The Impact of Syrian Crisis on the Forestry Areas in North Latakia Governorate

Ilene Mahfoud*(1)

(1). Forestry and Ecology Department, Faculty of Agriculture, Tishreen University, Latakia, Syria.
(*Corresponding author: Dr. Illene Mahfoud. E-Mail: mahfoudilene@gmail.com).

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Abstract

This study aimed to estimate the forest sector losses in the north of Lattakia Governorate, as a result of terrorist attacks during the Syrian crisis, that started in March 2011. Three aerial photographs were used with spatial resolution ranged between 30 cm and 50 cm, for the years 2011, 2014 and 2016. The visual interpretation technique was applied to identify the forest types in studied sites. The results showed that the forests occupied about 5022 ha, 12708 ha and 4387 ha in Qastal Maaf, Rabia, and Ain Eido, respectively in 2011. These superficies decreased to 2581 ha, 3568 ha and 1010 ha respectively in 2016. The fires that occurred during the crisis period devoured about 5439 ha in 2014, and about 16077 ha in 2016, in addition to the forests that were slightly affected by the fires, which reached 4476 ha in 2016. In terms of the remaining forests and degraded forestry areas, which represents the main forestry areas in Lattakia in particular and in general in Syria, attained only 21427 hectares, or 51% of what was in 2011, before the crisis.

Keys words: Lattakia Forestry, Fires, Aerial photographs, Visual interpretation.

Introduction:

War and terrorism have a considerable environmental impact by altering urban and rural landscapes (Mannion, 2003). A terrorist could easily ignite several massive wildfires to severely damage regional economies, military forces, and terrorize the population, this phenomenon is defined as pyro-terrorism; the use of arson attacks to terrorize the civilian population and coerce the government to advance political or social objectives (Baird, 2005). Whereas future pyro-terrorist attacks may seem to target city centers, the major threat remains to be forested areas (Sheppard, 2017). Mukherjee and Gupta (2006) indicated that many terrorist organizations around the world seek shelter in forests and this phenomenon has an impact on forest conservation. So it is important to measure the forest loss when a terrorist lives in the forest and has full control over the forest resources, especially when the government tries to combat them.

The document of nationally determined contributions within the framework of the Paris Climate Agreement (2018) indicated that, in Syria, the natural forests had formed 32% of the total country territory at the beginning of the last century, but it gradually deteriorated until it reached less than 3% of the country area, due to the effect of successive droughts and the natural fires, in addition to forest sites encroachment. Forest cover in Syria suffered significant damage during the period 2011-2016 due

to natural factors, however the biggest damage was due to the current crisis (Fifth national report of the Convention on Biological Diversity, 2016).

The forest areas in Lattakia Governorate is not precisely defined, according to the Ministry of Agriculture, it reachs 85,000 hectares, representing about 37% of Lattakia area, which is 240697 hectares, and they are mainly concentrated in the north and east of the governorate. A statistical data published on Mongabay website indicated that the area of forest cover in Lattakia was about 54572 ha, 60249 ha and 52928 ha in 2000, 2010 and 2018 respectively. It was also indicated that about 3380 hectares of forest areas, in which the trees coverage exceeds 30 %, was lost in Lattakia Governorate between 2001 and 2010 (about 6% of Lattakia forests). Whereas about 7366 hectares of forest areas were lost between 2010 and 2018. But this statistic seems inaccurate, for instance, in 2012, the area of the burned forest reached 10699 hectares, two fires in Lattakia governorate, the area was greater than 1000 hectares, near the borders with the occupied Iskenderun District (Joint Research Center, 2012), in this year, the fires moved across the border and burned 2218 ha in the occupied territory by Turkey (Atasoy and Gecen, 2014). As for the records of the Forestry Department in Lattakia (2020), the burned area between 2000 and 2010 was about 3298 hectares, and these areas increased during the period 2011-2018 to reach 11,092 hectares.

Aerial photographs and high-resolution satellite imageries currently allow defining the forest areas, its distributions in the place and its changes over time, in other words, allowing to identify changes in forest cover at the temporal and spatial levels (Kumar, 2011). The visual interpretation of aerial photographs and high-resolution satellite imagery is one of the methods used to obtain information on landscapes, which is a specific process that relies on the detection, spatial identification, characterization of phenomena and terrestrial shapes captured (Svatonova, 2016). This technique is simple, inexpensive, and gives accurate results (Sivakumar, 2010). The visual interpretation depends on elements such as the phenomenon shape on the imagery and its size, as well as the spatial arrangement of the phenomenon components that give it a distinctive shape, the color of the phenomenon and the texture with which it appears on the imagery (Sivakumar, 2010).

In fact, to this day there is no accurate estimation of the forest areas that have been deteriorating as a direct and indirect consequence of the terrorist attack that began in 2011. Therefore, this research aims to monitor changes in the forest cover of the most important forest areas in Lattakia Governorate (Qastal Maaf, Rabia and Ain Eido) at the spatial and temporal levels, and to estimate the forest loss because of the terrorist attacks during the period 2011-2016.

Materials and Methods:

1- Study site:

The study was carried out in north Lattakia, in three forest areas (Qastal Maaf, Rabia and Ain Eido), which represent the main forests in Lattakia Governorate (Figure 1). The studied forests are composed of major populations, the most important of that are the *Pinus brutia* forests, then maquis of Palestine oak (*Quercus calliprinos*) which are common and rarely form a forest because the great encroachments on its populations to get the industrial coal and many other uses. The *Quercus cerris subsp. pseudocerris* populations are also distributed as patches scattered within the Brutia pine forests like Fronloq forests. In view of the prevailing climate changes in the region and terrorist increase, the rate of fire increased during the study period compared to previous years. The number of agricultural fires

has also increased dramatically, as a consequence of farmers neglecting their lands, and the fires have spread to neighboring forest areas.

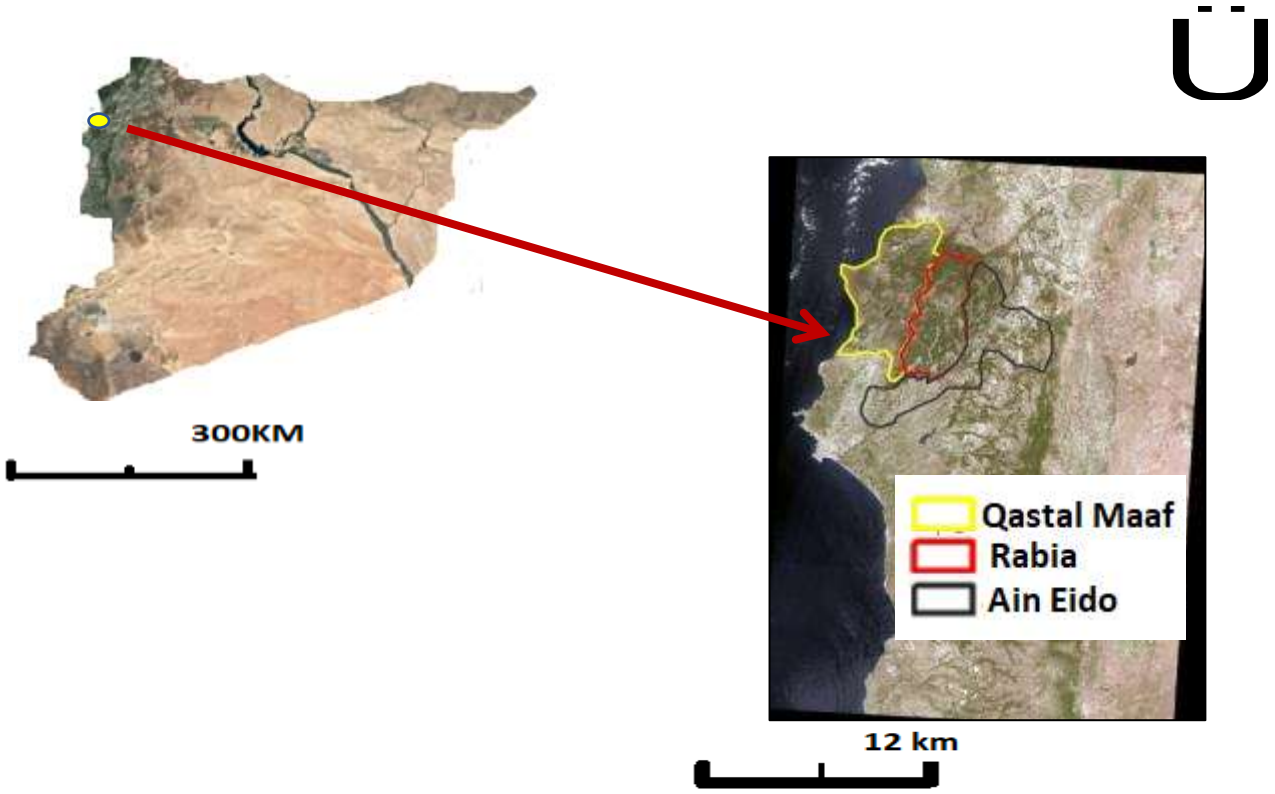


Figure 1. The studied forestry areas in Lattakia Governorate.

In this study, three aerial photographs of Lattakia were used, they were taken on 2011, 2014 and 2016, with resolution of 50 cm, 30 cm and 40 cm respectively.

A cartographic databases of Lattakia forest areas, as well as land use of the Syrian coast (2006) and (2011), were also used, these databases are realized by the General Organization of Remote Sensing (GORS). The visual interpretation technique was applied to identify the different forest types of studied areas on the aerial photographs using ArcGIS 10.3, 6 different forest types according to the report the Global Forest Resources Assessment 2000 (FRA, 2000) were identified as follows (Figure 2) :

- Forest **(F)**: trees cover more than 40% of the observed area.
- Degraded Forest **(DF)**: trees cover between 10 % and 40% of the observed area.
- Opened Forest **(OF)**: trees cover less than 10% of the observed area.
- Burnt Forest **(BF)** : the burned area of forest cover is more than 70% of the observed area.
- Forest Affected by Fire **(FAF)**: fires spread in form of small patches not exceeding 20% of the observed area.
- New Artificial Afforestation **(NAA)**: the observed area appears on the aerial imagery is occupied by new pure afforestation.
- Terraced area **(TA)**: the observed area appears on the aerial photography in form of terraces occupied or not occupied by forest cover, on condition that they do not represent agricultural areas.

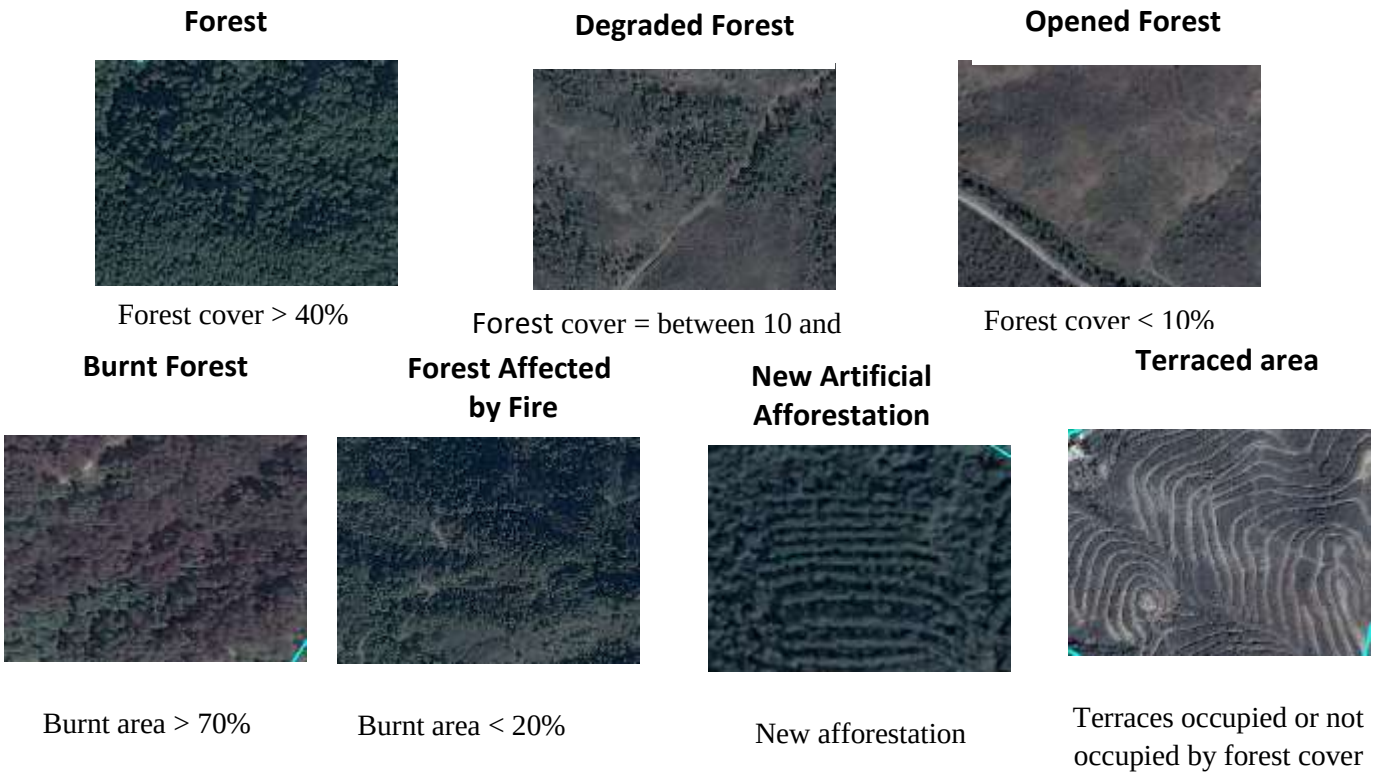


Figure 2. The studied forest types in north Lattakia.

Three land cover maps were established for the forests of Qastal Maaf, Rabia and Ain Eido, in applying the visual interpretation technique to the studied photographs using ArcGIS10.3 software. The area occupied by each type was calculated for studied years, the forest cover changes and its spatial distribution during the studied period were also analyzed.

Results and Discussion:

Three land cover maps were gotten for Qastal Maaf forests, in 2011, 2014 and 2016 (Figure 3: A, B, C), the obtained maps show the distribution of the studied forest types in Qastal forests. The land cover map of 2011 shows that the total forest areas in Qastal reached 19925 ha, the surface occupied by the forest type was about 5022.4 ha (Figure 3: D), which represents 25% of the total area of Qastal forests (Figure 3: E). It is also observed that the degraded forest occupied the largest area of Qastal forests, which was about 10307.4 ha (51%), while the opened forest area reached 3483.4 ha (17%) (Figure 3: D, E). As it is observed that no burnt forest or forest affected by fire were done, and the remaining forests of Qastal has been distributed between new artificial afforestation (77.7 ha) and terraced area (1397.2 ha) (Figure 3: D).

The land cover map of 2014 shows the outbreak of fires in the northeast of the Qastal forests due to the military operations (Figure 3: B), and these fires caused a loss of about 2218.2 ha or 11% of the total area of Qastal forests, while the area of forest affected by the fire was 1435.2 ha or 7% of the total area of Qastal forests (Figure 3: D, E). As these fires and those that preceded them caused a decrease in the area of the forest and degraded forest up to 15% (2993.3 ha) and 44 % (8731.8 ha) of the total area of Qastal forests respectively, While the proportion of opened forest observed in 2014 was decreased about 2 % compared to 2011, this is due to the residents migration from some area of Qastal, as a results of the terrorist attacks, which led to a very slight return to the vegetation in some sites

The land cover map of 2016 shows an expansion of fires towards the west and south areas (Figure 3: C), the forest areas damaged by fires has increased compared to 2014, as the burned areas reached about 4495.2 ha or 22% of total Qastal forests, and forests affected by fire are about 1108.1 ha or about 6 % of total Qastal forests. These fires have led to a slight decrease in the forest area and an important one in degraded forest, where it remained about 13% and 33% as forest and degraded forest respectively. While the opened forest areas has re-increased slightly compared to 2011 and 2014 (18% of total area), that is due to the fire spread at a large level in 2016. For the new artificial afforestation and the terraced area no important changes were observed, it is because the inability to afforestation and land reclamation in the prevailing conditions of terrorist attacks in this region.

For the studied forest types changes in Rabia during the studied years, it was remarked that change behavior was quite similar to that happened in Qastal Maaf. Rabia forests were the epicenter of terrorist attacks during the studied period. The land cover map of 2011 shows that the total forest areas in Rabia is about 15396 ha, the forest type had represented the largest proportion of its forests (82% or about 12708 hectares) (Figure 4: A, D,E), and thus Rabia was the main stock of forest in Latakia particularly, and therefor in Syria. Degraded forests occupied the second place with an area of 2614.7 ha (17%), the opened forest and terraced area come after with an area of 40.6 ha and 193.9 ha respectively (Figure 4: A, D, E).

The fires broke out in north Rabia in 2014, devouring about 2138 ha, and affecting another 609.4 ha. In 2016, the fires spread throughout the whole of Rabia, devouring again 6061.4 ha and affecting 1988 ha (Figure 4: B, C, D, E). So the forest area decreased up to 10197.7 ha in 2014 and to 3568 ha in 2016 (23% of total Rabia forests). The Degraded forests did not constitute large areas in the Rabia forest, as they decreased to 2140.8 ha in 2014, to rise again to 3575 ha in 2016, where they were mainly concentrated in the north of Rabia, and were often resulted from fires that happened between 2014 and 2016 (Figure 4: A, B, C,D,E).

As noted the opened area increased very low during the studied years, while the terraced area decreased from 139 ha (2011) to 37 ha (2016), and this is due to the return of vegetation to the reclaimed areas, which made them lose the shape of the terraces on aerial photograph. It was also noticed that there were no recent artificial afforestation in any of the studied years (Figure 4: A, B, C,D,E).

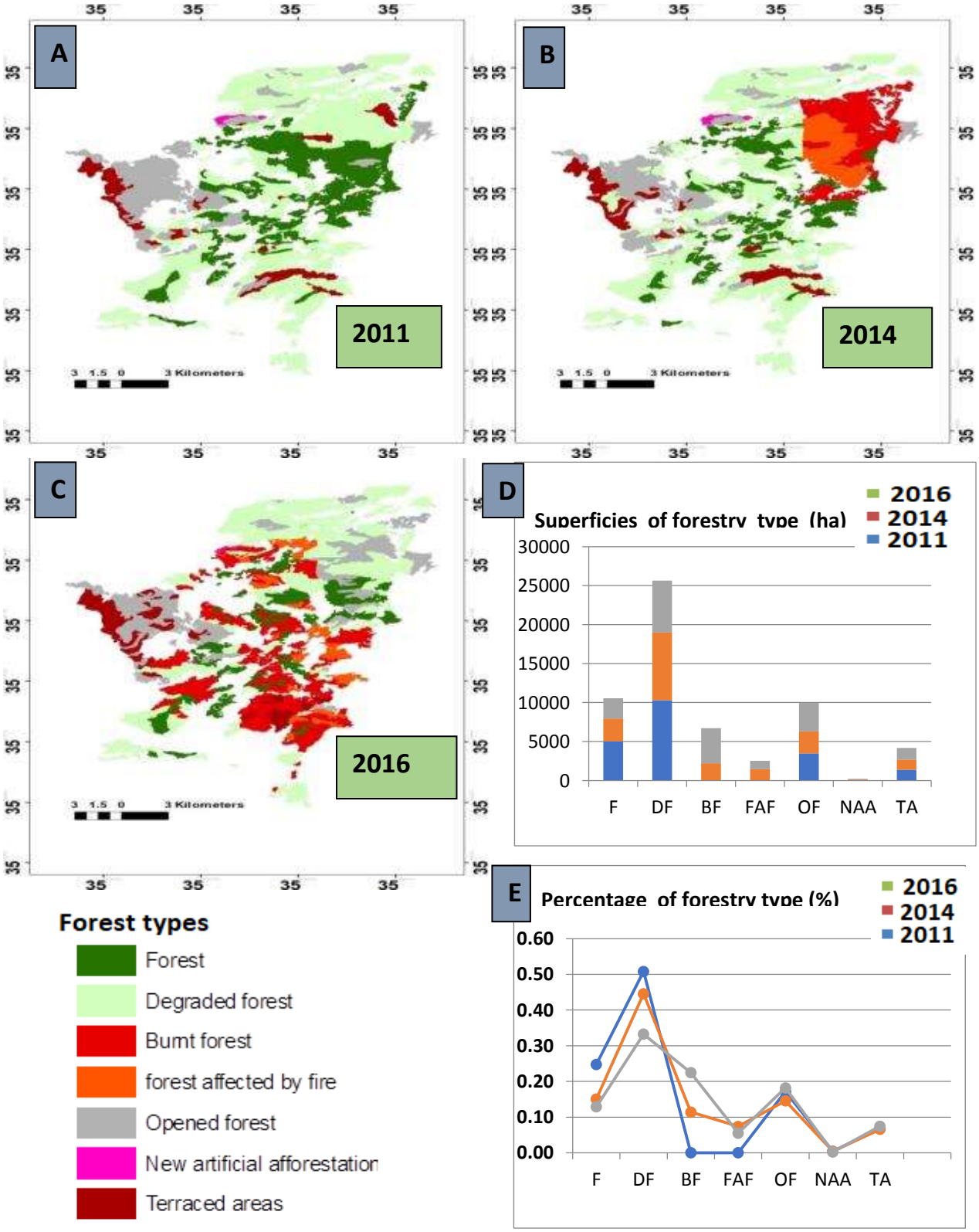
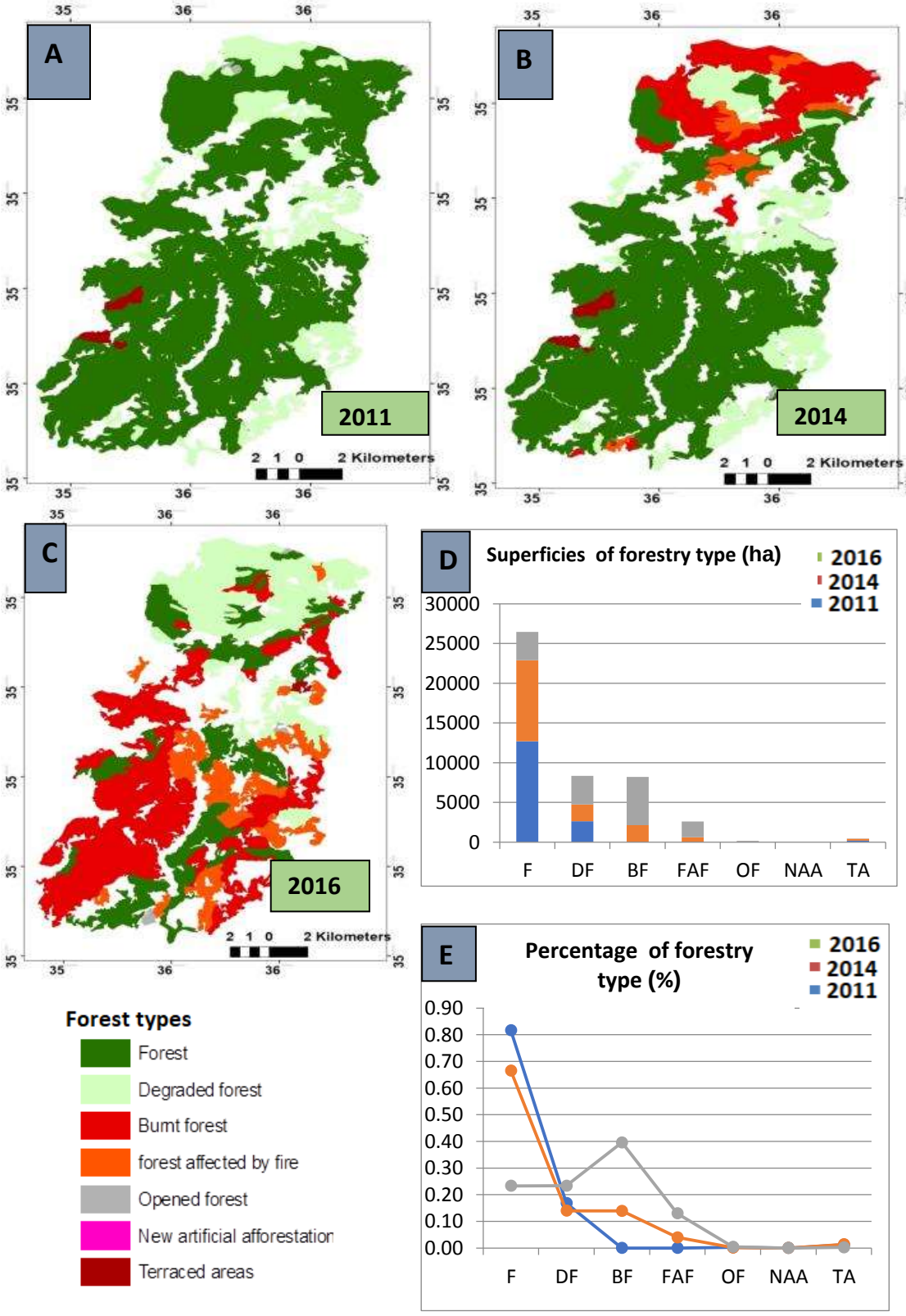


Figure 3. The Qastal Maaf forest cover changes during the period 2011-2016 (A, B and C), the superficie of forest types for studied years (D), The percentage of superficies occupied by each type for studied years (E).



igure 4. The Rabia's forests cover changes during the period 2011-2016 (A, B and C), the superficie of forest types for studied years (D), The percentage of superficie occupied by each type for studied years (E).

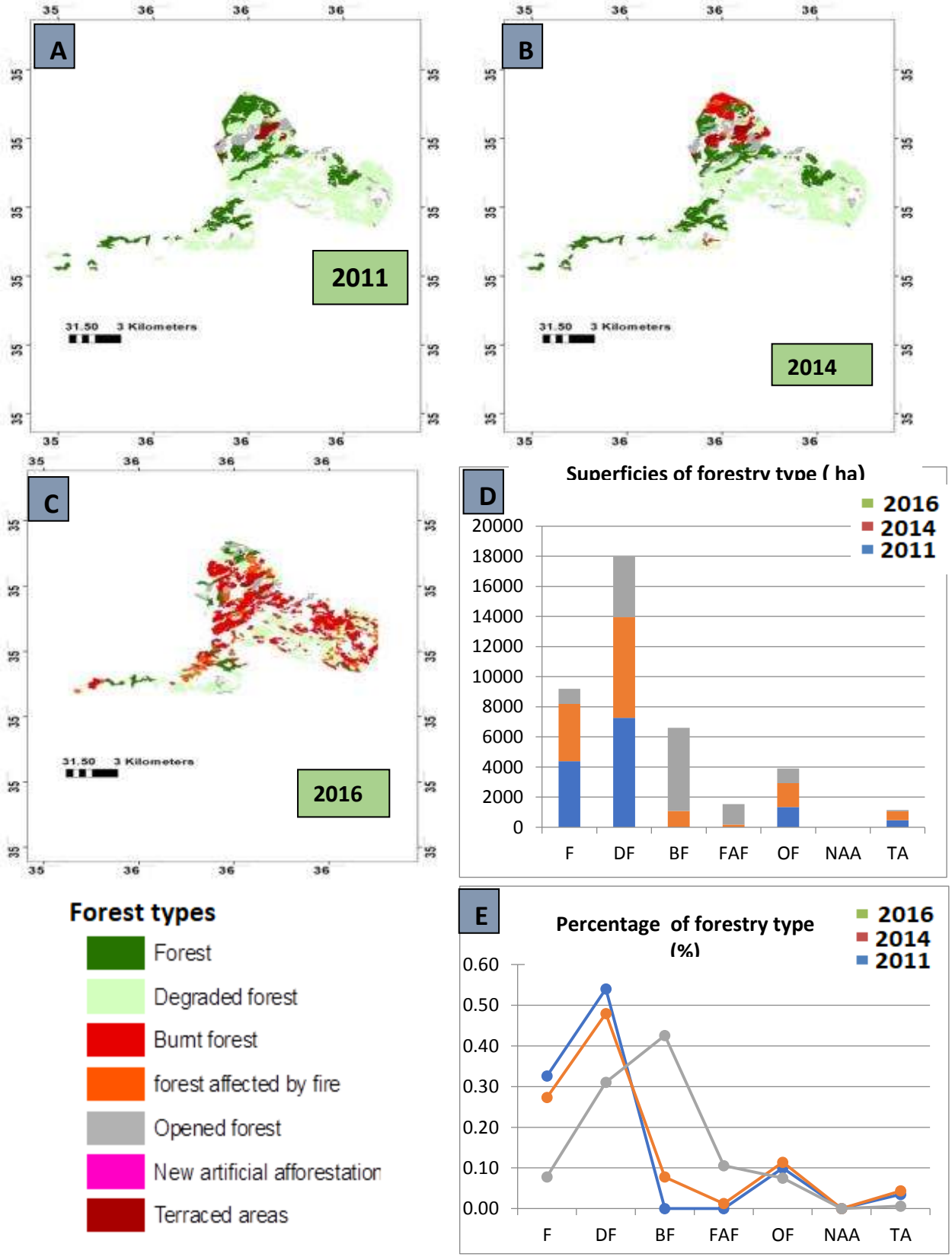


Figure 5. The Ain Eido forest cover changes during the period 2011-2016 (A, B and C), the superficie of forest types for studied years (D), The percentage of superficie occupied by each type for studied years (E).

Finally for Ain Eido forests, the total forest area is 13463 hectares in 2011, the figure 5: A, B, C, D and E clarifies that forest type occupied one third of the studied area in 2011, while degraded forestry occupied the largest area, which was about 54**%**, and opened forest was 10% of studied area, it is also observed that terraces were about 3**%**. On the other hand, it was not noticed any burned areas or recent afforestation.

In 2014, the fires were started in the north of studied area, that deteriorated about 8 % (1588 ha) and affected 1% (173.6 ha) of total studied area, forest and degraded forest superficies lowly decreased to 27 % and 48% respectively, opened forest, new afforestation and terraces superficies did not differ a lot that its in 2011 (Figure 5: A, B, C,D, E).

In 2016, as happened in the two previous studied areas, fires broke out all over Ain Eido forest as shown in the figure 5: C, where the fires caused a loss about 5520.7 ha (43%), and the forests which were slightly damaged by the fires, it reached 11% of the Ain Eido forests, resulting an important decrease in the percentage of forest and degraded forest of Ain Eido to reach up 8% and 31% respectively. The figure 5: E illustrate that opened forest and terraces did not differ much between the studied years, while no recent artificial afforestation was observed during the studied years.

Conclusion

Forest areas in the studied sites was about 49000 ha in 2011, these forests suffered significant losses during the period 2011-2016, The fires that occurred during the crisis period devoured about 5439.3 ha during the period 2011-2014, and reached about 16077 ha during the period 2011-2016. Forests of Rabia and Ain Eido were most damaged by the fires in 2014 and 2016 in comparison with Qastal Maaf forests. The forest type in 2011occupied about 5022 ha, 12708 ha and 4387 ha in Qastal Maaf, Rabia, and Ain Eido, respectively, these superficies decreased to 2932.3 ha, 10197.7 ha and 3805.5 ha in 2014, then to 2581 ha, 3568 ha and 1010 ha in 2016 respectively, in addition to the degraded forests, whose superficies reached up 6662.7 ha, 3575.7 ha and 4028.1 ha in 2016. So the remaining superficies of the forests and degraded forests, which represents the main forest areas in Lattakia in particular and generally in Syria in 2016, only 21427 hectares, or 51% of what was in 2011, before the crisis.

It should be noted that the statistics related to the burned areas may not represent a long-term loss at all times, as it was observed in field that the survival of some spots within these areas with the success of natural regeneration helps in a rapid return to the forest cover in the burned sites and if its return to what it was previously would need to many years later.

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تأثير الأزمة السورية على المناطق الحراجية في شمال محافظة اللاذقية

إيلين محفوض*(1)

(1). قسم البيئة والحراج، كلية الزراعة، جامعة تشرين، اللاذقية، سورية.

(*للمراسلة: د. إيلين محفوض. البريد الإلكتروني: mahfoudilene@gmail.com).

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الملخص

تهدف هذه الدراسة إلى تقدير خسائر القطاع الحراجي في شمال محافظة اللاذقية جراء الأعمال الإرهابية التي اندلعت في سورية منذ آذار 2011. تم استخدام ثلاث صور جوية بدقة مكانية تتراوح بين 30 سم و50 سم للأعوام 2011 و2014 و2016. تم تطبيق تقنية التفسير البصري لتحديد الأنماط الحراجية في المواقع المدروسة. أوضحت النتائج أن الغابات شغلت عام 2011 حوالي 5022 هكتاراً، 12708 هكتاراً و4387 هكتاراً في القسطل وربيعة وعين عيدو على التوالي. وانخفضت هذه المساحات عام 2016 إلى 2581 هكتاراً، 3568 هكتاراً و1010 هكتاراً على التوالي. التهمت الحرائق التي حدثت خلال فترة الأزمة حوالي 5439 هكتاراً عام 2014 ، وحوالي 16077 هكتاراً ، إضافة إلى المواقع التي تأثرت قليلاً بالحرائق، التي وصلت مساحتها إلى 4476 هكتاراً عام 2016. أما مساحة الغابات والمناطق الحراجية المتدهورة، والتي تمثل المنطقة الحراجية الرئيسية في اللاذقية على وجه الخصوص وفي سورية بشكل عام، فقد بلغت 21427 هكتارا فقط، أو 51٪ مما كانت عليه في عام 2011 قبل الأزمة.

الكلمات المفتاحية: حراج اللاذقية، الحرائق، صور جوية، التفسير البصري.