

Proceedings of the Fábos Conference on Landscape and Greenway Planning

Volume 7
Issue 1 *Moving towards Health and Resilience
in the public realm*

Article 43

August 2022

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Recommended Citation

Bzour, Ansam and Valánszki, István (2022) "Peri-Urban Green Areas and the Landscape Transformation in the Case of MENA Region," *Proceedings of the Fábos Conference on Landscape and Greenway Planning*: Vol. 7: Iss. 1, Article 43.

DOI: <https://doi.org/10.7275/sqda-m003>

Available at: <https://scholarworks.umass.edu/fabos/vol7/iss1/43>

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Peri-Urban Green Areas and the Landscape Transformation in the Case of MENA Region

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1. Abstract

Peri-Urban greens are defined as transitional zones where the rural areas of land located outside the densely populated urban areas transform into urban forms of lands where it becomes more populated regarding the change in the land use which are mainly located between the outskirts of urban regional centers and rural environments.

The study of the Peri-Urban greens takes place in the MENA region which refers to the Middle east and North Africa where countries share similarities in the culture, economic and environmental factors. Looking back through history, the MENA region has been suffering from an uncontrolled growth of the urban expansion that tackled the transformation of the land use and threatened the rural areas which remained as an ongoing issue until today.

In order to fill this gap, this study investigates a structured review of evaluating and comparing the landscape transformation based on two main pillars of analysis: 1) Investigating the landscape transformation through studying the development of the lands and 2) identifying the landscape change by studying the socio-cultural identity of the lands using examples of mapping system methodologies.

All pillars of analysis are applied on areas of study with different scales of assessment; the regional scale which compares the impact of urban/rural growth on the landscape state between two selected countries (Egypt from the North African side and Jordan from the Middle Eastern side) and the city scale which is based on comparing two categories of cities; the comparison between the capitals (Amman and Cairo) and two selected cities located next to water resources (Luxor in Egypt and Aqaba in Jordan).

This research paper detects the urbanization dynamics of the four selected cities and its impact on the land use and land cover transformations and the effect of changing the scales of analysis on the result of the comparison.

The study contributes and results in implementing the level of landscape change in relation to the rapid urbanized areas by reinforcing the cultural importance of the city center and observing the urban sprawl moving toward the rural areas. Moreover, studying the nexus between the city and the water surface and enhance the quality of natural and green spaces. It is essential to study the percentages of green spaces, agricultural lands with the urbanized areas.

2. Introduction and Literature Review

Urban sprawl and the speed of urbanization movement have been forming as continuous processes of change as cities are considered a result of a complex interaction between inhabitants and the physical surrounding through developing social, economic, environmental, and cultural bindings (Alnsour 2016). Even though the urbanization process helps in the development of cities by enhancing the socio-economic flows, the rapid urban growth and the speed of change leaves a significant impact on the quality of the landscape and rural areas regarding the movement of people from more populated areas (urban areas) toward the less populated areas (rural areas).

This study illustrates and compares the effect of urbanization and urban growth on the landscape transformation and agricultural percentage between rural and urban areas and the cultural heritage and identity regarding the effect of urban growth on the cultural cradle and the sense of belonging between four different cities in the MENA region.

Throughout history and regarding the migration waves and the political influence, the MENA region has been going through waves of unexpected growth rates which caused a substantial stress to the landscape and ecological value of the lands, not to mention the effect on the cultural aspect (Jaad et al. 2021). The uncontrolled increase in the population left a negative impact as well on the land use and land cover over the past 50 years as the population of the MENA region has increased from around 100 million in 1950 to around 380 million in 2000 which makes it 3.7 times more in comparison with other regions around the world (Madbouly 2009).

With the speed of expansion comes the need and demand for resources. Therefore, the competition for resources such as food and water rises. When the level between demand and resources availability is unbalanced, a harm in the landscape and a degradation in the agricultural quality and production occurs (Flörke et al. 2018).

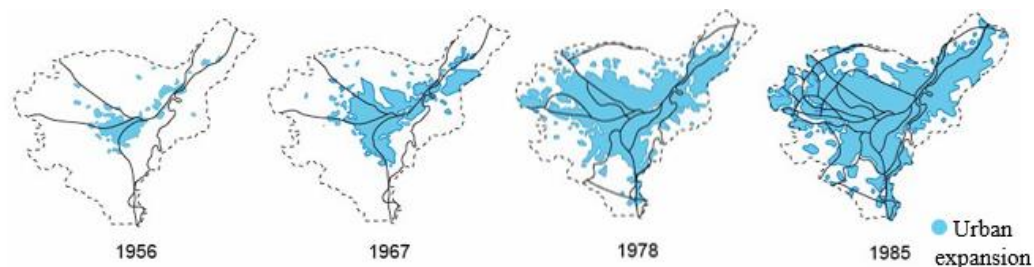
One of the cities in the MENA region that was mostly affected by the urbanization waves is Cairo in Egypt. Regarding the dry climate of Cairo, the agricultural production is mainly depending on the irrigation water. The transformation of the agricultural lands in Cairo into constructed highways caused a loss in the agricultural production and contributed to demolishing the peri-urban lands which increased the percentage of the urban areas by 135% in the period between 1948 and 2013 (Osman et al. 2016). Moreover, in the period between 1987 and 2011, the city of Luxor in Egypt showed changes where there was a decrease in the percentage of agricultural lands over urban areas (Ahmed et al. 2014).

In the case of the eastern part of the MENA region, the capital of Jordan, Amman, has faced a significant drop in the percentage of the agricultural lands in the period between 2003 and 2015. This drop was mostly shown after 2011 because of its location that is centralized in the middle of a war zone which attracted many refugees to settle there. However, Amman contains 14% of its agricultural lands in the current time which are included in the municipal boundaries of the city. While moving to the south of Jordan, Aqaba city went through a different impact as many lands there have transformed to serve the heavy industrial need and tourism which caused damage to the agricultural lands and polluted the water (Al-Kofahi et al. 2018).

Urbanization does not only cause changes in the land itself, but it also appeared to leave an impact on the cultural development. As cities start to grow, civilizations cradle along water elements for

living purposes and needs. In the case of Cairo in Egypt, the shift of people settlement formed a direction extending from the Nile River toward the desert areas located on the northeastern side of Egypt as people settlements exceeded the river fringe capacity to accommodate them. This shift influenced on how people define themselves within the landscape which was reflected on the cultural heritage and values, and the sense of identity (Williams 2004). In the case of Luxor in Egypt, the city is considered as one of the largest and most well-known archeological sites across the world (Mahmoud 2018). Due to urbanization movements, the conservation and protection for heritage sites and natural resources becomes more difficult not to mention the deterioration of historic landscapes which causes the detachment between people and the heritage sites (Mahmoud et al. 2019).

It is necessary to mention the effect of the war and political conflicts when studying the landscape and cultural identity. Jordan formed a safe spot for refugees fleeing from the surrounding countries. Regarding the continuous urban growth and refuge waves, Amman city started to urbanize in a fragmented way (Figure 1) resulting in a cultural gap and spontaneous compositions of development (Melnik 2019). Amman has transformed the traditional cityscape to a global one with no reference to the cultural heritage and historical background (Aboutorabi et al. 2019). As well as, in Aqaba city, the effect of tourism and growth rates was visible on the overall environment of the city. Based on a study that was made on the shops' signs and the business sector, the change in the local language usage to English in a percentage of 58.1% is one of the factors of following globalization which weakens the identity values and the cultural attachment (Amer et al. 2014).



1. Figure Amman urban fragmentation/ (Amman Municipality Archive, 1987)

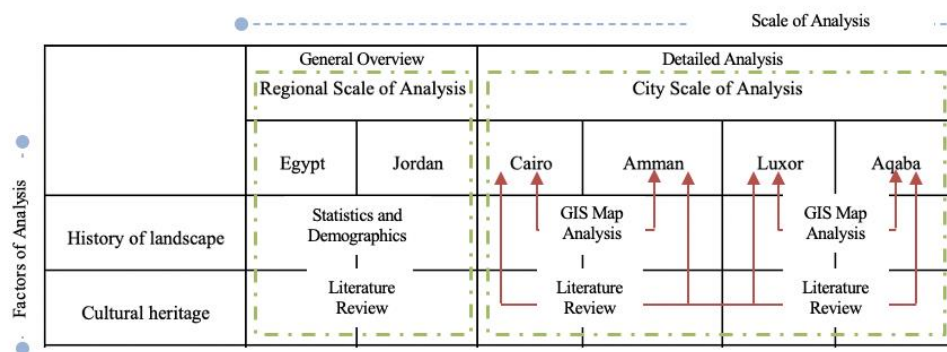
The effect of urbanization and urban growth follows different scales, from the city scale toward the urban scale and so on. The continuous increase in the population poses a significant challenge toward the connection between cities and greenways. The green infrastructure under the urban pressure suffers from the reduction of the efficiency of its ecosystem services which leads to an unhealthy urban environment not to mention the climate change. For example, in the case of Egypt, regarding the continuous growth in the population over the area of the land, the urbanization movement caused discomfort and modification in the human daily life, not to mention weakening the quality of the agricultural lands. Moreover, the urbanization movement is connected to the fragmentation of the green spaces which results in numerous socioeconomic and environmental problems.

3. Materials and Methods

The selection methodology of the study areas follows two scales of analysis: 1) the regional scale which is represented by choosing two examples of countries in the MENA region which were mostly affected by the speed of growth represented by Jordan in the middle east and Egypt in North Africa. 2) the city scale of analysis. In this part, the selection is made on four cities following two categories. The first category is defined by choosing a city that is mostly dense in population -in the case of this study- (Amman in Jordan and Cairo in Egypt) and the second category is represented by choosing cities close to a water source (Aqaba in Jordan and Luxor in Egypt).

The criteria of using the method of comparison and analysis are chosen according to two main factors: the history of landscape development, and the cultural heritage and identity. All factors contribute to study the impact of urbanization on landscape and the possibility to develop livable cities by measuring the urban/agricultural areas using QGIS and RS. Table 1: Case studies comparison method.

1. Table Case studies comparison methods. (By Author)



3.1. Regional Scale Case Studies

The first stage of analysis is made on a regional scale between Jordan and Egypt. In this stage, the use of the demographic data provided by the ministry of statistics in both countries is collected and transferred into statistical charts representing the numeric data of urban and rural land areas to measure the growth in both countries between 1970 and 2020 (Mahmoud et al. 2018).

In the same scale of analysis, the use of literature reviews and online data sources formed the main method of understanding the cultural patterns and cultural differences between the two countries to study the relation between urban development and the cultural aspects and values (Ababneh et al. 2016).

The second stage of analysis is following the method of comparison that is made with the help of reviewing and analyzing previous literatures that used base maps and shapefiles provided by (<http://www.diva-gis.org/gdata>) of the study areas imported into QGIS 2.18.18. By using the GIS mapping technique showing the landscape transformation and land use change of urban and agricultural lands in relation to morphological distribution and water bodies which are detected via the process of overlapping and tracing the changes in the maps along the time between 1970s until 2000s. In this stage of analysis, a deeper study is made to illustrate the urban expansion, green

areas, land use and agricultural land cover, and some statistical data which are collected using satellite maps and GIS data concerning the urban growth with the focus on the cultural aspect.

3.2. City Scale Study areas:



2. Figure Case Studies (By Author)

3.2.1. Cairo and Amman

The first category of selection is based on choosing the most populated cities in each country. The selection was made on Cairo in Egypt and Amman in Jordan. Both cities are capitals and located in a metropolitan area. Cairo is the capital of Egypt with a population of about 21.7 million in 2020 which makes it the most populated city in Egypt. With an area of 3085km², it forms as one of the biggest cities in the MENA region (Hereher 2012). While the city of Amman is also the capital of Jordan. It has a population of about 2.1 million inhabitants together with the refugees. It forms an area of about 1680km². In order to understand the urban and rural development of both cities, it is important to highlight the relationship between the geomorphology (highlands and deserts), natural resources (agricultural lands and the water resources), and the urban expansion and growth.

Cairo is a city that has undergone a loss of the agricultural lands which were located within the city boundaries regarding the accelerated population growth. Although, it is considered as a very important spot due to its centralized location between the Nile valley and delta. In order to detect the change in the landscape, a comparison method is made between the morphological state, the urban expansion and the natural resources by overlapping existed maps from the different timescales.

In the case of the landscape transformation of Amman city, Amman is considered an overpopulated city in the middle east regarding the speed of growth in a timeframe. The same tests were run to examine the relation between the urban expansion and the agricultural lands.

3.2.2. Luxor and Aqaba

In this phase of study, the focus is to investigate the natural and urban maps taking into consideration the relation between the city and the water. Luxor is a city located on the edges of the Nile River with a population of 422,407 in 2021 and an area of about 416km² (Mahmoud et al.

2019). It is considered as one of the historical cities that has a rich heritage value due to the nexus between the city and the archeological sites which made it a destination to tourists as well as locals. The urban expansion of Luxor has developed rapidly between the years 1970 and 2017 due to the connection to the heritage sites and the nexus to water which left an impact on the percentage of green areas and agricultural lands. The study is made by calculating the urban/agricultural areas using existing remote sensing maps from two different years to develop the comparison.

Aqaba is a coastal city that is located on the southern part of Jordan. It is connected directly with the Red Sea and has an area of about 7579km² and a population of 80059 people. What makes this case different from the previous ones is the sprawling by density compared to other cases regarding the importance of the city role as an industrial free trading center which affects not only on the lands but on the cultural development of the city and the speed of growth (Daoud 1995). The focus is to collect available base maps and shapefiles from the website (DIVA-GIS) to measure the area of agricultural lands and urban growth in relation with water and during the development of the industrial city using QGIS 2.18.18. and RS techniques. Along with the urban expansion comes the shrinking of the agricultural lands. Regarding the scarcity of data and the political sensitivity of Aqaba city on the borders with Israel, ariel photographs were the best solution to study the urban/agricultural development and land cover study of the city on RS and QGIS.

3.3. Cultural Study and the impact of urban growth:

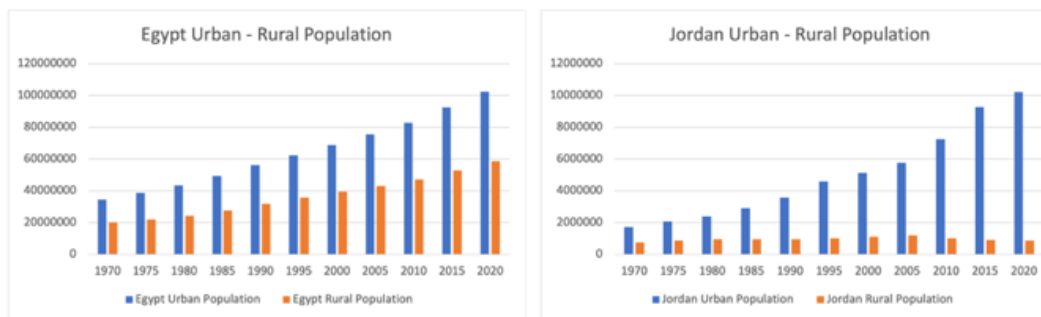
Along with the landscape and urban development of cities comes the cultural change. To understand the cultural development of the selected cases, this study followed a classification methodology built on literature reviews and analysis. The methodology is based on analyzing the impact of urban growth on the cultural cradle and movement by referring to the history of cultural development followed by categorizing the similarities and highlighting the differences between the selected cases. A special evaluating technique is used to define the level of the urban growth factor impact which is measured by dividing urban areas into one km² grids and evaluate them by using four gradient colors listed from number (0) which represents “No impact” to number (3) that represents “Highest impact”.

2. Table Cultural comparison factors and cities. (By Author)

Factors	Impact on Culture				Scale of Analysis
	Cities	Cairo	Amman	Luxor	
Natural (Rivers, Arable lands)					0 No Impact
Tourism (Archeological, heritage)					1
Political (Wars, refuge waves)					2
Socio-economic (Jobs, Industry)					3 Highest Impact

4. Results

In the first stage of analysis, according to the data representing the urban/rural growth in Jordan and Egypt. The bar chart in the case of Egypt shows a dynamic growth between the number of population in urban areas extending to the rural areas. Hence, the growth of the population in the urban areas is followed by an increase of inhabitants in the rural areas. On the other hand, in the case of Jordan, there was a slight drop in the number of population living in rural areas dropping from 20% in 2000 to 16% in 2010. However, from 2010, the growth rate of population in urban areas has been growing with an annual growth rate of 1.8%. This slight change is caused regarding the internal migration from rural to urban areas searching for job opportunities. Geographically, the highest concentration of population in Jordan rural areas takes place next to the valleys where the fertile soil forms a big percentage of the lands.

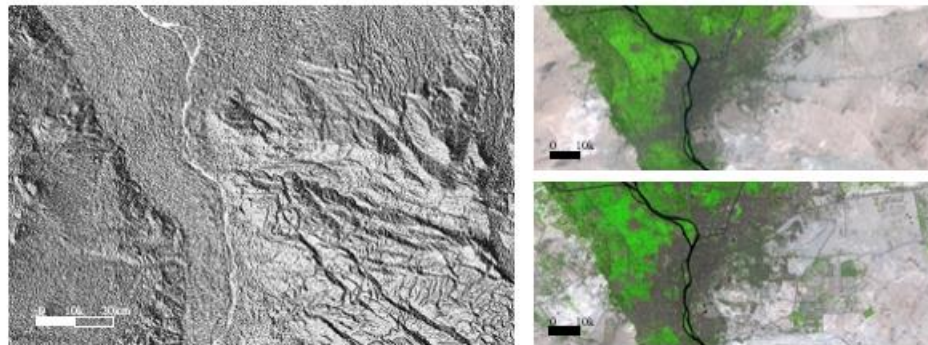


3. Figure Urban and rural growth charts for Jordan and Egypt between 1970 and 2020. (By Author)

Following literature reviews and historical studies, the Jordanian territory did not have a major urban center until the late 1940s. Going back in time, the cultural value in Jordan was mainly focusing on the local market and administrative centers instead of centers of high cultures. With the speed of urban development, Jordan became a safe spot for many cultures around the world which left an impact on the cultural patterns and values and caused a loss of identity. While in the case of Egypt, the cultural homogeneity and the lifestyle of people is becoming more diffused between the cultural heritage and the new cultural additions caused by the change in the society members and distribution.

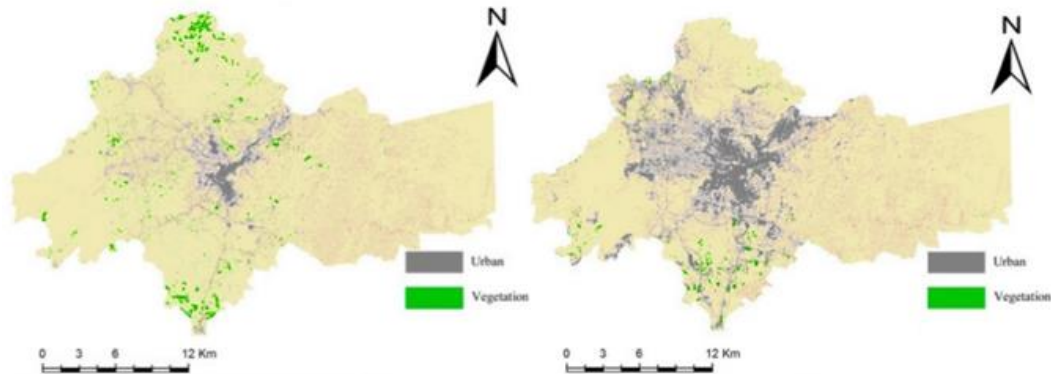
In the second stage of analysis and starting with the case of Cairo, figure 4 shows that civilization settlements cradled along the sides of the Nile River extending toward the plain areas away from the mountains. Although, Cairo is geographically limited by natural desert borders, the reclamation processes of the desert areas helped in the expansion of the settlements. The natural color maps in figure 4 illustrate the urban expansion (grey/brown) over the agricultural lands (green) resulting in a significant urban expansion and growth along history as urban areas formed an estimated area of 233.78km² in 1987 while the area kept increasing to reach 557.87 km² in 2006 which forms a percentage of increase of about 3.24% over the agricultural lands. The loss of agricultural lands formed a percentage of 13% from the year 1987 till 2006 representing approximately 19 thousand hectares and almost 12% loss from the year 2006 till 2014 with an area of 21 thousand hectares. Thus, the urban expansion reached the surrounding desert area as shown in the natural/Urban map of 2014. Three percent of the desert area has been urbanized between the year 2006 and 2014 with an area of 31 thousand hectares. The urban agricultural expansion toward the desert area rises the needs to use the Nile water for human needs and irrigation processes.

In the case of Cairo, the green areas along the Nile River were marginalized and the city has been losing significant quantities of its already limited green spaces. The green network of Cairo contains several types of green spaces that are different in areas, features, and use. According to the municipality archives, 23 new desert cities have been introduced between the year 1970 and 2015 and 910,894m² of its green spaces were lost regarding the urbanization movement.



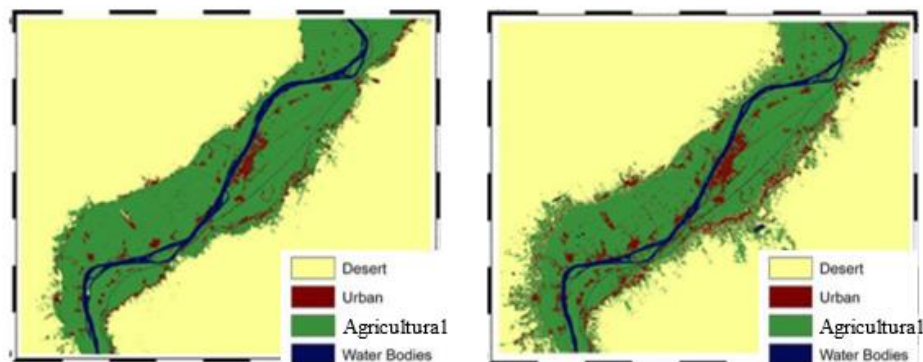
4. Figure Morphological map (Left), Urban/Natural map 1970 (Upper right), Urban/Natural map 2014 (Lower right) (Maurizio 2011).

On the other hand, in the case of Amman city, the urban settlement and expansion started from the center and expanded radially (Al rawashdeh et al. 2006). Unlike Cairo, the physical urban morphology of Amman started to form in a mixture of elements regarding its topographic features. The beginning of settlement was in a mountainous area (formed as series of mountains) extending toward the valleys (Potter et al. 2009). According to the maps shown in figure 5, in 1987, the urban expansion formed a percentage of 19.39% with an area of 147.08 km² while the agricultural lands formed a percentage of 4.64% and an area of 35.32 km² in the same year. Moving toward the year 2017, the urban growth increased to reach an area of 237.86km² which represents 31.36% while there was a shrink in the agricultural lands as the area of it dropped to become 16.40km² with a percentage of 2.16%. As a result, the percentage of the increase in the urban area of Amman is 61.73% between the year 1987 and 2017 while the percentage of the decrease in the agricultural lands is 53.54% during the same period. This means that the urban area in the city of Amman started small in the center in 1987 and spread rapidly away from the center toward the agricultural lands which harms the quality of the lands. Along with the urban growth and the agricultural loss comes the loss in green spaces and causes damages in the overall green network of the city resulting in harming the green infrastructure and the ecological biodiversity. Figure 5 shows the distribution of the urban expansion and agricultural lands between the years 1987 and 2017 related to a study that was made using Google earth mapping technique.



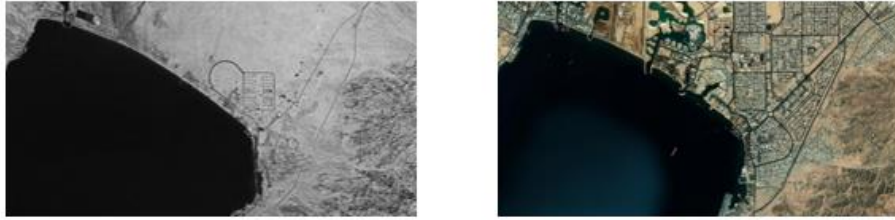
5. Figure Amman Urban/Natural map 1987 (Left), Urban/Natural map 2017 (Right) (Al-Bilbisi 2019).

The second category of analysis is made via the comparison between Luxor city and Aqaba city with respect to the water source. In the case of Luxor city, regarding the urban/agricultural maps shown in figure 6, the urban area has increased over the agricultural lands. As a result of the urban/agricultural analysis and calculations, the urban area in 1997 was 37.7 km² with a percentage of 9.06% and has increased over the agricultural lands until the year 2017 to form an area of 74.4 km² and a percentage of 17.80%. The area of the urban expansion between the year 1997 and 2017 in Luxor city is 36.7 km² and the percentage of the expansion is 8.80%. The urban area of Luxor city was formed at first along the eastern bank of the Nile River and was surrounded by many agricultural lands in the 1970s then started to expand gradually to the eastern bank of the Nile River to form this rapid expansion until the year 2017. Accordingly, the agricultural lands area was decreasing. The drop in the agricultural lands and the increase of urban areas resulted in land use transformation. Hence, the peri-urban lands were developed.



6. Figure Luxor Urban/Natural map 1997 (Left), Urban/Natural map 2017 (Right) (Mahmoud et al. 2019)

In the case of Aqaba city, the expansion of urban areas over the periods between the 1990s formed an area of 4.6 km² with a percentage of 0.06% while in the 2000s the urban area reached a percentage of 0.13% with an area of about 9.9 km². This change is caused by the transformation of the lands to adjust to the industrial free trading center which influenced the living quality and enhanced tourism regarding the connection between the city and the sea which made it more accessible for trading. Although the change in the urban area is significant, the green areas were not affected by the change as they were slightly decreased between the 1990s and 200.



7. Figure Aqaba Gulf Ariel Images for the Urban Development 1968 (Left) and 2018 (Right)/ (Left image: Corona mission, USGS. Right image: Worldview, ESRI)

After the study of the urban development and growth, this paper discusses the effect of the urban growth movement not only on the agricultural lands, but also on the cultural development using literatures that demonstrate the reasons behind the urban growth (Alhusban et al. 2021; Mahmoud et al. 2019). After that, and based on the methodology mentioned before, the evaluation method is determined based on the results of the urban growth studies to decide which factor of the urban growth affected mostly on the cultural development in the four mentioned case studies. Table 3: Results of urban growth impact on cultural development.

3. Table Results of Urban Growth impact on Cultural Development. (By Author)

Factor	Cities	Cairo	Amman	Luxor	Aqaba
Natural (Rivers, Arable lands)		2	0	3	3
Tourism (Archeological, heritage)		1	1	3	2
Political (Wars, refuge waves)		0	3	0	0
Socio-economic (Jobs, Industry)		3	3	0	3

5. Discussion and Conclusion

The urban expansion in Cairo caused direct geomorphological changes as the misunderstanding of the geomorphological settings caused a huge loss in many fertile and agricultural lands. Not to mention the socio-economic development that enhanced the urban growth and urban-rural change. Resolving the relation between natural resources and urban expansion is considered essential for the sustainable development of the lands and to reduce the loss of the agricultural production. In the case of Amman city, the main urban growth was shown in the study during the past century regarding the huge waves of refugees who fled their countries and settled there. Like Cairo, the socio-economic situation and job opportunities played a major role in the urban growth and development. The expansion followed a certain system aligned with the road network that were previously considered as heritage trails leading to other cities and countries. In the case of Luxor and Aqaba city, the study shows the effect of the natural and water connection in the enhancement and expansion of the urban settlement whether regarding the land use transformation or the cultural aspect and civilization cradle. Moreover, the industrial situation in Aqaba and tourism effect in both Aqaba and Luxor helped in causing changes in the cultural patterns of the cities. In contrast with the study that was made on the exact four cities (Riad 2020) the urban development in this study was mostly affected not only by transportation distribution but also by the natural and socio-

economic factors.

During the years of the study, urbanization and the urban growth have strongly affected on the land use changes and the development of peri-urban lands. In all cases, the peri-urban lands were developed because of the increased urbanization wave over the agricultural lands. Then followed by the shrinking of the peri-urban lands to accommodate the continuous urban expansion. For future recommendation, it is important to study the change in the quality of the peri-urban lands overtime.

The change in the urban expansion resulted in the change of the cultural patterns overtime and vice versa. Thus, along with the adaptability of all cities to change, understanding landscape meanings by studying the historical development and civilization cradle can help in enhancing the resilience to change. To come up with a flexible plan for the growth of the cities, it is essential to understand the urban morphology and landscape of the cities along with the cultural heritage and development. In the case of Luxor city, the protection of the archeological sites from the effect of urbanization is a complicated process which was discussed in detail in the study of the relation between the urbanization cradle and archeology (Elfadaly 2017). In the mentioned study, the main discussion was about how the placement of the archeological heritage impact the civilization cradle and development which stated a parallel relation between both.

Greenways play an important role in the development of urban and peri-urban areas in the MENA region, as they help in mitigating the loss of green spaces and agricultural lands, reduce the climate change effect and preserve a natural habitat and ecological biodiversity. Hence, documenting green spaces and green network loss and distribution is important since no recent published data is available for decision-makers, researchers, and planners in the MENA region especially in the case of Luxor and Aqaba city. Data is also scattered between different sources. The loss of green spaces can be considered as a very important factor that plays an essential role in influencing and transforming peri-urban greens into becoming more urbanized which harms the green infrastructure of the cities and degrade the quality of the green network.

The results of this study show that cities have changed rapidly overtime at an alarming rate. Thus, the focus should be directed in the future into how to encompass the speed of change and what can researchers do to protect the cultural features of cities from that change. In summary, a table of the main findings is provided based on the result of this study of the four cities regarding four main aspects, the relation between urban expansion and geomorphology, the cultural aspect and development, the urban/agricultural aspect, and the green infrastructure and green network.

4. Table City Scale Main Findings of the Study. (By Author)

	Cairo	Amman	Luxor	Aqaba
Urban Expansion and Geomorphology	Natural: Urban expansion radially starting from the river and the valley and expanded toward the plain areas away from mountains	Natural: Urban expansion started from the mountain toward the valley radially then chaotic following the topography	Natural: Urban expansion followed the river formation Cultural: Human settlement adjacent to the heritage site	Natural: Urban expansion started following the water body then Socio-economical: following the industrial city plan
Urban growth Factor and Cultural Development	Socio-economic (Job opportunities) Natural (Cultural cradle Along the river)	Political (Refugee camps) Socio-economic (Job opportunities)	Natural (Cultural cradle Along the river) Touristic (Heritage site)	Natural (Water body) Socio-economic (Trading, job opportunities)
Urban/Agricultural Relation	Urban increase (1987-2006) = 3.24% Agricultural loss (1987-2006) = 13%	Urban increase (1987-2006) = 61.73% Agricultural loss (1987-2006) = 53.54%	Urban increase (1987-2006) = 8.80%	Urban increase (1987-2006) = 0.7%
Green Network and Green Infrastructure	Loss of green areas along the Nile River (New desert areas were developed)	Loss of green areas and damages in the continuation of green infrastructure	Lack of resources	Lack of resources

While moving toward the bigger scale, the following table summarizes the findings regarding the case of Jordan and Egypt.

5. Table Regional Scale Main Findings of the Study. (By Author)

	Urban Growth	Rural Growth	Cultural Growth
Jordan	Increased (1970s-2000s)	Increased (1970s-2000) Drop (2000-2010) (Internal migration) Continuous Increase (After 2010)	Local markets, administrative centers (No high cultural centers)
Egypt	Increased (1970s-2000s)	Increased (1970s-2000s)	Heritage and Natural Influence

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