RESEARCH PAPER

EFFECT OF LAND-USE CHANGES ON LANDSCAPE FRAGMENTATION: THE CASE OF RAMALLAH AREA IN CENTRAL PALESTINE

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ABSTRACT. The urban sprawl of cities periphery is one of such changes that has led to drastic land-use changes, which resulted in landscape fragmentation. The objective of this study is to understand the process of landscape fragmentation because of urban expansion; identifying the most influential drivers that have changed the land-use. To achieve the objectives due to changes in land use, a study had conducted in Ramallah area of Palestine. The study utilized Fragstat software to quantify the landscape changes with regard to its pattern and structure through a number of indices, also using Geographic Information System tool to draw up different landscape parcels spatially with its characteristics.

The spatial analysis carried out on the land-use change used the 1997 and 2017 aerial photos to quantify the landscape fragmentation, which included a variety of land-uses. Over 52% of the study area underwent noticeable urbanization process, resulting in appreciable landscape changes to the area, especially after 1993. The statistical analysis of the landscape fragmentation revealed significant changes in land-use during the period from 1997 to 2017; the green landscape has been fragmented at a large scale by increasing the number of landscape patches (from 71 to 148 patches). As a result, there was an obvious reduction in agricultural lands, such as olive groves and grassland. At the same time, the urban surface areas increased from 654 patches in 1997 to 2019 patches in 2017. These results indicate that the landscape has become more fragmented due to geopolitical and socio-economic drivers since mid-1995 after Oslo accord.

KEYWORDS: land-use, landscape fragmentation, pattern, Fragstat

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INTRODUCTION

The process of fragmentation involves splitting the green areas into smaller patches whereas in some areas becoming isolated (Flowers et al. 2020) that called it unravelling. Landscape has fragmented all over the world due to the disintegration of wildlife and the ecosystem (Mumu 2016). The landscape fragmentations were also affected by socioeconomic factors (Luo et al. 2015). Landscape fragmentation is subjected to land-use change, the main driver of environmental change, which caused by intensive urban expansion due to population growth, unplanned land use shift and poor land management, in addition to urban and infrastructure developments are considered main drivers of landscape changes and fragmentation (Jaeger and Raumer 2006).

The analysis of landscape fragmentation requires an analysis of the driving factors influencing the land use changes from green to urban areas. Recent studies addressed the role of land use on the fragmentation of forests and agricultural land that has been linked to a number of environmental consequences (Bryon et al. 2020). (Antonio et al. 2019) included the role of human activities in landscape fragmentation, the transportation networks, urbanized area and suburban and rural sprawl in Natura area of Sardinia-Italy as influential factors that affected landscape and caused fragmentation.

Urban growth and transportation networks are rapidly encroaching on the peripheral and rural areas that led to a high urbanization rate around the world, which is one of the most important drivers of landscape fragmentation besides other socioeconomic factors. Over the recent decades, urbanized areas have extremely expanded and associated with the growth of transportation networks, deforestation and decreasing of cultivated land areas. Gradually, as a result, the landscape pattern has dramatically changed over time (Weng Yc 2007).

The demand for new infrastructure and houses has pushed toward the conversion of the agricultural land to urban land-use (Radad and Samat 2016). Hence, in 1943, the land-use map showed that agricultural land had been the dominating land-use. The declining importance of traditional culture of agrarian society and the farming system (Nazer 2009) is proof of the agricultural terraces degradation.

The land-use of the Palestinian communities has changed in the last two decades. During this period between 1997 and 2017, Ramallah area underwent one

of its greatest changes, due to the geopolitical and socio-economic situation (Bilgin 2016; Hilal and Saka 2015; Bimlom 2014; UN-Habitat 2015 and Shaheen 2013).

Ramallah as the study area of this paper has experienced a noticeable growing population coupled with rapid urban area growth. Nowadays, Ramallah area ranks as the first condensed area in the West Bank, and functions as one of the urban centres. Moreover, Ramallah is experiencing significant building units, particularly in the duration between 2007 and 2017, including suburbs-style (out-skirt) landscape that characterized the current de facto.

However, the spatial analysis in the study focused on the changes in the green areas that occurred because of the development of built-up area, considering it as one aspect depicting the changes in the landscape. Hence, the study area faces land-use changes, fragmentation of its landscape, and such changes is associated with socio-economic transformation processes (Abu Helu 2012; Noubani 2010; Taraki 2008 and Khamaisi 2006). The implications of this issue are not fully being taken into consideration.

The random urban model characterizes the study area based on the de facto situation. Many studies related to the landscape have demonstrated landscape change due to urban development and its effect on other elements of the landscape through spatial and temporal analysis (Riitters et al. 1995 and Baker 1989).

Evidence from several studies, including (Muhsen and Abu Hammad 2017) and (Hammad and Sharkas 2008), showed the research area's landscape pattern had changed significantly throughout that time period. The Palestinian authority onset is a significant part of the process of transformation from rural landscape into new urban landscape model (Al-Houdalieh and Suader 2009). The onset of the authority caused internal migration, thereby creating a dire need for residential areas in the first stage of the development process.

According to (Muhsen and Abu Hammad 2017) studies revealed that the urban area extended over 300 hectares during the periods of 1997 and 2017; most of the land converted to built-up area with a 52-percentage increase in the same period. However, Ramallah area has faced a new situation within the past two decades, connected to the high demand for dwellings to meet the high need of newcomers to the study area (Harker 2014). The high need for dwellings connected with a high completion and demand on lands, services, and other uses, which affected adversely agricultural land, and other green areas causing a change in land-use. In later stages, this process is associated with raising value and prices of land.

In addition, number of studies (Zaho et al. 2020; Zambrano et al. 2019; Kong and Kakagoshi 2006), the effects of the landscape's fragmentation mainly had negative consequences on species richness and animals in the ecosystem. Indeed, they have reduced the space of the green area (forest, natural grassland and agricultural land). In addition, the fragmentation has substantial adversely effects on the landscape due to the limited green areas in some regions. That means more threats on the natural ecosystem, biodiversity and water resources by reduction, loss habitat or in some areas replaced by invasion habitat, wildlife diversity devastation and changing the natural landscape pattern etc.

According to Samsuri the area of the forest in Batang Toru watershed has fragmented between 1989 and 1993 because of the anthropogenic activities in the area, the study has conducted by using Fragstat to generate landscape metrics to quantify the fragmentation rate (Samsuri et al. 2014). Concurrently, in all over the world, forests and agricultural areas are the most affected areas where process of fragmentation occurred due to deforestation and other accompanied human activities, which is similar to what has been found by (Jane et al. 2004) in their study about Honduras region.

According to (Jochen A. et al. 2007) and (Chen 2003) it is an important environmental indicator in assessing the sustainable land use, biodiversity and urban growth by quantitative methods (i.e., size perimeter). While according to (Davidson 2006), landscape fragmentation index can be defined as the breaking up of continuity such as habitat, decreasing or increasing number of patches, and decreased average patches size. This study aims to identify the land-use changes and the scale of landscape fragmentation; analyzing the new urban landscape based on the evaluation of the new development; and understanding its implications through landscape fragmentation index.

The high pace of urbanization in the Palestinian territory in general, and specifically in the study area after 1993, and the land changes are responsible for the beginning of landscape fragmentation with its associated negative outcomes, which was characterized by a period of rapid changes according to a number of studies such as (Samar et al. 2018). Samar study focused on the landscape changes in Ramallah City by using Fragstat tool and found that Ramallah city landscape has been changed during the period between 1994 and 2014 because of the rapid urban growth at the expense of greenery areas (i.e., trees and shrub).

In the same track, few studies have addressed the influence of urban expansion on landscape fragmentation in the study area. For example (Samer 2015) has analyzed land use changes in Ramallah metropolitan during 1990 and 2003; the analysis based on urban expansion increase and utilized aerial photos analysis to quantify the changes by using GIS and Remote Sensing. The study revealed that the impact of the Israeli limitations and obstacles on Palestinian urban expansion, which accelerated fragmentation more into the greenery areas.

However, increasing the urbanized areas and the anthropogenic activities resulted to landscape fragmentation that has converted larger areas of natural landscape into smaller and isolated areas.

Though, the lack of spatial statistical analysis on the land use as well as landscape changes are considered as one of most important field information of urban studies for Ramallah area. This study has fostered the spatial statistical analysis to bridge the gap lack of spatial analysis for the study area, but more studies need to be achieved in the near future about the urban development and its implications.

Moreover, not many researches and studies have focused on addressing the main drivers that led to the landscape fragmentation. Therefore, more studies need to interlinked these drivers to give an answer for the rapid pace of urbanization that affected adversely on the study area landscape.

Precisely, the critical questions of the study are: what is the land use is and landscape changes that happened on the study area the last two decades, and what are the drivers that led to those changes. Towards this, the study aims to quantify the landscape fragmentation of the study area based on land use changes, the landscape patterns change over the time, and to identify the main drivers responsible for the fragmentation process.

MATERIALS AND METHODS

Study Area

The study area is comprised of three adjacent cities: Ramallah, Al-bireh, and Betunia. The total area is about 188,2 hectares (Fig. 1) and the population is 200,000 (Ramallah Area Municipality 2017), or nearly two-thirds of the 328,861 inhabitants who live in the Ramallah district (PCBS 2018). The study area experienced land use changes, which fragmented the landscape and affected the vegetation cover through human-driven changes such as urban development.

A number of Israeli colonies and military bases are surrounding the study area. The area is about 800 meters above sea level. This area has a Mediterranean climate, with an average annual rainfall of about 600 mm, between the months of December and February. The average annual temperature is about 17 c°, and the warmest months are July and August. In addition, the area is characterized by topographic variation in terms of elevation and slope aspects, which are western and eastern slopes. Terrarosa soil with limestone and dolomite origin covered the study area. The fertile soils combined with the Mediterranean Sea climate, makes most of the land in the study area suitable for agriculture.

The region had a mixed vegetation cover including olive groves, forest, agricultural land…etc. Historically, the number of populations has been affected by internal migration due to political conflicts between the Israelis and the Palestinians (1948 and 1967 war).

The population of the area increased about three times from 9,250 in 1945 to 31,485 inhabitants in 1961. This increase coincided with the return of the Palestinian Authority in 1993, as well as, the emerging trend of internal migration due to the centralization of Palestinian governmental institutions and the private sectors in this area. In addition, the number of the population increased to be 103,335 inhabitants in 2015 (PBCS 2015), but if compared with the number provided by the municipalities of the three cities, it is estimated to be more than 200,000 inhabitants.

In 2017, the number increased rapidly, due to the high pace of internal migration after 1997, which accompanied a high rate of urban development that changed agricultural landscape into urban landscape.

Methodology

The study used two sets of aerial photos (1997: cell size 1.25 and 2017: 0.25) to detect changes in urban area, supervised aerial photo analysis of different land use elements in 1997 and 2017. The different land use elements were extracted from aerial photos. Urban land is classified as (Unattractive Indicators) which includes residential dwelling and excludes yards, sidewalks, transportation, and industrial areas. While, agriculture/Natural vegetation land, Natural grassland, Forest and olives groves are classified as (Attractive Indicators). This classification is according to the Ministry of Local Government.

The study used geographic information system (GIS-ArcMap 10.5) tool to detect the past and the actual land use changes that have occurred over the specific period to quantify different land use pattern and characteristics (size, shape, perimeter etc…). The Ministry of Local Government has provided the researcher with the tow aerial photos.

The land-use maps production of the study area depended on the direct and visual interpretation of the 1997 and 2017 aerial photos by digitizing the completely targeted area for two class of land-use urban area and green area, where the extracted data was manually transferred to base maps of

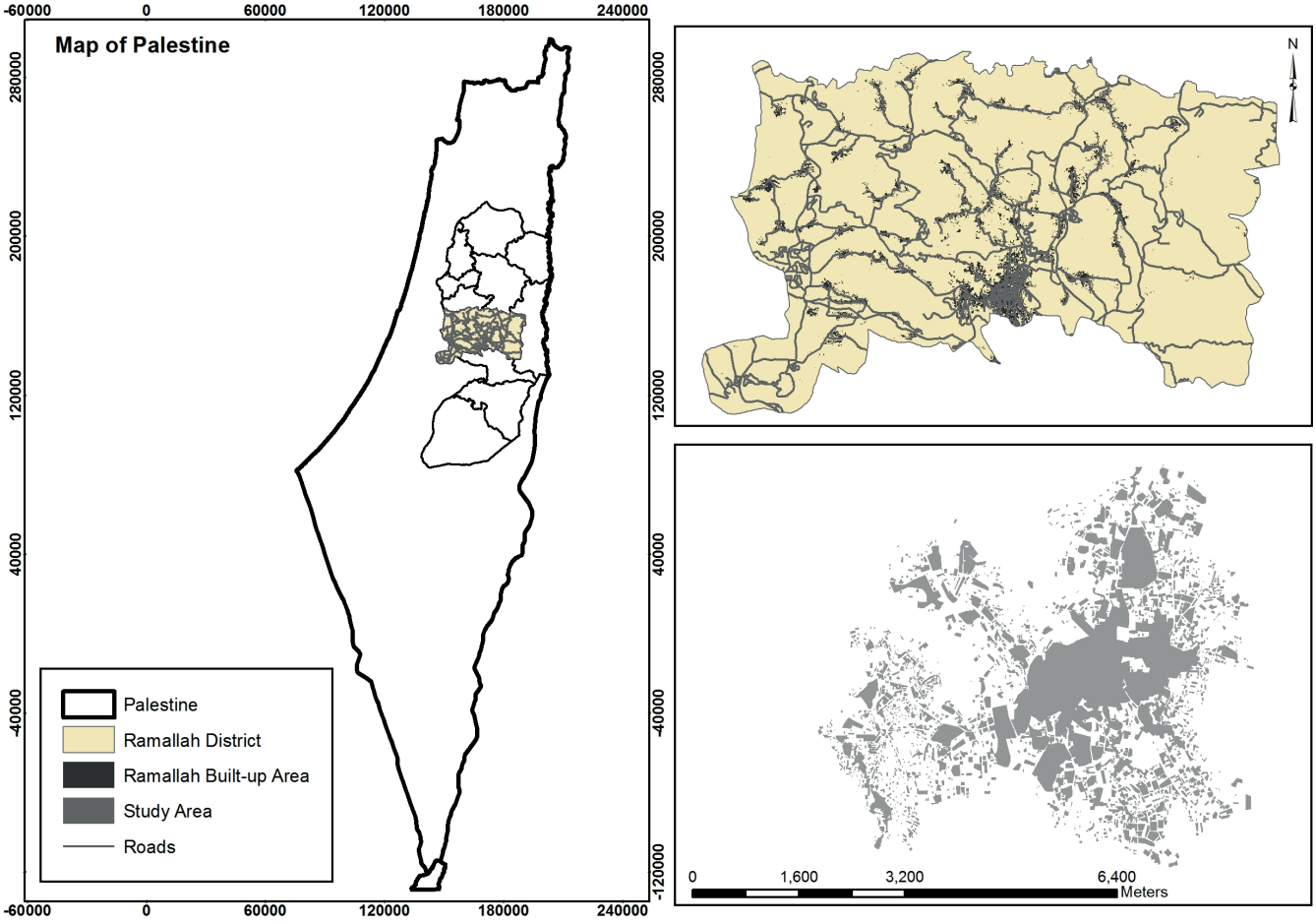


Fig. 1. Location of the study area (source: Department of Geography-Birzeit University)

the previous land-use classes. The ground truth verification method used through three field visits were conducted to ensure accuracy of the process of land-use analysis, and to obtain more data about the land use classes. The attribute data was used for the spatial pattern analysis and to produce several maps.

Generally, the research carried out by three stages: Data collection (Literature review, aerial photos and feature class), Data processing (digitizing, tabulation…) and Data analysis (landscape metrics…) (Table 1).

The land-use maps of the study area interpreted using the ground truth visual interpretation of the 1997 and 2017 aerial photos, where the extracted data was manually transferred to base maps of the various land-use classes. In this technique of ground truth verification, the number of field visits were done to ensure accuracy of the process of land-use analysis, and to obtain more data. The attribute data was used for the spatial pattern analysis and to produce several maps.

In order to follow up on the land-use changes and facilitate analysis, the study area was divided into two main classes: Green and Urban land-use. The green area was classified to four sub-classes as mentioned previously. The Fragstats program which is regarded as a spatial statistical program to measure the landscape fragmentation (Batty 1999) and (Baker 1989) and its characteristics by landscape metrics (Keles et al. 2008) and (Li X et al. 2001), was used to measure the landscape fragmentation using the patches-dynamics approach. These metrics and their acronyms are as follows:

NP: Number of Patches
PD: Patch Density
ED: Edge Density
LPI: large patch index
LSI: Landscape Shape Index
P.M: Perimeter Mean
F-Index: Fraction Dimension Index

RESULTS AND DISCUSSION

Land-use Aggregation

In 1997 the agriculture land use covered about 40 percent of the total study area (Fig. 1). The agricultural/natural vegetation cover has been badly changed in correspondence to the increase of the urban land-use, as it decreased from 40 percent of the total surface area in 1997 to 32 percent in 2017, whereas natural grassland decreased from 10.4 percent in 1997 to 8.3 percent in 2017 (Fig. 2). Thus, urban land-use increased from 38.75 percent in 1997, to about 51 percent in 2017. Generally, land-use showed a general trend of increasing urban land-use and decreasing agricultural area between 1997 and 2017. As a result, 2017 is dominated by mixed agricultural/non-agricultural land and urban/sub urban agglomerations.

This analysis indicates that the mean area of the urban agglomeration significantly increased due to the urban development that converted agricultural land to urban land in a short span of time, which also characterized the new pattern in the past two decades. The accelerated process of urbanization helped in decreasing the residents' awareness towards the importance of the agricultural land. 82 percent of respondents ensured that this change is connected to the anthropogenic driver that is related to the high value of land for a commercial purpose rather than an agricultural purpose, for example the price of 1m^2 of commercial land is estimated to be more than $500 in some part of the study area.

Table 1. The Study Data

Data Collection	Format	Data Processing	Data Analysis
Aerial Photo 1997, 1.25*1.25	Raster	Input Data	-
Aerial Photo 2017, 0.25*0.25	Raster	Input Data	-
Land use feature class: 1997 and 2017	Vector	Digitizing ArcGIS	Visual Interpretation
Land use feature class: 1997 and 2017	Vector	Tabulation ArcGIS	Classification
Land use feature class: 1997 and 2017	Raster	Rasterization ArcGIS	Raster Map of land use
Land use Map: 1997, 2017	Raster	Fragstat Software	Output file: Landscape Metrics, PN, PD i.e….

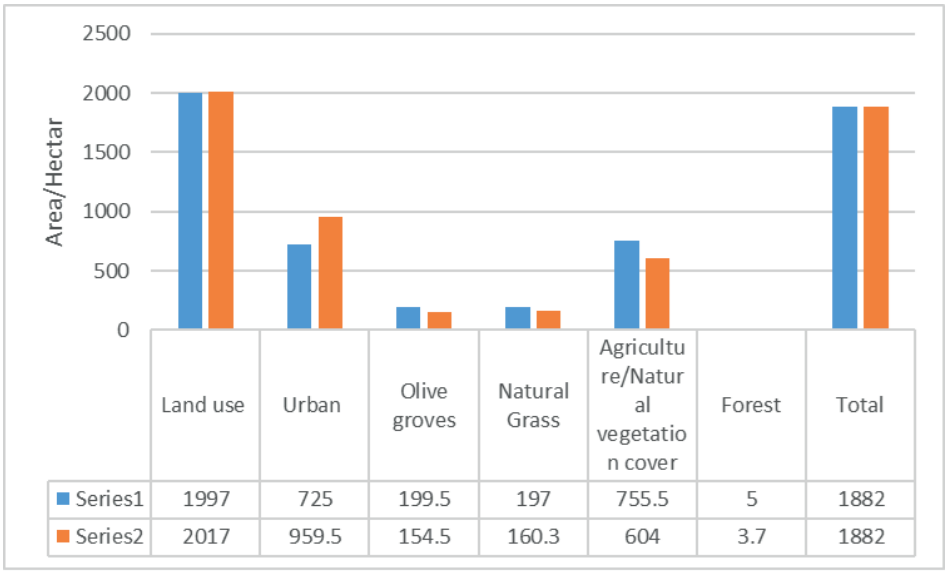


Fig. 2. Area of different Land-uses (Hectare) in 1997 and 2017

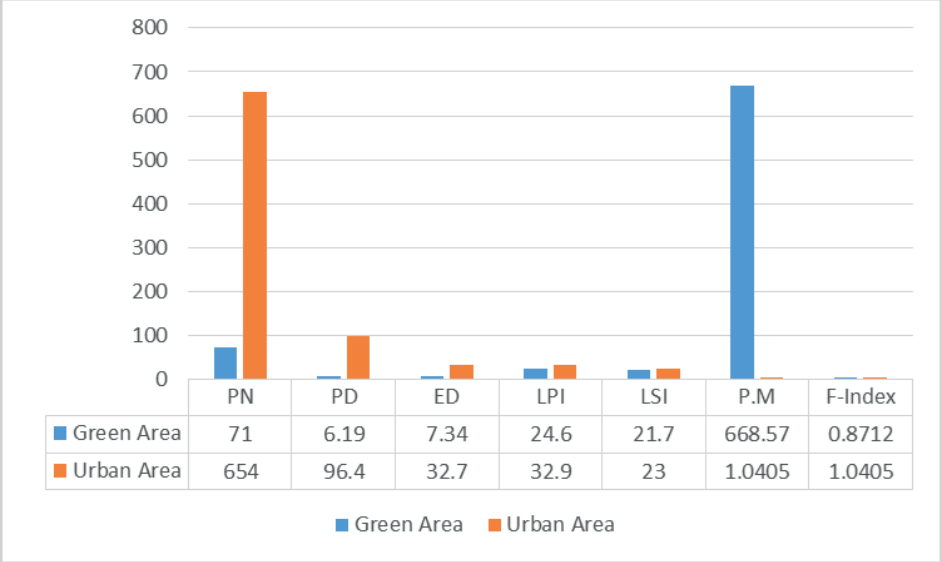
Forested land decreased by about 0.05 percent due to the urban development; particularly in some areas, that has biodiversity. Forest area also decreased by about 26 percent in favor of urban areas. Despite these negative changes in the green areas, the municipality has attempted to save the rest of the forest part by creating a public park for local residents.

Fragmentation Analysis

Spatial analysis of the landscape from 1997 to 2017 indicates that there is a trend of increasing urban area and at the same time decreasing green area. Agricultural land experienced the largest decrease of about 25 percent, with an increase of urban area of about 13 percent. Urban area constitutes the dominant class of landscape with about 51 percent in 2017 compared to 38.5 percent in 1997.

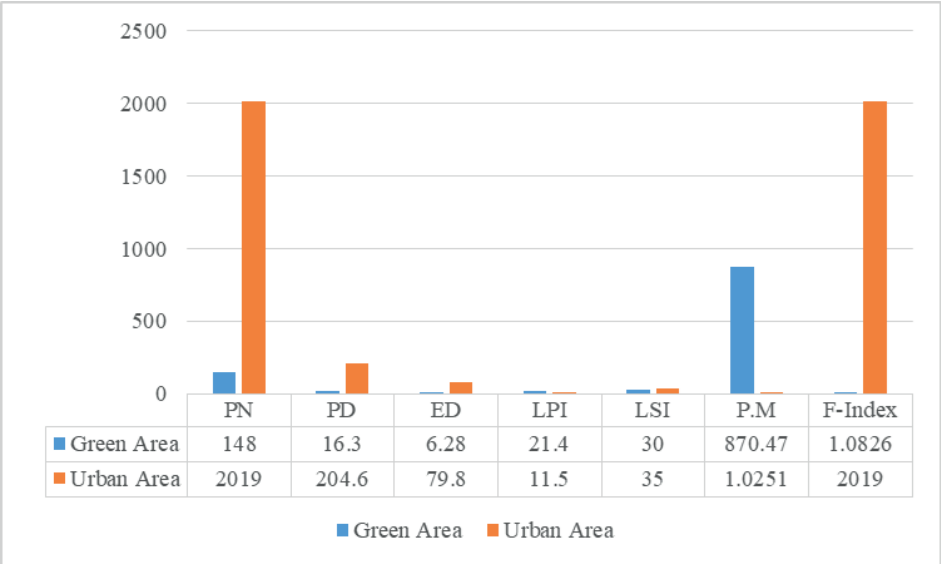
According to the spatial analysis of Fragstat, the number of patches of urban area has increased from 654 patches in 1997 to 2,019 in 2017, whereas the green area increased from 71 patches in 1997 to 148 patches in 2017. The increase in the number of green area patches could indicate that the landscape has fragmented even more than before. The raising number of patches could also mean an increase in the urban development through increasing patches of the built-up area surface that adversely impacted on the green landscape, which has been linked to a number of environmental consequences, particularly on the agricultural system of the area, such as land degradation due to dividing the land (Fig. 3 and Fig. 4).

However, in depth, analysis shows that the degree of fragmentation of the green area has increased, merely due to the urban expansion. Therefore, the number of patches of the green area has increased to about 148 patches, which is considered to be of high level regardless of the surface area. The fragmentation index was 0.8712 in 1997 against 1.0826 in 2017. In addition, the edge density has decreased from 7.34.6 in 1997 to 6.28 in 2017, in relation to the declines of the largest patch index from 24.6 in 1997 to 21.4 in 2017. The analysis shows also a relative increase in landscape shape index from 21.7 in 1997 to 30 in 2017, which is linked with the increasing number of patches accompanied with an increase into the perimeter and its shapes of the green areas. All these metrics indicate that the green area has fragmented, because of the urban development process. While the increase in heterogeneity of the urban landscape by an incremental rise has taken the urban sprawl pattern. This is obvious from the fragmentation index of urban area that has decreased from 1.0405 in 1997 to 1.0251 in 2017, and at the same time becoming more dominant. Hence, all these indices indicate that there is a decline in the green landscape heterogeneity and it has become more dispersion (Fig. 5 and Fig. 6). The



	PN	PD	ED	LPI	LSI	P.M	F-Index
Green Area	71	6.19	7.34	24.6	21.7	668.57	0.8712
Urban Area	654	96.4	32.7	32.9	23	1.0405	1.0405

Fig. 3. Spatial landscape analysis for 1997



	PN	PD	ED	LPI	LSI	P.M	F-Index
Green Area	148	16.3	6.28	21.4	30	870.47	1.0826
Urban Area	2019	204.6	79.8	11.5	35	1.0251	2019

Fig. 4. Spatial Landscape Analysis for 2017

patch perimeter (area ratio) also increased from 668.57 to 870.47 in the same period 1997 and 2017. This increase is strongly correlated to an increase in landscape shape index of the green area that reached 30 in 2017, considering it as another indicator for the landscape fragmentation that is strongly related to the decline of green land, especially the agriculture/natural vegetation land with 112 percent increase, which can be attributed to dividing large patches into smaller ones. These indices asserted that the decrease of the green land was driven by high rate of urban development.

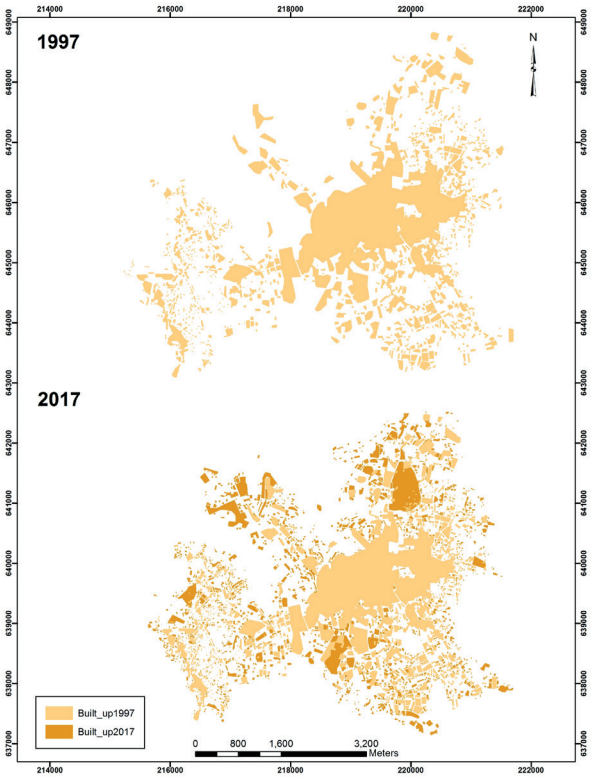


Fig. 5. Urban Area Distribution 1997-2017

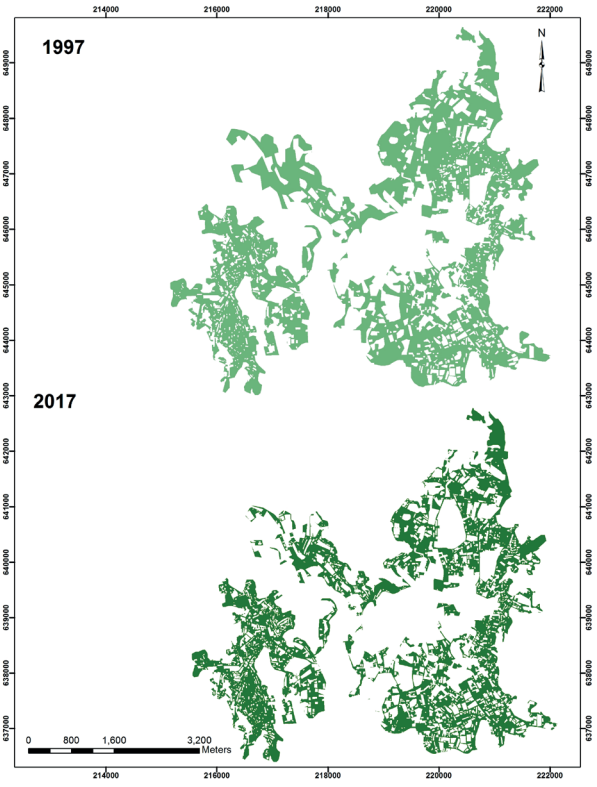


Fig. 6. Green Area Distribution 1997-2017

The analysis also showed that the patches density (PD) increased in the urban area from 96.4 in 1997 to 204.6 in 2017, this indicates that the landscape fragmentation is at a higher level. At the same time, there was an increase in PD for the green area from 6.19 in 1997 to 16.03 in 2017. In addition, the landscape Patch Index (LPI) was 32.9 in 1997, while 11.5 in 2017, and the landscape shape index (LSI) was 23 in 1997 and it increased to 35 in 2017. The main conclusion is that the combination of these analysis of indices (an increase in NP, PD and LSI, whereas a decrease in LPI) lead to a more fragmented landscape between 1997 and 2017, as well as smaller patches. While the increase in patches density indicates a more fragmented landscape Forman and Gordon (1981) Furthermore, the edge density ED is also related to the patch area; it was recorded 32.7 in 1997 and increased to 79.8 in 2017 for urban area. This increase in ED strongly supported the assumption of the fragmentation of landscape. As a result of this landscape fragmentation, the landscape fragmentation index affirmed increased from 1.0498 in 1997 to 1.0554 in 2017 (Fig. 7).

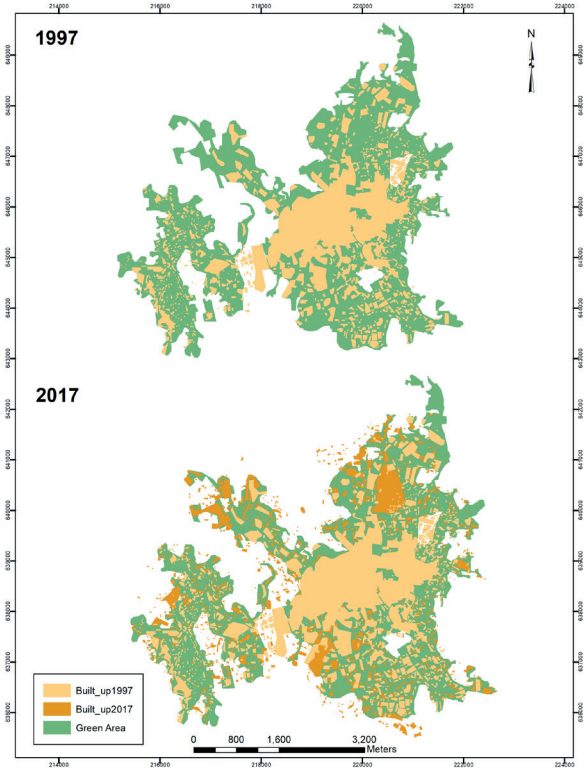


Fig. 7. Land-use Distribution during 1997 and 2017

Acceleration of urban expansion is the main trend that led to the dominance of urban landscape. Due to the increase of the number of edges through increasing LSI to 23, the landscape became more complex. However, as mentioned previously, the current urban landscape is characterized by urban sprawl pattern and leapfrog pattern towards the fringes, more dispersed alongside the transportation arteries, surrounding the core (centre) area and in adjacent rural areas.

Moreover, the landscape fragmentation has affected adversely the environment of the study area. For example, the abandonment of agricultural land, especially in sloppy areas, has increased the risk of soil erosion, which is evident from field visits. This resulted in a decrease in soil fertility that affected the natural vegetation, where some plants have either disappeared or decreased (i.e., Salvia officinalis, Thymus vulgaris, and Matricaria chamomile).

Generally speaking, the landscape of the study area has shown an increase in the urban land at the expense of a decrease in each class of green land, and the continuity and unity pattern of urban land-use indicates that this land-use has become dominant in the study area. Thus, rapid rate of urban development resulted in rapid rate of landscape fragmentation with associated decrease in the green area that was replaced with the urban surfaces.

Drivers of landscape Fragmentation

Agricultural and natural vegetation classes were more affected than other class. The surface area decreased from 755.5 hectare in 1997 to 604 hectare in 2017. The number of patches and fragmentation index are both divided into smaller units. This could refer to a number of drivers, which can be consider as key driver of landscape fragmentation: as following

Ramallah's strategic and unique geographical location, along with its closeness to Jerusalem, were among the strongest reasons for choosing Ramallah to be administrative and political centre for the Palestinian Authority in the mid-1990s (Harker 2014). This is accompanied with the increasing rate of population due to returnees and inside immigration. The increase in population necessitated dramatic increase in the number of residential dwellings that have been built the last 20 years. All of these changes have confronted unduly with the available land.

The rise of population was a primary driver of land use change in this period. Statistics revealed, the population number of the Ramallah area was about 55,380 inhabitants in 1997 (PCBS 2011 (while it reached 200,000 inhabitants in 2017 (Municipalities statistics 2018). The rapid population increase followed a high demand on land to accommodate people created an increase of about 54 percent in the built-up area which occurred during the 1997 to 2017.

Furthermore, the political conditions are an important driver that reshaped the landscape of the study area through restrictions to different lands that is being exerted by the Israelis, resulting in either accelerating or decelerating the changes in landscape. The analysis revealed that there are two colonies adjacent to the study area on northeast direction, a military base on south-west direction and the separation wall on south-west and south direction. These political restrictions enhanced building in certain direction and prevented in other directions, hence, created a densely urban area in certain directions more than others at the expense of agricultural lands.

One the main driver of Ramallah's urban development came from the 1993 peace prosses of Oslo. The Oslo Accord allowed Palestinian members of the PLO (Palestinian Liberation Movement), who were exiled, to return to Palestine and allowed them authority over the West Bank and Gaza Strip. The Palestinian Authority choose Ramallah as the core center amongst the other cities of the West Bank that let it grow.

The urbanization rate in the city increased from 37.3% in 1950, to more than 60% in 2005. Studies also had shown that Ramallah area had 32% of the total governorate population resided. Ramallah has become a very crowded due to the large increase and its limited area. The city is a main urbanized and political center in Palestine as well as having the first highest rate of internal migration, which makes it geographically, economically and centralized important in the West Bank (MAS 2008).

This rapid suburb expansion appeared between 1993 and 2015, and it is known as the boom years. More than other directions in the city, the northwest has seen the most growth. Furthermore, the population of Ramallah area has soared due to the urban-urban and rural-urban internal migration. Some of the benefits of this rapid growth was for land traders and to the real estate sector, not to forget profitable and rapid income all in which accelerated the pace of the urban development process.

The Oslo Accord had stated that the Palestinian areas are to be divided into three geopolitical areas (A, B and C). Ramallah area is divided under area 'A', which gives full control by Palestinian Authority.

However, the restrictions that are imposed by the Israelis in area 'C' (the Israeli have full control, which is 60% of the total land of the West Bank) have significant consequences for both areas 'A' and 'B' where over 90% of the Palestinians reside (The World Bank 2013), also according to the World Bank report; the Palestinian side has a scarcity on land affordability to meet the urban growing need due to the prevention of urban expansion into area 'C' that ended with further strain on land in area 'A' and 'B'.

Furthermore, the political conditions are an important driver that reshaped the landscape of the study area through restrictions to different lands that is being exerted by the Israelis, resulting in either accelerating or decelerating the changes in landscape. The analysis revealed that there are two colonies adjacent to the study area on northeast direction, a military base on south-west direction and the separation wall on south-west and south direction. These political restrictions enhanced building in certain direction and prevented in other directions, hence, created a densely urban area in certain directions more than others at the expense of agricultural lands.

Moreover, due to the lack of awareness of the rapid process of urbanization in the West Bank generally and in the study area particularity, adding the absence of legislations or its implementation, landscape fragmentation had noticeably increased.

CONCLUSIONS

This study represents a process of utilizing Fragstat method to measure the land-use changes, from green areas to urban aggregate, which caused landscape fragmentation. This work was achieved by comparing between two aerial photos during the periods between 1997 and 2017. The visual interpretation of aerial photos found that different agricultural land-use has decreased as a green area, against the increase in the urban land-use. During 1997 and 2017, the spatial statistical analysis indicates that the area has fragmented even more.

In the case of the Ramallah area, the observed pattern became the white stone landscape. The geopolitical factor after 1993 followed by high rate of cadastral investments may have provided the main factors for urban development of the study area, thus fragmented the landscape.

However, the process of urban development (Urbanization) was associated with the decrease of general vegetation cover. This finding asserted that the urban development affects adversely on the vegetation cover during 1997 and 2017, at an unpresented scale and more than ever.

It is concluded that there has been a considerable landscape fragmentation by land-use changes. Due to different factors, as well as, the most important population growth, that have posed many challenges at the scale of land-use management and planning, proper planning might have helped to limit the agricultural land decrease.

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