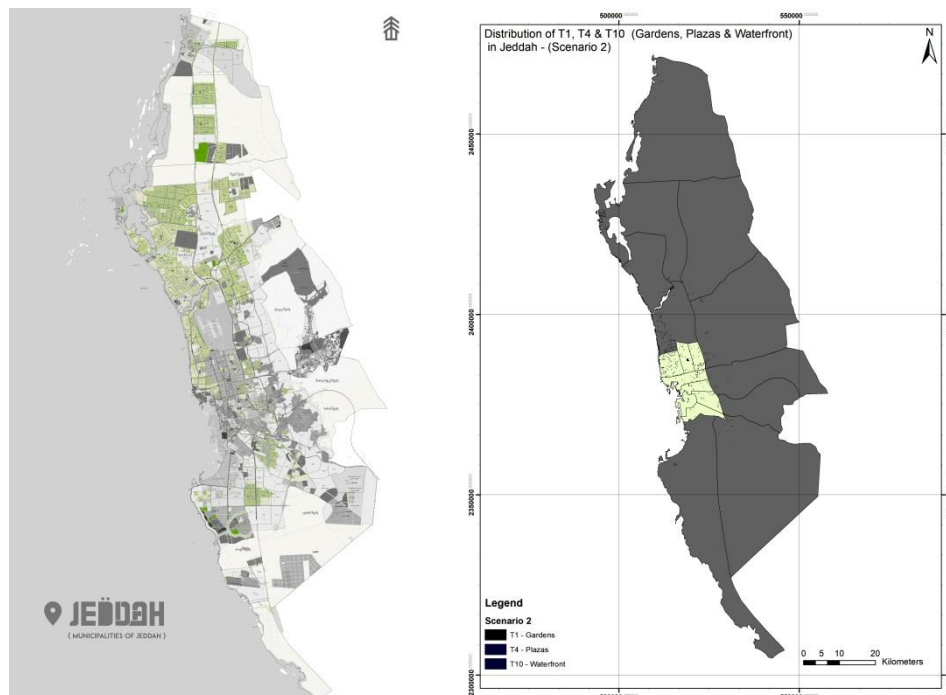
Scenario	300 m Buffer	Coverage percentage	800 m Buffer	Coverage percentage
Scenario 1	300	2%	800	6.33%
Scenario 2		2.5%		7.02%
Scenario 3	300	15.7%	800	26.04%
Scenario 4		15.9%		26.2%

Table 8. Coverage percentages for each scenario

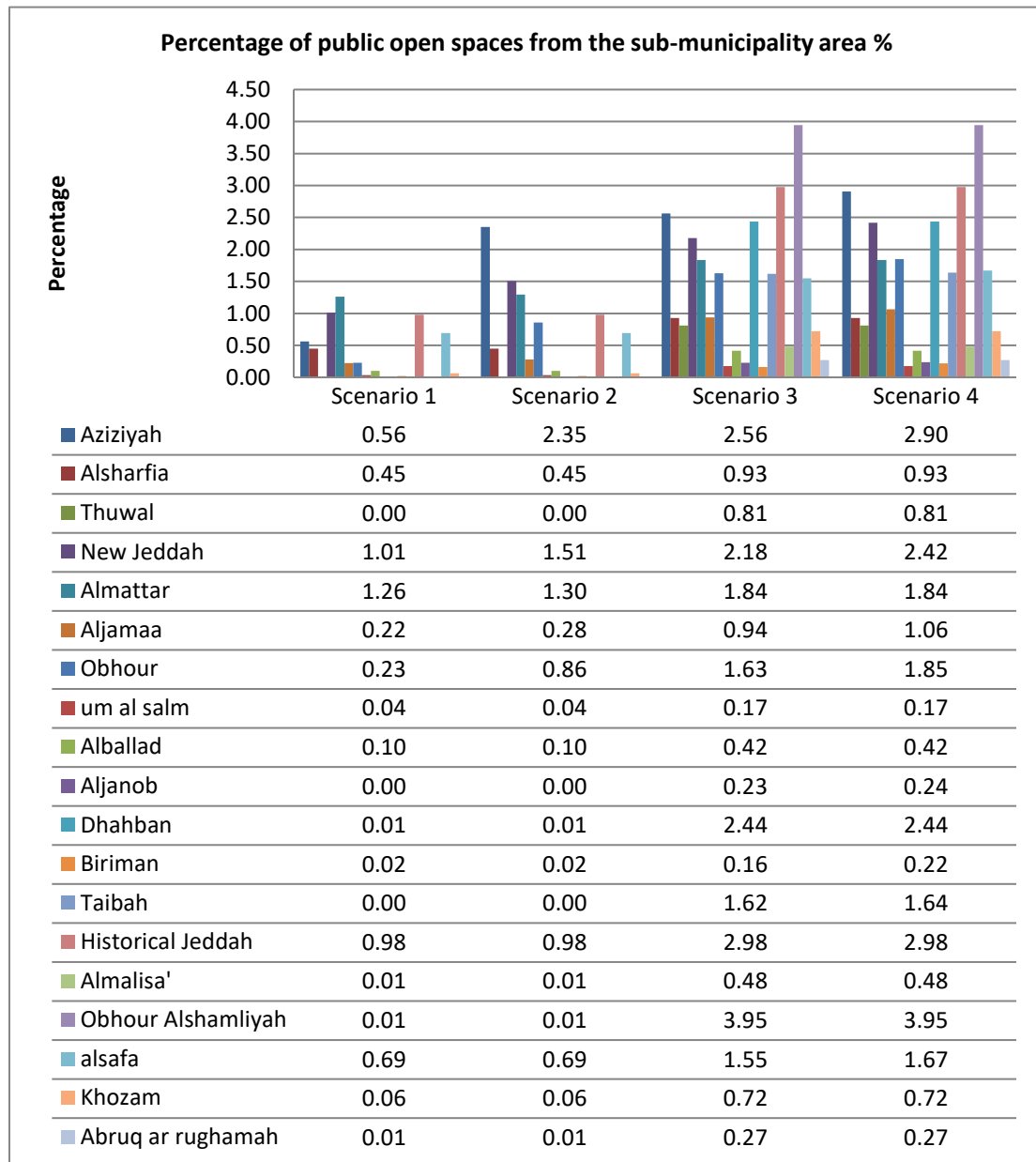
Discussion

The review of the latest Jeddah master plan indicates that the city has sufficient proposed green structures in terms of gardens and parks (Figure 11A). However, the findings showed a clear lack of understanding of the importance of the provision of public open spaces in Jeddah municipality (Figure 11B). Currently, the city is some way behind the NTP target (3.9 m² per capita) which aims to enhance the life quality in Saudi cities. In addition, there is a clear shortage of public open space areas in each district (Table 8).

Figure 11. A. gardens and parks; B. open space provision



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*under development district

Table 9. Percentage of the POS area for each sub-municipality in Jeddah

From the review of the first and second scenarios, which present the existing situation in Jeddah, we found evidence that Jeddah suffers from a lack of public open spaces. This is because, in the last few years, the focus has been on providing additional residential land, and this has led to rapid urban expansion in the city and the neglect of the green infrastructure (Addas, 2015). In addition, when comparing the result of the existing open spaces with the JUO 2016 report, which indicated that Jeddah had about 7 m² per capita in 2015, we found inconsistencies. By reviewing the

JUO report, we found that there is a miscalculation in the per capita figure. Data for each district was calculated separately and then the result of each was combined and divided by the total number of districts. In addition, central medians, roundabouts (traffic circle) and road edges were part of this calculation as the municipality considers them to be public open spaces. These are amenity spaces and cannot be usable spaces (Transportation Research Institute, Oregon State University, 1996) unless they designed to be used with extra consideration to the users' safety and to accessibility (Sankalia, 2014).

The results from the third and fourth scenarios indicate that Jeddah could reach the WHO minimum of 9m² per capita (WHO, 2010). However, it is important to emphasize that the calculation in this study did not take account of future increases in the population. Jeddah's population is increasing by 3.5 % annually, which means that from 2010 to 2029, about 2.25 million people are expected to be added to the population (Global City Focus Jeddah, 2016). Therefore, city policymakers should adopt a systematic approach to enhancing the spatial planning of open spaces to meet the international standard and benefit the city and its residents. Moreover, MoMRA needs to adopt one of the international standards or create a national standard for public open space per capita that reflects the country's characteristics in terms of the weather, social preferences and planning patterns.

The findings of this study also reveal that the city lost around 1,591,366 m² between both fully occupied and new districts. The land use changed either to residential (building or villas) or religious (mosques) in most cases. It is important to note that, when the municipality approves a master plan for the districts, there are requirements of land use that are supposed to be met according to MoMRA guidelines, which include religious land use. However, from the investigation, we find

out that some mosques are donated by different people from the community and, in these cases, land allocated to gardens is used.

While the WHO recommends that the cities should have a minimum of 9m² of public green space per capita, this area is only viable if the space is accessible (Fan et al., 2017; Thompson, 2002; Takano et al., 2002), safe (Francis et al., 2012; Frumkin, 2003) and with suitable activities and facilities (Villanueva et al., 2015; Singh et al., 2010). Unless these requirements are met, the suitable open space per capita will be compacted. Thus, urbanized cities in practice require 50 m² per capita, depending on the city population density and total area, which should be reflected in the city master plan (WHO, 2010). All countries have applied the numbers and attributes mentioned in this study in different ways to ensure the provision of suitable, accessible, safe and usable spaces because of the various benefits and values that these spaces offer. Various studies have identified the importance of considering the spatial distribution of public open spaces and the per capita of these spaces according to the city's population (Russo & Cirella, 2018; Kabisch et al., 2016; Fuller & Gaston, 2009).

Open Spaces Spatial Distribution

Although the accessibility assessment showed that there were gaps in the spatial distribution of open spaces, when assessing the third and fourth scenarios using the MoMRA or WHO and EN standards, we found that the city could perform well and the majority of the residents could be served. However, policymakers need to consider creating a typology for the city with different categories of public open space in different residential areas, or the city will be a long way from achieving international standards and the national target (Maruani & Amit-Cohen, 2007; Zamanifard et al., 2018; Masoumi et al., 2019). Taking this step will help the city to deliver types of public open space which serve different uses and demands.

Quantity and Quality

It is important to state that this study looked at the open spaces as numbers without investigating the value and quality of these sites. Other studies (Mandeli, 2008; Mandeli, 2010; Aljoufiea et al., 2012; Addas, 2015; Yoseph, 2017; Addas, 2017; Addas & Rishbeth, 2018; Alawi & Mostafa, 2019; Mandeli, 2019) have explored the quality of open spaces in Jeddah and highlighted the importance of identifying a systematic structure for the municipalities and MoMRA to enhance the provision of public open spaces.

Public Open Spaces Network

We found that the concept of an open spaces network is not effective in Jeddah city; gardens and parks are not working to link the city services or to enhance walkability (Hepcan et al., 2006; Von Schönfeld & Bertolini, 2017). If the city was designed with consideration to a public open spaces system, it would perform well and encourage residents to walk and reduce dependence on cars (Rahman & Nahiduzzaman, 2019). There is a need to understand the importance of this network within the planning process to enhance the accessibility to the spaces.

Conclusion

This study examined the public open spaces per capita in Jeddah and found evidence of misguided planning practices resulting from a lack of understanding of the importance of these spaces, not only for residents but also for the city's different sectors. Planning practices affect the built, natural and human environments of the city. Western literature and practice use public open spaces as a major tool to enhance the life quality and improve physical, mental, social, economic and natural wellbeing of cities and people.

PUBLIC OPEN SPACE PER INHABITANT IN THE CITY OF JEDDAH

Saudi Arabia is creating several programs to enhance the life quality; however, these programs could have negative impacts if the aim is simply to achieve the KPIs, as is the case of the public open spaces per capita target in Saudi cities. There is a need to build capacity in MoMRA and municipalities with expert Saudi planners and designers and involve them in the urban transformation of Saudi cities. This will lead to the need for a public open space typology, system and network in all Saudi cities.

This study indicated that Jeddah could have a good level of public open space per inhabitant if all proposed and unbuilt spaces were implemented. However, there is a need to establish a proactive framework that enhances the quality and value of the spatial distribution of the spaces in the city.

Finally, MoMRA and the municipalities in Saudi cities need to adopt a collaboration system to support the implementation of public open spaces. This study revealed that, currently, 24% of the planned open spaces are unbuilt, due to funding of design, operation and maintenance. Collaboration and partnerships with the private sector would reduce the financial load on both the ministry and the municipalities.

References

- Abubakar, I. R., & Aina, Y. A. (2018). Achieving Sustainable Cities in Saudi Arabia: Juggling the competing urbanization challenges. In *E-Planning and Collaboration* (pp. 234–255). IGI Global.
- Addas, A., & Rishbeth, C. (2018). The transnational Gulf City: Saudi and migrant values of public open spaces in Jeddah. *Landscape Research*, 43(7), 939–951.
- Addas, A., (2019). Landscape Architecture and the Saudi Arabia Quality of Life Program. *Emirates Journal for Engineering Research*, 21-29.
- Addas, Abdullah, N. (2017). *The Creation of Outdoor Spaces and Public Engagement, Jeddah, Saudi Arabia*. ECLAS Conference 2017 / Proceedings Creation/Reaction, 45–55.
- Akbar, J., (1981), *Responsibility and the Traditional Muslim Built Environment*. Cambridge, Massachusetts, MIT. PhD.
- Alawi, G., & Mostafa, L. (2019). Users' Satisfaction in CityWaterfront: The Case of Jeddah Corniche. *The Academic Research Community Publication*, 3(2), 100.
- Alharbi, T., (1989), *The development of housing in Jeddah: Changes in built from the traditional to the modern*. University of Newcastle Upon Tyne. Ph.D.
- Al-Hathloul, S. and Mughal, M., (1999), Creating identity in new communities: Case studies from Saudi Arabia. *Landscape and Urban Planning* 44(1999): 199-218.
- Al-Hathloul, S., & Mughal, M. A. (2004). Urban growth management-the Saudi experience. *Habitat International*, 28(4), 609–623.
- Aljoufiea, M., Brussel, M., Zuidgeest, M., & van Maarseveen, M. (2012). Urban growth and transport infrastructure interaction in Jeddah between 1980 and 2007. *International Journal of Applied Earth Observation and Geoinformation*, 21(1), 493–505.

- Al-Musawi, M., (2010, March 21), *Arabgeographers*. Retrieved June 23, 2019, from arabgeographers: <http://www.arabgeographers.net/vb/showthread.php?t=11032> (Arabic.(
- Al-Nassan, M., (2008, November 10), *Land of Civilizations*, Retrieved June 06, 2019, from Land of Civilizations: http://www.landcivi.com/new_page_44.htm (Arabic(
- Al-Nowaiser, M., (1982), *The role of traditional and modern residential rural settlements on the quality of environmental experience: a case study of Unyzeh and new Alkabrah in Saudi Arabia*, Los Angeles, University of Southern California. PhD.
- Atef Elhamy Kamel, M. (2013). Encouraging walkability in GCC cities: Smart urban solutions. *Smart and Sustainable Built Environment*, 2(3), 288–310.
- Bokhari, A., (1978), *Jeddah: A study in urban formation*, University of Pennsylvania, PhD.
- Burgess, J., Harrison, C. M., & Limb, M. (1988). People, Parks and the Urban Green: A Study of Popular Meanings and Values for Open Spaces in the City. *Urban Studies*, 25(6), 455–473.
- Chiesura, A., 2004. The role of urban parks for the sustainable city. *Landscape and Urban Planning*, 68, 129–138.
- Curtis, S. (2010). *Space, place and mental health*. Ashgate Publishing Ltd.
- Dimoudi, A., & Nikolopoulou, M. (2003). Vegetation in the urban environment: Microclimatic analysis and benefits. *Energy and Buildings*, 35(1), 69–76.
- Eben-Saleh, M., (2002). The transformation of residential neighbourhood: The emergence of new urbanism in Saudi Arabian culture. *Building and Environment*, 37, 515-529.
- Fan, P., Xu, L., Yue, W., & Chen, J. (2017). Accessibility of public urban green space in an urban periphery: The case of Shanghai. *Landscape and Urban Planning*, 165, 177-192.

- Fuller, R. A., & Gaston, K. J. (2009). The scaling of green space coverage in European cities. *Biology Letters*, 5(3), 352–355.
- Giles-Corti, B, Broomhall, M H, Knuiman, M, Collins, C, Douglas, K, Ng, K, Lange A, and Donovan, R J (2005). Increasing walking: how important is distance to, attractiveness, and size of public open space? *American Journal of Preventive Medicine*, No 28(Suppl 2), 169-176.
- Harrison, C., Burgess, J., Millward, A., & Dawe, G. (1995). Accessible natural greenspace in towns and cities: a review of appropriate size and distance criteria. *English Nature Research Reports*, 153(8), 1–49.
- Hepcan, Ş., Kaplan, A., Özkan, B., Küçükerbaş, E. V., Yiğit, E. M., & Türel, H. S. (2006). Public space networks as a guide to sustainable urban development and social life: A case study of Muğla, Turkey. *International Journal of Sustainable Development and World Ecology*, 13(5), 375–389.
- Hillsdon, M., Panter, J., Foster, C., & Jones, A. (2006). The relationship between access and quality of urban green space with population physical activity. *Public Health*, 120(12), 1127–1132.
- J.U.O. (2016). Jeddah Urban Indicators Report 2015. Jeddah : Jeddah Municipality.
- Kabisch, N., Strohbach, M., Haase, D., & Kronenberg, J. (2016). Urban green space availability in European cities. *Ecological Indicators*, 70, 586–596.
- Koohsari, M. J., Mavoa, S., Villianueva, K., Sugiyama, T., Badland, H., Kaczynski, A. T., ... Giles-Corti, B. (2015). Public open space, physical activity, urban design and public health: Concepts, methods and research agenda. *Health and Place*, 33, 75–82.
- La Rosa, D., 2014. Accessibility to greenspaces: GIS based indicators for sustainable planning in a dense urban context. *Ecological Indicators*, 42, 122–134

- Mandeli, K. (2019). Public space and the challenge of urban transformation in cities of emerging economies: Jeddah case study. *Cities*, 1-11.
- Mandeli, K. N. (2008). The realities of integrating physical planning and local management into urban development: A case study of Jeddah, Saudi Arabia. *Habitat International*, 32(4), 512–533.
- Mandeli, K. N. (2010). Promoting public space governance in Jeddah, Saudi Arabia. *Cities*, 27(6), 443–455.
- Mandeli, K.N., (2011). *Public Spaces in a Contemporary Urban Environment: Multi-dimensional Urban Design Approach for Saudi Cities*. University of Newcastle upon Tyne, School of Architecture, Planning and Landscape, Global Urban Research Unit (GURU) Ph.D.
- Maruani, T., & Amit-Cohen, I. (2007). Open space planning models: A review of approaches and methods. *Landscape and Urban Planning*.
- Masoumi, H. E., Terzi, F., & Serag, Y. M. (2019). Neighborhood-scale urban form typologies of large metropolitan areas: Observations on Istanbul, Cairo, and Tehran. *Cities*, 85, 170–186 .
- Norton, B. A., Coutts, A. M., Livesley, S. J., Harris, R. J., Hunter, A. M., & Williams, N. S. G. (2015). Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. *Landscape and Urban Planning*, 134, 127–138.
- Olwig, K. R. (2016). Life between buildings: using public space. *Landscape Journal*, 8(1), 54–55.
- Rahman, M. T., & Nahiduzzaman, K. M. (2019). Examining the walking accessibility, willingness, and travel conditions of residents in saudi cities. *International Journal of Environmental Research and Public Health*, 16(4).

Russo, A., & Cirella, G. T. (2018). Modern compact cities: How much greenery do we need?

International Journal of Environmental Research and Public Health, 15(10).

Sankalia, T. (2014). The Median Picnic: Street Design, Urban Informality and Public Space

Enforcement. *Journal of Urban Design*, 19(4), 473–495.

Senanayake, I. P., Welivitiya, W. D. D. P., & Nadeeka, P. M. (2013). Urban green spaces

analysis for development planning in Colombo, Sri Lanka, utilizing THEOS satellite imagery - A remote sensing and GIS approach. *Urban Forestry and Urban Greening*, 12(3), 307–314.

Shahfahad, Kumari, B., Tayyab, M., Hang, H. T., Khan, M. F., & Rahman, A. (2019).

Assessment of public open spaces (POS) and landscape quality based on per capita POS index in Delhi, India. *SN Applied Sciences*, 1(4).

Sidky, T. & Bastawisi, A., (2010), *Planning and Treatment of Urban Spaces within the*

Layout of Urban Expansion of the City, First Arab Housing Conference -

Construction Sustainability in the Arab Region, Especially the Desert Environment

(pp. 110-145), Cairo: National Centre for Housing and Construction Studies

Thompson, C. W. (2002). Urban open space in the 21st century. In *Landscape and Urban*

Planning (Vol. 60, pp. 59–72).

Timperio, A., Ball, K., Salmon, J., Roberts, R., & Crawford, D. (2007). Is availability of

public open space equitable across areas? *Health and Place*, 13(2), 335–340.

Transportation Research Institute, Oregon State University. 1996. *Medians: Discussion*

Paper No.4. prepared for the Oregon Department of Transportation, Salem, Oregon.

Accessed May 30, 2013.

Villanueva, K., Badland, H., Hooper, P., Koohsari, M. J., Mavoa, S., Davern, M., ... Giles-

Corti, B. (2015). Developing indicators of public open space to promote health and wellbeing in communities. *Applied Geography*, 57, 112–119.

- Von Schönfeld, K. C., & Bertolini, L. (2017). Urban streets: Epitomes of planning challenges and opportunities at the interface of public space and mobility. *Cities*, 68, 48–55.
- Wood, L., Hooper, P., Foster, S., & Bull, F. (2017). Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing. *Health and Place*, 48, 63–71.
- World Health Organization. (2010). *Urban Planning, Environment and Health: From Evidence to Policy Action*. [Online] available at http://www.euro.who.int/__data/assets/pdf_file/0004/114448/E93987.pdf?ua=1, accessed on June 22, 2019.
- Yoseph, W. S. (2017). Measuring public spaces identity in Jeddah corniche. *Architecture and Planning Journal*, 24.
- Yung, E. H. K., Conejos, S., & Chan, E. H. W. (2016). Social needs of the elderly and active aging in public open spaces in urban renewal. *Cities*, 52, 114–122.
- Zamanifard, H., Alizadeh, T., & Bosman, C. (2018). Towards a framework of public space governance. *Cities*, 78, 155–165.