

# THE EXPANSION OF OLIVE GROWING AREAS IN THE HIGH PLAINS OF EASTERN ALGERIA. DRIVING FACTORS, SOCIO-ECONOMIC IMPACTS AND CHALLENGES

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*Key-words:* Olive growing, Agriculture system, Rural development, Algerian high plains.

**Abstract.** The present study focuses on the emergence of olive trees cultivation and its expansion within the surveyed area (i.e., the high plains of north-east Algeria). It is presumed that the Algerian government evidently favoured the olive oil sector by encouraging the semi-intensive systems through different plans and policies. In addition, the Socio-economic and climatic conditions were the main factors behind this emergence. This particular activity has improved the quality of life for several rural families. On the other hand, it has led to a marked change in agriculture land use and landscapes in several target regions, from a cereal monoculture to polycultures. The findings have revealed some challenges to ensure the future sustainability of olive orchards and to reach the objectives related to guaranteeing food security and, hence, to promoting rural development. The current agriculture trend can be followed up by relevant surveys for a better understanding of the process of growing olive trees from a socio-economic and environmental perspective.

## 1. INTRODUCTION

Olive cultivation has existed since ancient times in the Mediterranean Basin (Angles, 2000). In fact, it took up a significant part of its mountains and hills (Loumou and Giourga, 2003). According to the Food and Agriculture Organization of the United Nations (FAO, 2001), 95% of the total olive oil production in the world comes from the Mediterranean. In same vein, the International Olive Council (IOC, 2017) stated that, in the 2016/2017 season, about 2.33 million tons of olive oil were produced in the region, making up more than 90% of the global yield. Therefore, olive oil production is essentially an important economic sector for the Mediterranean region, which dominates the global olive oil production. Regarding the olive cultivation systems in the Mediterranean, it should be noted that several factors threaten traditional olive cultivation, as the activity is being transferred from the most fragile areas toward irrigated plains, due to the intensive scheme practice of olive orchards (Loumou and Giourga, 2003). Additionally, Duarte *et al.*, 2008, identified that the abandonment of traditional olive growing is principally caused by low productivity. In this context, for example, Sánchez-Martínez and Cabrera, 2015 analysed the olive cultivation expansion in plain regions (Southern Spain). Likewise, in North Africa, new modern olive orchards are planted in plains with higher densities (Gregoriou, 2009). On the other hand, several studies discussed the future of olive grove development on sloping areas, such as the works of de Graaff *et al.*, 2010 and Fleskens and Graaff, 2007, in addition to Fernandez Escobar *et al.*, 2013 who reviewed the evolution of olive growing from traditional to intensive systems, and Xiloyannis *et al.*, 2008, who focused on the constraints of a semi-intensive system on sloping land.

Algeria is part of the Mediterranean countries, and for a very long time it has been an agricultural and rural country (Côte, 1996a), where olives are a traditional crop, and the most dominant of the Algerian

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arboreal orchards; in the 2000–2009 decade, 39% of the arboreal surface was dedicated to olive orchards (MARD, 2018). In fact, in the past two decades, Algeria has focused intensely on agricultural and rural areas, especially with regards to the cultivation of olives as a strategic activity that contributes to the development of rural areas. Indeed, the policy adopted in the country has yielded positive results in this vital agricultural branch; the area assigned for planting olive trees increased from 168,080 hectares in 2000 to 432,961 hectares in 2017. Consequently, the production nearly tripled from 217,112 to 684,461 tons for the same timeframe (FAO, 2017). It should be noted that the olive tree orchards have taken over significant areas, not only in mountainous areas, but also in high plains such as in the north-east of Algeria, which is known for its long favourable region for cereals cultivation and livestock farming. Moreover, the olive oil cultivation appeared in the southern part of the country under totally different conditions from those of its region of cultivation, whereas, the olive trees have been located in the Tell region (Bord, 1981) and are only planted in mountain areas (Côte, 1996a).

In fact, agricultural landscapes mutation is a topic discussed in many studies, such as the works of Hafiza, 2013, in addition to those of Rouabhi *et al.*, 2014 and Rouabhi *et al.*, 2016, that showed a variety of changes in agriculture typology in north-eastern Algeria. Therefore, the start of the olive cultivation spatial dynamic that has been recently observed regarding our study area needs to be assessed, since developing and managing the quality of rural areas and the quality of their products is of great significance (CENEAP, 2003b). On the other hand, research focusing on the olive growing survey is limited with regards to the north-east of Algeria.

This study focuses on a selected area from the plains of north-eastern Algeria. This area was chosen because it is made up mainly of cereals, in addition to the recent emergence of olive cultivation. The focus of the present study is to survey the spatial dynamics of olive groves, by identifying the main reasons that influenced their expansion and understanding their impact on agricultural systems and landscape. The findings are followed by a set of recommendations that can be proposed for rural areas in terms of local and sustainable development.

## 2. MATERIALS AND METHODS

### 2.1. Methods

In order for this research to achieve its goals, we have adopted the following methodology: (i) the general presentation of the olive groves' status and their spatial expansion, using the spatial statistics analysis, a detailed analysis of the different driving factors that have influenced the olive cultivation emergence in the study area, (ii) the exploration of the spatial impact resulting from the marked progress of olive cultivation, and discussing the possible spatial challenges related to the activity.

For accurate results, the analysis is based on the reports issued by the International Olive Oil Council (OOC), and the Food and Agriculture Organization of the United Nations (FAO). Furthermore, the review of the different relevant reports and studies of the Algerian Ministry of Agricultural and Rural Development (M.A.D.R), the National Office for Rural Development Studies (B.N.E.D.E.R), and the National Centre for Studies and Analyses of Population and Development (C.E.N.E.A.P).

In addition, field surveys and practical experiences were conducted over the last years in several rural areas for a better understanding of the spatial patterns of olive trees and the identification of their dynamics. As for the mapping process, the authors used scientific and methodological materials such as Professional Google Earth, the ArcGIS software, in addition to the Trimble eCognition software.

## 2.2. Study Area

The Algerian high plains area is located in a semi-arid climate, between the Tellian Atlas and the Saharan Atlas, at an average altitude of 800 meters (Côte, 1996a). In fact, our study area is part of the high plains in north-eastern Algeria (Fig. 1), and according to The National Office for Rural Development Studies (BNEDER, 2008), it is situated in the Bordj Bou Arreridj (**BBA**) territory, between 35.87° and 36.31° North latitude, and between 4.56° and 5.18° East longitude. The study area covers an expanse of 1,577.36 km<sup>2</sup>, that is, 40% of the **BBA** territory, where most of it is flat lands; the altitude varies between 634 m and 1,313 m, while 86.71% of the study area is low-sloping lands (less than 9° of slope).

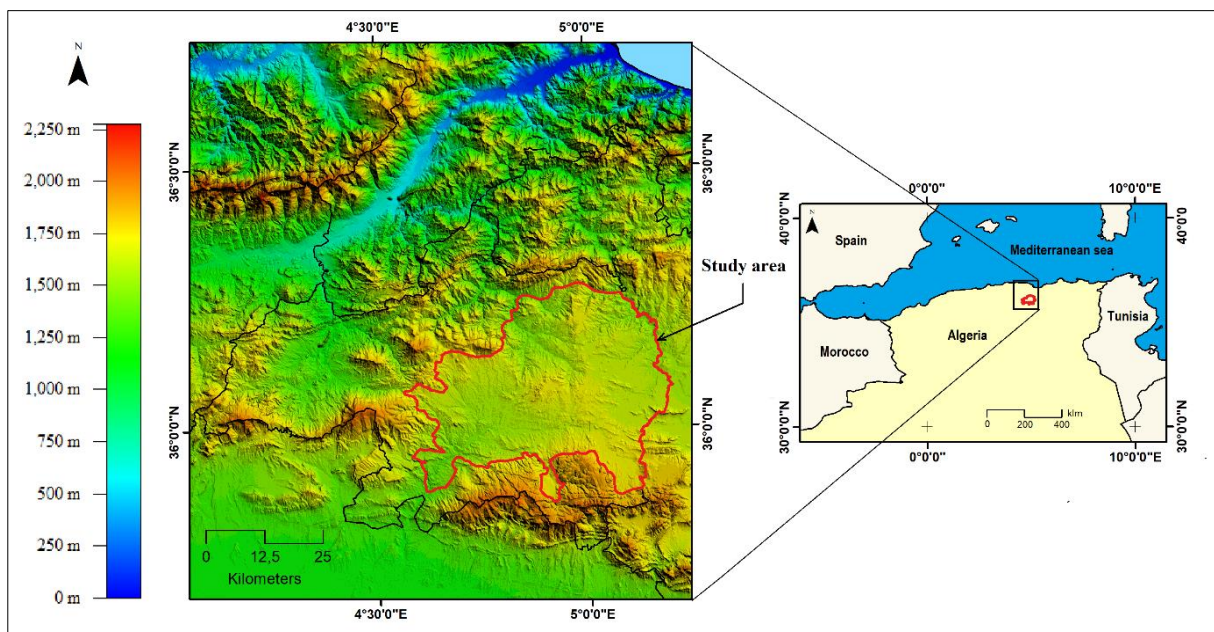


Fig. 1 – Location of Study Area in the High Land (North-East Algeria).

Note: Made by the Authors.

## 3. RESULTS

### 3.1. Changes in Agriculture Land-use from 2001 to 2017

According to the statistics regarding to the study area obtained from the Department of Agricultural Services of the **BBA** province, as shown in both Figure 2 and Figure 3, a significant increase in the number of olive trees was recorded between 2001 and 2017, as olive groves augmented from 478.5 hectares to 5,297 hectares, an increase of about 4818.5 hectares. It should be noted that besides this new dynamic, and in the same period, there was a small decline in large-scale farming area (fallow/cereals systems) of 8.2% of its original surface area. In this context, it should be noted that the study area is a favourable region for producing cereals, mainly barley and wheat, which are the basic products of Algeria (CENEAP, 2003a), with a rain-fed regime. As for vegetable farming in the study area, it occupies very small areas, which is only 1%.

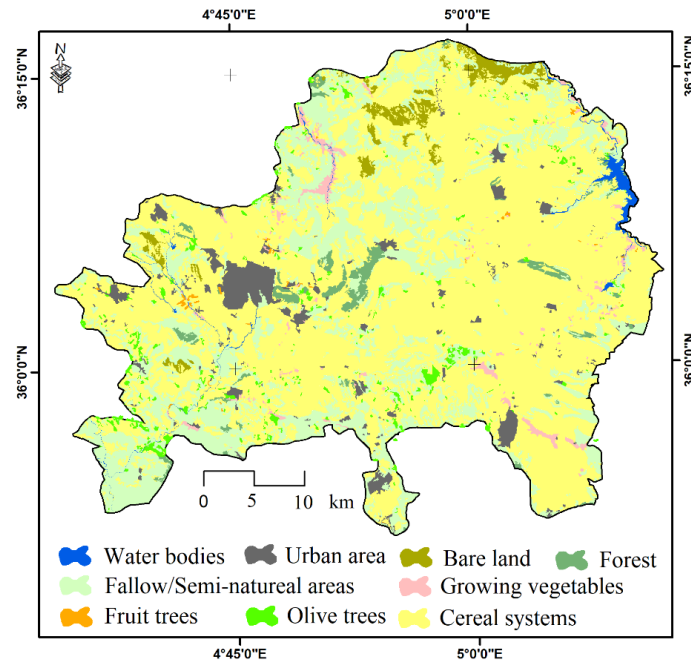


Fig. 2 – The Agriculture Land Cover /Use in the Study Area (2015)  
Source: **B.N.E.D.E.R**, 2015.

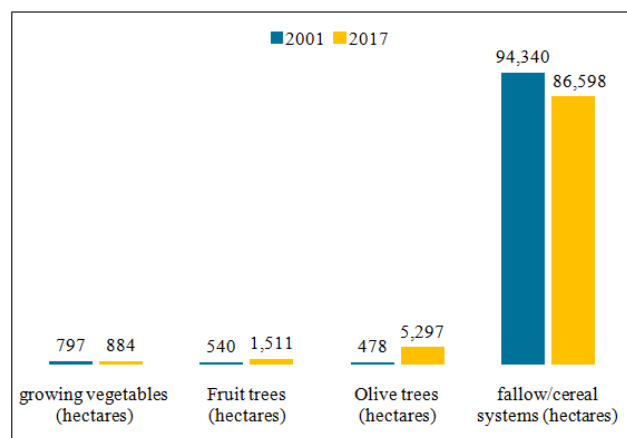


Fig. 3 – The Growth of Agricultural Activities from 2001 to 2017 in the study area  
Source: Elaborated by the authors according to statistics from the Department of Agricultural Services of the **BBA** province.

### 3.2. Patterns of the Olive Growing Area and its Spatial Dynamics

In the past 20 years, the olive area in the study area has multiplied nearly 10-fold due to the newly implemented olive trees, which are distributed over approximately 9,000 plots of land. In actuality, the olive area constitutes around 78% of the fruit trees in the area of study. That is to say, the initial olive areas were represented mainly by traditional plantations with medium yields, while the new ones are widely cultivated by semi-intensive production systems in small and medium-scale farms, averaging between 0.5 hectares and 5 hectares, with the presence of many olive cultivars.

The olive-growing activity in the study area has been marked by a clear spatial movement, which extends right up from the mountains to the contact area with the plains. Olive trees have emerged in recent years in numerous small plots within the same perimeter, forming agricultural poles and creating a new transitional landscape, with a clustered pattern, especially in both the northernmost and the south-western regions of the study area. Meanwhile, some olive groves can be spotted in the centre of the region's plains (Fig. 4).

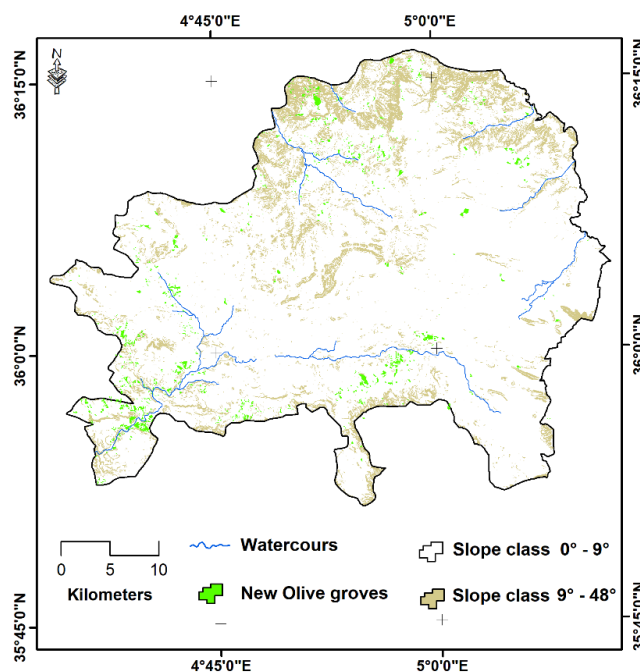


Fig. 4 – Location of the New Olive Trees Orchard in the Study Area (North-East Algeria)

Note: Localizing the olive groves was done by the authors based on the field surveys and the high-resolution aerial images generated by the free Google Earth software. Afterwards, the map was made by the ArcGIS software.

## 4. DISCUSSIONS

### 4.1. Factors of Olive Trees Emergence

The emergence of olive trees in the study area was related mainly to the following factors: the objectives of the government towards agricultural and rural development and the interest of peasants, as well as the characteristics of olive farming practices. In what follows, we present a detailed analysis of the driving factors of the emergence of olive groves in the study area.

#### 4.1.1. The Agricultural Policy of the Government

Planting olives has become an important activity for agricultural and rural development in Algeria. The National Agricultural Development Plan (**NADP**) launched in 2000 in Algeria was a factor that has promoted the activity in rural areas, where fruit trees cultivation has strongly developed since 2000 (Bedrani, 2008). In addition to this, the Rural Renewal Policy (**RRP**), launched during the 2009–2014 period, continued to support this activity through its various agricultural programmes. In fact, the means and forms of support from the government for olive trees cultivation are mainly: offering olive trees according to the accepted requests, where some of the target areas are supported by

opening rural roads, digging wells and providing equipment, in addition to providing financial support. It should be noted that besides these subsidies, many peasants have been offered a specific training on olive tree cultivation, which is a new activity for most of the locals.

The expansion of this activity is due to its great importance, which is mainly related to the diversification of economic practices, one of the four main objectives of the new policy in rural areas, which would create more jobs and an influx of income for the local population (Bessaoud, 2006).

#### 4.1.2. Land Ownership and Peasants' Initiatives

According to MARD, 2002, the rural population in the study area makes up about 23.38 % of the total population of the **BBA** territory, 8,855 of whom are farmers. On the other hand, the Used Agricultural Area (**UAA**) is estimated at 102,240 hectares, which is divided into 7,129 exploitations; the private sector accounts for 56% of the **UAA**, while the rest is related to the public sector, which consists of Collective Farms known as **EAC**, Single Farms known as **EAI**, in addition to Typical Farms. In this context, it should be noted that the proportion of the public-sector land localized especially in Algerian plain regions was estimated at about 24.5% (CENEAP, 2003a). Furthermore, regarding the study area, there are almost 103 ha/exploitation for the public sector and nearly 9 ha/exploitation for the private one, where the public sector has a small number of exploitations that are characterized by a large area and concentrated in high plains, particularly in the eastern region of the study area. Conversely, the private sector has a great number of exploitations, but they are characterized by their small-scale structure (Fig. 5). Thus, the individual ownership of lands was an important factor in olive cultivation emergence in the area under study, where the private initiatives of farmers towards olive trees investment have increased, since the diversification of activities in small lands leads to a greater economic revenue.

#### 4.1.3. Environment Conditions and Characteristics of Olive Farming Practices

The Mediterranean region is among the areas most affected by climate change (Giorgi, 2006; IPCC, 2007), where the phenomenon negatively affects agriculture, and drives farmers to seek more income by choosing the use the available water, such as planting fruit trees (Nefzaoui *et al.*, 2012). This is the case of our study area, where olive trees are preferred, given that the North of Algeria is characterized by a Mediterranean climate (UNDP, 2009). In addition to the aforementioned factors, olive trees are preferred as a new activity in view of their characteristic practices, as they are rustic trees with a long life, low-maintenance and low-cost, and which suit a wide range of soils. Moreover, peasants are taking advantage of mechanization as they are familiar with the exploitation techniques in low-sloping lands.

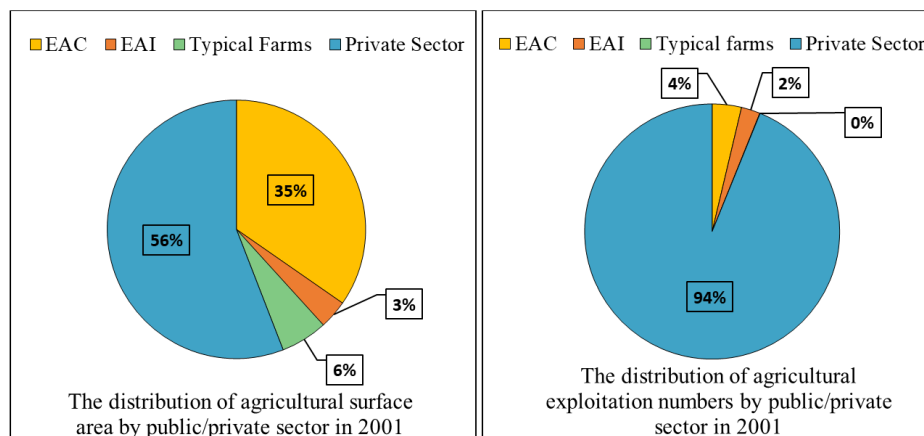


Fig. 5 – The characteristics of agricultural exploitations by public and private sectors in 2001  
Source: MARD, 2002.

## 4.2. The Impact of the Emergence of Olive Orchards

### 4.2.1. Socio-economic Impacts

Interestingly, olive cultivation has multiple uses, depending on farming practices (Marangon *et al.*, 2008). In this context, and regarding our study area, the details of the contribution of olive farms to local development, in particular from the socio-economic perspective, are taken through numerous conversations with those directly involved in this activity (local peasants and stakeholders). It is concluded that olive tree farming attracts many farmers, while for most of them it is a new experience. On another side, the rural farmers have invested plots of their own land, which are not far from their houses, in order to take better care of their olive orchards.

Farmers are interested in this type of agriculture mainly in order to increase and diversify their income, which has led them to become more engaged in farming; olive farmers ensure part of the food needs from their own production, and assign an important part of their income as well, hence the idea of bolstering their livelihood that motivates a significant number of them to be more stable in their lands.

The stability of the rural population is one of the major challenges, because the Algerian rural areas have long suffered from the phenomenon of rural exodus, especially in the past few years (Bessaoud, 2006). Given the situation, olive cultivation has, certainly, contributed to the stability of the rural populations in the countryside, as is the case of all North Africa, which encourages olive tree growing in rural areas for the same purpose (Gregoriou, 2009). In fact, the activity has proved to be successful, since it is considered a vital element of the rural economy, in addition to other local agricultural activities, by improving the living conditions of many rural people, especially in vulnerable rural areas.

### 4.2.2. The Impact on the Agricultural System

Indeed, about 70% of the olive trees, were planted mainly on low-sloping lands (under a 9° slope). However, there isn't a high number of olive groves in the central and eastern parts of the study area, which for a long time mainly intended for large-scale farming. On the other hand, the status of the agricultural land ownership characteristic of this part of the study area has been a factor in slowing down the expansion of olive trees. Generally, this current phenomenon is in a silent dynamic that started to make a slow transformation in agriculture practices, from monoculture to polyculture in the region of **BBA**, where the agricultural landscape is divided into two categories, as illustrated in Figure 6: (a) cereal farming in the high plain, especially in the centre of the BBA territory, and (b) mixed farming that recently appeared around it in several areas near the mountain sector. The latter generally combines three main agricultural activities: cereals, olive trees and poultry. In the midst of such heterogeneity, there is also a diversity of planting density mainly in terms of the olive orchard structures. Also, in the same plot where olive trees are grown, cereals and vegetables may be intercropped.

## 4.3. Challenges

In fact, Algeria is far from being self-sufficient in the production of fruit of the rustic arboriculture, including olive trees (Bedrani, 2008). Moreover, based on FAO, 2017, estimations, Algeria remains a modest producer of olive oil, ranking 10<sup>th</sup> among the top ten olive oil-producing countries in the Mediterranean. Therefore, in order to remedy this situation, important efforts are made on the development of the olive crops with the aim of contributing more to the international production of oil and of diversifying the country's economic revenue. Consequently, with respect to the study area, the activity proved its positive influence on the stability of the rural population, as it provided them with employment opportunities resulting in a higher degree of socio-economic empowerment for the farmers. However, the emergence of the olive cultivation activity in several areas of the high plains can influence the cereal landscape, which is the main agricultural activity of the



region, especially under the high expectation of increasing new areas for the practicing of the activity in the future. In this context, it should be noted that the majority of cereal production exists in the arid and semi-arid areas of Algeria (Ramdane and Christine, 2012), and cereals adapt well to the semi-arid and continental climate (Côte, 1996b), which includes our study area. Accordingly, it is necessary to take into account the importance of the strategic agriculture typology in these areas that can play a significant role in food security and attaining a strong agricultural economy, especially when considering the year 2017, when the dependence of Algeria on imports of cereals reached 72.2% (Bessaoud *et al.*, 2019).

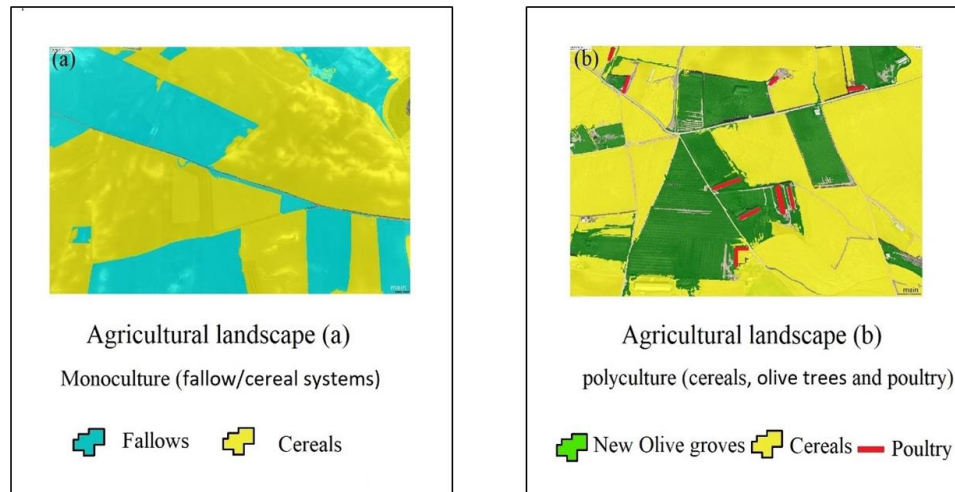


Fig. 6 – The impact of the new olive groves on the agricultural system and landscape of the study area. Note: The agricultural landscapes were identified by using the Object Based-Image Analysis (OBIA) method, which is proposed by Baatz and Schäpe, 2000, and is available through the Trimble eCognition software. The data used for the segmentation process were derived from High-resolution aerial images that had been generated by the free Google Earth software.

Given that the new Algerian agricultural vision is more concerned with crops that are less subject to rainfall hazards (Bedrani, 2008), the olive cultivation activity seems to be widely preferred to mitigate climate change and the water irrigation shortage. However, based on the above analysis, the new olive tree growing systems expected in the future should be controlled to ensure the crops' sustainability, by selecting appropriate lands for expansion and investment, taking into consideration the advantages of the olive trees' characteristics and practicalities pertaining to the function of preserving vulnerable soils on a sloping area, which is a factor that helps in managing natural resources.

## 5. CONCLUSIONS

In conclusion, planting olive trees has proven to be a strategic agricultural activity in Algeria, where it was encouraged as part of the implementation of new policies in rural areas, especially since 2000. Our area of study is a sample of olive cultivation practices that have recently emerged in the high plains of northern Algeria.

The agriculture trend towards olive tree planting is confirmed in our study area. It has been noticed for almost two decades and has become an important activity that many farmers are practicing for the first time. This tendency has created a new agricultural landscape in the high plains, where the latter have witnessed a shift from monocultures to mixed farming in several areas, as represented by a new agrarian landscape mixture between three agricultural activities: cereals, olive trees and poultry.



This agriculture dynamic seems to be slowly expanding towards an area with a high agricultural potential, especially the area under study, where more areas can be exposed to the conversion to future olive tree growing. This is due mainly to the socio-economic context. To that end, it is necessary to set-up a comprehensive approach that establishes the areas dedicated to olive tree plantation, such as low-quality lands, which are the most suitable for future agriculture intervention, as this will truly be at the service of sustainable development by taking on the economic and food security challenges.

This paper is a modest contribution to the ongoing discussion regarding the olive cultivation that has recently emerged on high plains. However, further studies on the issues are required. For example, useful studies may focus on determining potential sites, which may be more appropriate for olive trees plantation throughout Algerian rural areas, based on an environmental and socioeconomic vision, taking advantage of remote sensing technologies and geographic information system applications in this context. Moreover, assessing the efficiency of agricultural system trends, alongside their spatial challenges, is also worth investigating.

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