

# Land Use distribution as a Sustainable indicator in Arab Cities

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## **Abstract**

Land use distribution represents a major sustainable indicator. It has a cause and effect on transportation systems, time, power, and energy consuming, regarding the location of source and destination for each daily trip. Consequential, it affects the environment and the sustainable development planes.

Arab city centers have multiple layers of development through history, they form a unique memory and cultural proud. The research analyzes the transformation of land use distribution from the Arab traditional cities' core to the modern patterns. For their long period of development, it is argued that their locations of land use have been adapted to be suitable for its inhabitants. There are various theories explaining those adaptations; the research adopts the spatial configuration theory, which links the spatial with the social logic of movement (pedestrian/ vehicles). As a result, the spatial configuration affects the pedestrian movement flow that in its turn affects back on the land use distribution. Modern Arab cities demand a rising increase for mobility transportation pursuant to the inappropriate land use distribution. These requirements do not consider the current spatial morphology of the urban fabric, or its role as major stimuli on the successfulness of activities location. The paper highlights the differences between traditional and modern extensions for Arab city centers on the base of sustainable land use location. It proposes a model framework for analysis and understands the distribution of land uses and their correlation with the spatial configuration. In addition, the model framework could compares land uses distribution for current situation and to forecast the successfulness of any future intervention.



## 1. Introduction

Land use distribution represents an important factor in designing new communities or urban re-generation development plans for traditional city centers. Their location affects its inhabitant's pattern of movement, social interaction, livability, health issues, safety, economic, and other factors. Through history, various theories tried to formulate logical distribution for locating socio-economic activities within existing cities or newly established settlements.

Arab cities have evolved over time, giving a well-settled central core for livable activities. However, the current wave of globalization, from the end of the twentieth century to present, affects the traditional Arab city centers. It affects their urban form and daily habits, reshaping their spatial configuration to depend more on vehicles as main way of movement rather than walkable distance activities that depends on pedestrian movements. The paradox is that the newest actions and indicators related to sustainable urbanism, as development theories, resemble the conventional actions of design used in the traditional Arab cities. Mixed uses, increasing densities, compact designs, and others indicators are all typical configurations for historical Arab city centers before the colonization period (starting from the 19<sup>th</sup> century to the mid of 20<sup>th</sup> century for most of Arab countries).

The research highlights the role of land use distribution as a main sustainable indicator in Arab cities. Moreover, investigates three main waves of land use distribution along Arab cities' history in comparison to the global movements: zoning, mixed-use activities, and smart codes. The next parts of the paper discuss sustainable design and the role of land use as a sustainable indicator, highlighting its causes and effects on Arab cities center development plans.

## 2. Land Use Overview

### 2.1. Arab Cities development

Traditional Arab city's core was generated as a bottom-up system, as people were shaping their built environment in their neighborhoods (Hakim, 2007). Abu-Lughod argued that their land use and governmental system were based on full decentralization as one of the three conditions that generated the form of traditional Arab city (Abu-Lughod, 1987). Daily socio-cultural activities were located within walkable distance from the residential zones, while the multifunctional core is surrounding the central mosques by different layers of interconnected '*sucs*' (Bianca, 2000), see figure (1). The residential quarters sometimes accommodate light industries and minor economic trading activities,



which according to Hakim (Hakim, 2007) these new activities should not harm the neighborhood or conflicts with the existing land use (custom's law (*urf*)). However, these systems have changed gradually due to the influence of western modernity thoughts. Taking Khedive Ismail's modern Cairo for example, boulevards, and wide streets are introduced to connect the new town, which was a small-scale replica of Haussmann's schemes of Paris, with the old fabric of historical Cairo, causing graduate shifting of important land use to the new developed part. This development affect the old city center causing a partial segregation, see figure (2A). Neighborhoods areas expansion with distant daily land use activities from residential areas cause an increasing demand on the mobility as a major transportation (private vehicles in particular), which leads to rearranging land uses to be zoning distribution of segregated activities. See figure (2).

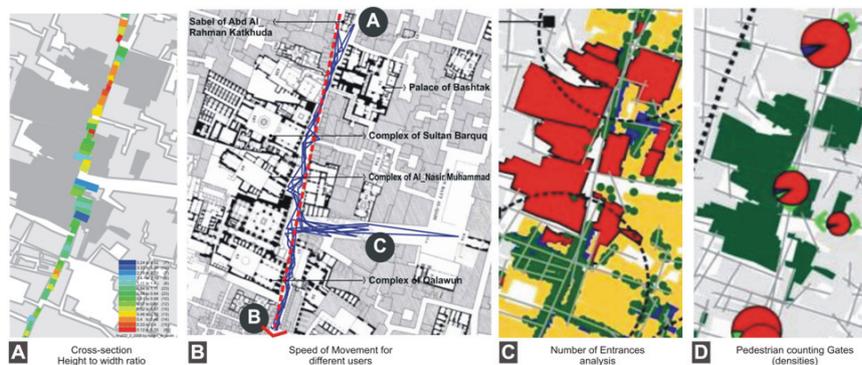


Figure 1 Analyzes the relationship between the pedestrian movement, as a social aspect, and the spatial morphology of the routes. (a) Represents the cross-section, (b) speed of movement for different users, (c) number of entrances and (d) pedestrian gates, they are all highly correlated. (Source: Author)

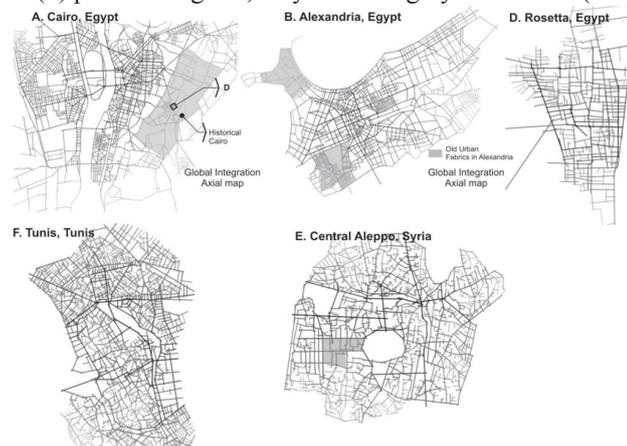


Figure 2 Axial maps for accessibility (Integration Rn) Cairo, Alexandria, Rosetta, Tunisia, and Aleppo. Their major commercial and socio-cultural activities are located on highest integrated routes (black lines), while residential parts are partially segregated (light gray routes) (Source: Author)

Shifting in land use distribution is obvious in relatively new city centers such as in the Gulf region. For example, Al Ain City's major schools are isolated in one main route; residential areas are remote from commercial areas causing an extreme depending on private car for any daily needs, this issue also exists in



new parts of Abu Dhabi, Dubai, Manama, and Riyadh.

The land uses distribution for Arab cities started with moderate mixed-use activities, dynamic forms, organic compact urban morphology, and they responded to the environmental needs. It ends with zoning distribution of activities that depends heavily on vehicle traffic as a major transportation. In addition, to the appearance of urban sprawl for low densities neighborhoods for example in new Cairo, the residential zones for national residences in UAE, and others. On the other hand, this cycle is reversed in the western theories for city center's sustainable development and land use distributions.

## 2.2. Western Cities development

In the beginning of the 20th Century, 'Euclidean' zoning was the major action for land use distribution. The term 'zoning' promotes for community division based on zones, as specific land uses are either allowed or prohibited (Burdette, 2004). Each activity was assigned for a particular zone to control its activities and separate the harmful industries from the residential parts. Although, this system of segregation is useful to administrate the activities, supply their infrastructure needs, and control their expansion, however, zoning system affects the socio-cultural activities cohesion, and maximizes daily trips from sources to destinations, consuming huge amount of time and energy, in addition, to their harmful effects on the environment. This process increased the depending on vehicle for daily movement, and caused a static process of urban growth. Some adjustment has been applied to the Euclidean zoning to make it more flexible, such as the performance and incentive zoning (<http://www.zoningmatters.org/facts/trends>).

There were critiques for the zoning processes in particularly by Jan Jacobs' book "The death and Life for great American Cities, 1961," (Jacobs, 1961) which gave the rise of mixed-zoning for activities, as a dynamic process for urban growth. The latest movement for development is sustainable urbanism. It includes the philosophical ideas of three major reform movements at the late of 20th Century: Smart growth, new Urbanism, and green building movements (Farr, 2008). Its main ideas are based on walkable and transit-served urbanism integrated with high-performance buildings and high-performance infrastructure (Farr, 2008). Therefore, sustainable urbanism is promoting for mixed-used activities, as its location should be within walkable distance, which encourage walking rather than using vehicles. See figure (3) for comparing how each movement act regarding hypothetic development for one parcel

Comparing the previous two cycles for land use distribution for Arab and



Western Cities through the last and current Century, we find the newest theories are promoting almost the same ideas that were once applied in traditional Arab old cities. Moreover, Arab cities are still in the zoning era with partial applications toward mixed-uses. Their interest in sustainability is green architecture for buildings, Dubai newest regulation for green architecture, rather than a holistic vision including the urban sustainability as a total process.

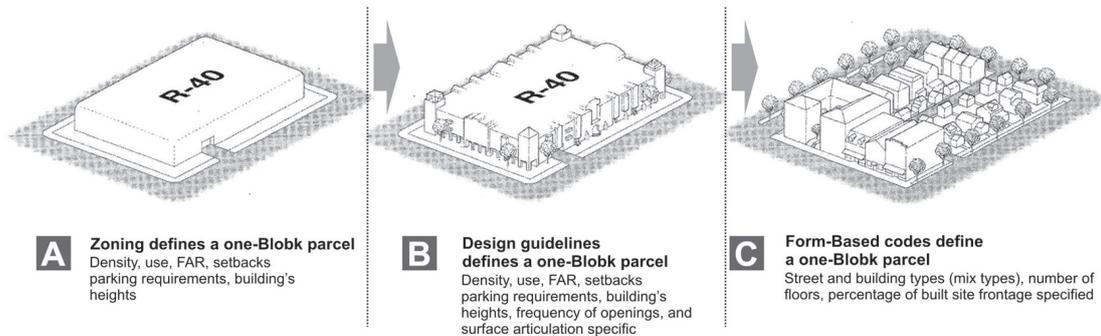


Figure 3 How different approaches (zoning, design guideline, and form-based codes) define an one-block parcel. Source: (Farr, 2008)

### 3. Land use role in sustainable development

There is diversity of views about the role of land use distribution method in shaping city centers. In this part, the paper investigates sustainable development as a meaning and definitions, followed by different theories for the role of land uses as a cause and effect in city's development plans. Finally, the paper highlights land use value as a sustainable indicator.

#### 3.1. Sustainable development definitions

Since the first recognized definition of sustainability by (WCED, 1987), the term and its definition is subjected to several modifications and re-formulated versions according to different point of views. It was first used in the 'world conservation strategy' developed by the International Union for the Conservation of Nature (IUCN) in 1980 (Haberl and Schandl, 1998). The most popular definition is "meets the needs of the present without compromising the ability of future generations to meet their own needs," (WCED, 1987). Another definition for sustainability from Center for sustainability 2004 is "The capacity for continuance into long-term future. Anything that can go on being done on an indefinite basis is sustainable. Anything that cannot go on being done indefinitely is unsustainable," (Litman, 2008). It is also defined using the three pillars (triangle) as a model depending on a social dimension (human capital), an environment dimension (natural capital), and an economy dimension (man-made capital) as main issues, and recently developed four



pillars of sustainability adding an institutional dimension (social capital) as the fourth issue (Keiner, 2005).

### 3.2. Causes and effects of Land use in development

There are different points of view on the land use role as a cause and effect on other indicators. The first view argued that land use distribution is affected by the spatial configuration of the city. Hillier (2007) argued that urban grid is a record of historical process of evolution rather than a static spatial framework holding human activities. He added that urban dynamic is a feedback cycle of 'movement economy' as spatial configuration, land use, and densities become interrelated factors. Consequently, from Hillier's view, land use distribution is a result of spatial configuration interrelationship and movement (pedestrian/vehicles). Structure, movement and land use operate together to construct a dynamic spatial- functional process, as land use distribution acts as a catalyst (Hillier et al., 2007). It also affects economic values of properties and land prices.

From a social point of view, William Whyte focuses on the role of urban spaces as places of socialization, in addition to the pedestrian movement analysis (Whyte, 1980). He compared patterns of movement and sitting to determine why people were attracted to different places. Analyzing people attraction and what repelled them in the urban environment. Whyte argued that density made the city attractive. A successful street has to have a critical mass of people and activity as what attracts people most is other people. It is argued that sustainable urban development should involve a more efficient use of energy (human and other recourse), where dense integration of people could substantially reduce the use of car, promote pedestrians, cycling, and at the same time contribute to a lively street life with natural, unobtrusive social control. Many note the importance of planned land-use diversity for developing compact, and therefore sustainable city environments (Perdikogianni et al., 2007).

In recent theories, Form-Based codes, it is tied very closely to New Urbanism school that promotes compactness, pedestrian oriented design, healthy mixed-uses, neighborhood interaction, and building's shape integrated in public realm, see figure (4). Form-based codes highlight the zoning problems for segregating land uses in these points: Consume more lands, Increase travel distance, demand more public transportation, domination of car movement than pedestrian one (Parolek et al., 2008). However, it argues that land use is not the guiding forces as under conventional Euclidean zoning, as physical or building form is the main issue, while use is a secondary consideration, the market directs the appropriate use to the building (Parolek et al., 2008).





#### 4. Land Use model framework for sustainable development

The paper establishes a model framework for land use as a sustainable indicator based on the prior literature review. The model utilizes the three main pillars of sustainability: social, environment, and economic issues. These pillars measure varieties of variables concerning land use distribution. Each variable has its detailed measuring points that elucidate the main variables. The model framework suggests multi-layer analytical tools, based on qualitative and quantitative measuring techniques, in order to have a comprehensive spatial configuration view regarding land use sustainable distribution, see figure (5). The tools are space syntax for spatial configuration analysis; a questionnaire (semi-closed interview) to comprehend the social needs; field survey for data gathering; environmental measurements and simulation for environmental data gathering; and finally, aggregate the data into GIS (Geographic Information System) system for storing and analyzing the data outcomes. This framework will reflect on the decisions taken by the decision makers for selecting the appropriate land use regulations whether to establish new districts or urban re-generation developments in Arab city centers. See table (1) for the variables, detailed measuring points, and tools selected for measurements.

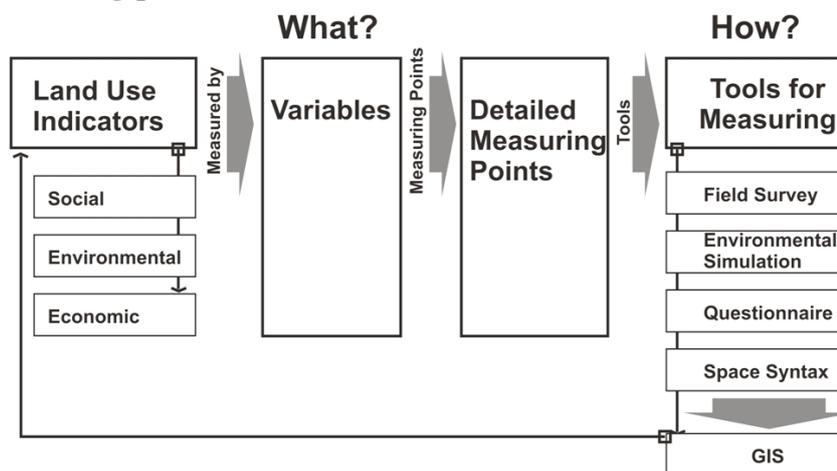


Figure 5 Proposal model frameworks for analyzing Land use as a sustainable indicator. Source: Author

#### 5. Discussions

This paper establishes a sustainable land use model framework based on variables and measuring points. It suggests a combination of qualitative and quantitative methods for analyzing the current or proposed land uses regulations as a main sustainable indicator, in the process of upgrading the Arab city centers.

There are two different cycles for sustainable city center's development; the state-of-the-art western theories promoting for sustainable urbanism, which gives back live to cities, using mixed-uses activities, walkable and transit-served

environment with high performance buildings. In contrast, Arab cities are still using zones regulations and a narrow application of sustainability on buildings only. As discussed previously, dialectically, these new theories should emerge from Arab cities, as once it was applicable in their traditional city centers. Arab cities should develop more holistic vision for their sustainable development plans, giving critical review regarding their land use distribution regulations.

Table 1 Illustrate the land use indicators, variables, measuring points, and the tools proposed to measure them. Source: Author

Indicators	Variables	Measuring	Tools
1- Land use- Social indicator	1.1. Pedestrian densities related to definite land uses	<ul style="list-style-type: none"> <li>- Integration / segregation location</li> <li>- Preferable destination</li> <li>- Preferable 'Through-movement' (Route Choice)</li> <li>- Highest percent of densities in relation to time (day/ night)</li> <li>- Speed of movement</li> </ul>	FS, SSx, GIS, Q
	1.2. Sense of Place	<ul style="list-style-type: none"> <li>- Active / Inactive spaces</li> <li>- Comfortable</li> <li>- Enclosure</li> <li>- Buildings frontages (passive/ active)</li> <li>- Appropriate re-use activities for buildings</li> </ul>	Q, FS
	1.3. Safety and security (crime, health)	<ul style="list-style-type: none"> <li>- Harmful Land uses location</li> <li>- Crime level locations in relation to definite types land uses</li> <li>- Accident risk from vehicles</li> <li>- Accessible routes for emergency evacuations</li> </ul>	DR, SSx, GIS
	1.4. Accessibility(visual accessibility permeability)	<ul style="list-style-type: none"> <li>- Spatial morphology</li> <li>- Spaces organization (solid / void)</li> <li>- Landmark activities/ building location</li> <li>- Pattern of movement (Pedestrian/ vehicles)</li> </ul>	SSx, GIS, FS
	1.5. Social integration/ Segregation	<ul style="list-style-type: none"> <li>- Community cohesion</li> <li>- Socio-cultural activities location</li> <li>- Cultural preservation</li> <li>- Aesthetics</li> <li>- Minority group distribution/ denisties</li> </ul>	SSx, Q
2- Land use- Environmental indicator	2.1.Greenhouse gas emission (Level of Co2 emission due to using vehicle as a transportation)	<ul style="list-style-type: none"> <li>- Routes length in relation to the source/ distention location</li> <li>- Type of transportation available/ Location</li> <li>- Population densities distribution</li> </ul>	GIS, ES
	2.2. Level of Co2 emission due to the land use typology and location	<ul style="list-style-type: none"> <li>- Land use distribution, industrial location</li> <li>- Wind direction</li> <li>- Weather conditions</li> </ul>	GIS, ES
	2.3. Noise, odor, visual pollution (type of land uses)	<ul style="list-style-type: none"> <li>- Human comfort</li> <li>- Pollution level</li> <li>- Waste level (from vehicles/ solid waste)</li> </ul>	GIS, Q



3- Land use- Economic indicator	3.1. Origin /destination distance trips	- Spatial configuration pattern ( street network) - Fuel consumption/ cost - Vehicle traveled Km per capita	GIS , SSx
	3.2. Origin /destination time for each trip	- Routes length - Congestion points (traffic jam) - Distance/ location of daily land uses (time consumed for each trip)	GIS , SSx
	3.3. Origin / destination type of transport (on foot/ cycle/ public transportation/privet Transportation	- Land blocks size (size of Land blocks in relation with type of transportation needed) - Distance/ location of daily land uses	SSx , F S , D R , GIS
	3.4. Land value (prices)	- Impact of new uses on the existing ones (price/value) - Land blocks/ plot size (adaptability to different land uses needs)	F S , D R , GIS
	3.5. Supplementary Facilities (Car parking, seating areas, etc)	- Current land uses potential supplementary needs - Impact of supplementary needs on land values (prices) - Type of Infrastructure needed / cost	GIS , DR

FS = Field survey, DR = Data records, SSx = Space syntax, Q = Questionnaire, ES = Environmental simulation, GIS = Geographic Information Systems

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# توزيع استخدامات الأراضي في المدن العربية كمؤشر للاستدامة الحضرية

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## ملخص:

يمثل توبوغرافيا استخدامات الأراضي في المدينة مؤشر رئيسي للاستدامة الحضرية، فله تأثير مباشر على نظام حركة النقل والوقت ونوع واستهلاك الطاقة، وذلك حسب مواقع بداية ونهاية كل رحلة يومية، وبالتالي فإن ذلك يؤثر على البيئة واستدامة خطط التنمية بها.

مراكز المدن العربية لها طبقات من التطوير خلال التاريخ مما يشكل وضع متميز لذاكرة المدينة وحضارة يفتخر بها. يهتم هذا البحث بتحليل التحولات والتغيرات في توزيع استخدامات الأراضي وذلك منذ عصر مركز المدينة العربية التقليدي إلى عصر الأنماط الحديثة، وي طرح البحث فكرة أن هذه التحولات عبر الحقب العديدة ينجم عنها تأقلم في توزيع استخدامات الأراضي ليناسب السكان. وهناك نظريات مختلفة تفسر هذا التأقلم، ويتبنى هذا البحث نظرية التشكيل الفراغي والتي تربط بين العوامل الفراغية والاجتماعية التي هي سبب الحركة للسيارات والمشاة، وبالتالي التوزيع الفراغي يؤثر على حركة المشاة والتي بدورها تؤثر على توزيع استخدامات الأراضي.

ويتناول هذا البحث المقارنة بين الامتدادات التقليدية والحديثة لمراكز المدن العربية على أساس التوزيع المستدام لاستخدامات الأراضي.

ويقترح البحث نموذج عام لتحليل وفهم لتوزيع استخدامات الأراضي ومدى توافقها من عدمه مع التشكيل الفراغي. علاوة على ذلك يمكن استخدام النموذج لمقارنة التوزيع الراهن لاستخدامات الأراضي بالوضع الأمثل وكأداة للتنبؤ بمستوى النجاح المتنوع لأي خطط تطوير مستقبلية.

