Effect of urbanization and socio-economic constraints on ancient palm grove in Algeria

Abdellah SIBOUKEUR¹,²*, Mustapha DADDI BOUHOUN², Oumelkheir SIBOUKEUR³

¹Département of Agronomic Sciences, University of Ghardaia, Algeria.
²Laboratoire de protection des écosystèmes en zones arides et semi-arides, University Kasdi Merbah Ouargla, Algeria.
³Laboratoire de Génie de l’eau et de l’environnement en milieu saharien, University Kasdi Merbah Ouargla, Algeria.

*Correspondence: siboukeur.abd@gmail.com

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Abstract: Oasis space in the northern Sahara has been little studied, despite its importance for the sustainability of the oasis, the Ksar of Ouargla in this case. This study focused on highlighting the extent of urbanization over the period from 1975 to 2015 and estimating areas lost due to the influence of environmental and socio-economic factors. The methodological approach adopted using, satellite images, aerial photographs and field surveys, has enabled us to estimate the losses in agricultural areas at 18.52% as a result of the above-mentioned problems and 17.23% are losses due to urbanization.

1. Introduction

An astonishing fact is that the world loses an average of 10 hectares of arable land per minute (IPTRID, 2006). Over the last 50 years, the oases have suffered degradation due to intensive exploitation, resulting from the increase of the world population and intensive animal husbandry. In addition, technological changes and natural factors have contributed to the degradation and abandonment of palm grove (El-Juhany, 2010), where the date palm represents the cornerstone of both the palm grove and the oasis ecosystem (Rhouma, 1996; Toutain, 1999; Bouguedoura et al., 2015; Salhi, 2020).

According to Malumphy and Moran (2009), during the last decade, date production has decreased in traditional oases due to environmental problems including diseases and insects (EL-Juhany, 2010). Algerian oasis ecosystem is no exception of this situation. On that concern, Bouammar and Bekhti (2008) states that the traditional palm groves are subject to degradation and marginalization in relation to the reflective changes in oasis societies in general, at the expense of the new agricultural system which is subject to particular interest on the part of the public authorities. Moreover, varieties intended for self-subsistence especially in traditional palm groves are increasingly replaced by other commercial varieties in monocultivar new palm groves (Houichiti et al., 2020).

In the traditional palm grove of Ksar of Ouargla, the biodiversity of palm date cultivars is a subject to genetic erosion due to various factors: the progressive degradation of the traditional palm grove, the aging of date palm trees, water deficit and the extension of urbanization (Idder, 2002; Idder-Ighili et al., 2021). In fact, the problem of the degradation of the traditional palm grove of Ksar of Ouargla has been subject to many studies by some researchers who treated it from socioeconomic perspectives. These studies had mainly conducted either within the framework of the palm grove
dysfunctions, through surveys carried out with the concerned administrations and citizens or within the framework of promoting the degradation of the KSAR palm groves (Idder, 2002; Idder, 2005; Bouammar and Bekhti, 2008; Idder et al., 2011; Faci et al., 2017; Daddamoussa et al., 2022). But it is crucial to note that the impact of urbanization on the agricultural space of Ksar has not been reflected in these studies.

In this context, Ksar palm grove present a spatial dysfunction related to the use of hydraulic resources and the change of agricultural vocation from land to construction. This had negative repercussions on the agrarian space, favoring the progressive degradation of the palm groves (Idder et al., 2011; Côte, 1998). The current study, carried out in the Ouargla basin, aims to assess the extent of the impact of urbanization and socio-economic constraints on the loss of agricultural land and the level of degradation of the Ksar palm grove.

2. Materials and Methods

2.1. Description of study area

The study of the Oasian environment is carried out in one of the oldest palm groves in Algeria. The Ksar palm grove is precisely located in the Ouargla basin as shown in figure below (Figure 1).

Figure 1. Location of the Ouargla basin (Sadine et al., 2018)

The Ksar palm grove is divided mainly into three parts: the palm grove of Beni Brahim and those of Beni Ouagguine and Beni Sissine surrounding Ksar city (Figure 2). The studied palm grove is characterized by dense plant cover and it also represents a huge stock of genetic variability resources for date palm cultivars (Idder, 2002).
2.2. Methodological Approach

This study is divided into two parts. The objective of the first part is to delimit and investigate the agrarian zone of KSAR of Ouargla in 2015 with observation of the state of gardens. The second part aims to study the evolution of the agro-urban landscape from 1975 to 2015 (Figure 3). To achieve our goals, we conducted a survey among citizens and at the level of Ouargla province headquarters and at Ouargla Agricultural Services Department (DSA).

At the same time, we collected and digitized maps and aerial images (Table 1) using ArcMap10.2.2 software to collect data on the former and current locations of the palm grove limits. It must be noted here that this work required confirming certain positions through field visits in order to check and make some adjustments to the boundaries of the palm grove and finalize agro-urban maps and their evolution over time.

Figure 2. Location of the Ksar palm grove in the city of Ouargla (Sebti et al., 2013)

Figure 3. Synthetic workflow scheme
Table 1. Materials used in this study

<table>
<thead>
<tr>
<th>Material</th>
<th>Scale/Resolution</th>
<th>Period/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rouvillois-Brigol maps of houses and palm grove of Ksar of Ouargla</td>
<td>1:50000</td>
<td>1975</td>
</tr>
<tr>
<td>Aerial image of I.N.C</td>
<td>1:60000</td>
<td>1982</td>
</tr>
<tr>
<td>Google aerial images</td>
<td>15 cm-15cm</td>
<td>2001-2015</td>
</tr>
</tbody>
</table>

3. Results and discussion

3.1. Demarcation of agrarian space

It is worth noting that Ouargla’ Ksar system is one of the oldest agrarian systems in the Sahara. It is based on the cultivation of date palm with underlying vegetable, fodder and tree crops, predominated by pomegranate, fig and vine. The social cooperatives named Touiza characterize the agricultural activity of the oasis. They can be used for such things as opening and maintaining drains. According to Pillet (1995), the exploitation of groundwater by artesian wells existed before 1883 and with the introduction of Mio-Pliocene drilling, artisianism decreased until it was finally stopped.

The agrarian system of the Ksar oasis had made it possible to exploit the region’s hydro-edaphic potential, to guarantee the family’s food needs and to ensure, with the surplus, an income, in addition to trade and crafts. This economic model persisted for a long time until other sources of income, notably oil, emerged, which led to a decrease in agricultural activity and sometimes even the abandonment of gardens.

Through this study we have marked out on a map the agrarian space of the three palm groves that constitute the palm groves of the KSAR, namely: that of Beni Brahim, Beni Ouaguine and Beni Sissine (Figure 4). The area of the palm grove is estimated at 561 ha.

Figure 4. Limits of the Ksar de Ouargla palm grove in 2015
In the field, we noticed the almost total absence of garden owners, which has probably reflected in their gardens. Also, we detected different levels of degradation in a form of:
1. severely deteriorated gardens with dead date palms;
2. deteriorated gardens with non-tended date palms carrying yields from precedent years;
3. tended gardens with tended date palms and no subjacent crops;
4. very well-tended gardens with tended date palm and subjacent crops.

3.2. Evolution of the agro-urban space

The agricultural area in recent years has declined because of changes in the vocation of the palm grove. An agro-urban or even urban vocation has supplanted the old one (Figure 5).

Examination of the agro-urban evolution map drawn up for the years 1975, 1982, 2001 and 2015 has shown that the palm grove has undergone two periods of degradation with distinct degrees due to urbanization. The first period (1975-2001) was characterized by a high level of degradation. The loss is estimated at 30 ha during the period between 1975 and 1982 and 75 ha between 1982 and 2001. The second period was characterized by a reduction in the urbanization of the palm grove, with a loss of 2 ha between 2001 and 2015. During the latter period, the rate of urbanization was very low, most likely due to:
- the urbanization of most of the land close to the main roads;
- difficulties (construction, electrification, etc.) in accessing other land where a high cost of building inside the palm groves, which requires land to be buried to levels of over 3 m deep;
- rising of shallow water table.

![Figure 5. Evolution of the agro-urban area of Ksar between 1975 and 2015](image-url)
So, we observed that 17.23% of land has been lost because of urban expansion, where this estimation is close to the 20% announced by Bouammar (2010) in the Ksar where he adopted a qualitative approach to estimate the urbanization of the palm grove. Furthermore, this situation that has been reported between 1975 and 2015 has known an exacerbation by hydro-halomorphia, fires, inheritance conflicts, lack of tending and a low income of gardens, the estimation of these losses reaches to 18.52% (Figure 5).

Another observation is that urbanization has invaded palm grove of KSAR of Ouargla, especially in south and around the city of Ksar. We estimated that 64 ha of the palm grove of Beni Sissine are urbanized, which gives it the first place in the palm groves overgrown by houses. The latter occupy large areas in the south-east and south-west of the city of KSAR. In the second order, it appears that urbanization has contributed to the loss of 28 ha in the palm grove of Beni Ouaguine, north-east of the city of Ksar. The palm grove of Beni Brahim is the less influenced by urbanization: 15 ha is lost in the northwest, the north of the city of Ksar and in the peripheries of the palm grove. These results show a considerable decrease in the area of the Ouargla Ksar palm grove due to urbanization, socio-economic and environmental constraints. The drawn results proved to be similar to a several conclusions reached by Bouammar and Bekhti, 2008; Bouammar, 2010; Idder et al., 2011; Bouguedoura et al., 2015; Houichiti et al., 2017; Zenkhir et al., 2020.

From a positive standpoint, the process of urbanization of the palm grove has been significantly propelled by two key factors. Firstly, the establishment of fire-fighting access routes which has incentivized residents to facilitate the transportation of construction materials to their gardens positioned along these roads. Secondly, the extension and integration of infrastructure networks of electricity, gas, potable water, and sewage systems have played a pivotal role in promoting the phenomenon of palm grove urbanization.

5. Conclusions

At present, no studies have been carried out on land degradation of the palm grove of Ksar of Ouargla. In addressing this gap, the study of the landscape of Ksar of Ouargla, employing a quantitative approach through the integrated use of satellite images, maps, and on-site boundary confirmation, constitutes a crucial element in assessing the current state of the palm grove and the influence of urbanization on it. Further, it contributes in providing estimation with a quantitative value for the agricultural space mutation and the extent of degradation.

In the light of this work, we can conclude that Ksar palm grove located in Ouargla basin has undergone a significant spatial mutation over time. This was proved by a delineation of the current agrarian space on site and by the estimation of the extent of urbanization. The urbanization invasion of Ksar palm grove varied between 1975 to 2015 with a high rate. This phenomenon is more noticeable in the palm grove of Beni Sissine in the south-east and south-west of Ksar city compared to the palm grove of Beni Ouaguine and that of Beni Brahim.

The current limitation is perpetually subject to agro-environmental constraints and this ancient agricultural area is still threatened, mainly by urbanization, socio-economic and hydro-holomorphic constraints.

Finally, this situation requires immediate action by local authorities to put an end to this alarming situation with the sole aim of safeguarding one of the oldest palm groves in Ouargla basin and ensuring its sustainability. It is indispensable to reestablish the substantial economic value of the traditional palm grove by introducing agri-tourism within the gardens, which will bring the farmer closer to the grove.

References


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