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AGRO ECOSYSTEMS IN THE BASIN OF OUARGLA (ALGERIA): DEVELOPING A TYPOLOGY AND ANALYSIS OF FUNCTION

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Abstract:

The Ouargla Basin is an oasis in south-eastern Algeria, located in the Sahara desert about 850 km south-east of the capital, and is considered the reason for human survival in a hostile, hyper-arid environment. Traditional agriculture has been the main economic activity of the oasis population, whose production is mainly intended for domestic consumption (subsistence farming). This oasis has suffered extreme neglect and degradation in recent years, threatening the existence of this heritage. The aim of the present study is to establish a typology for a better understanding of the real causes of the degradation of the palm groves, in order to be able to use it later to propose programs for the sustainable development of the oasis agrarian system. To do this, we went to the bottom of the palm groves. We carried out a diagnosis based on a survey of the palm groves in order to identify the agro-ecological, sociological and economic constraints and problems. We identified five agro-systems: the abandoned system, the regressive system, the stagnant system, the progressive system and the improved system. The diversity of the types demonstrates the importance of the activity within the palm groves of the Ouargla basin, which needs to be developed and to which we should pay more attention.

Keywords: Oasis agro-ecosystem, palm grove, Ouargla basin, diagnosis, typology.

Introduction

The oasis of Ouargla is one of the largest Algerian oases, it presents 15% of Algerian phoenicultural patrimony, with an area of 21.977,21 ha, and a total number of 2.576.582palm trees and a production of 1131301qx (D S A, 2016). Two-thirds (2/3) of the phoeniculture patrimony of the region are located in the old palm groves (old oasis system). The oasis system remains the only form of exploitation in this arid and specific environment (Senoussi, 1999). It is a social phenomenon far from being outdated and has its origins and concerns. Which needs real attention at all levels (Boumadda, 2014).

The old oasis is considered as a heritage to be revived and preserved. Since, on the one hand, the traditional palm groves are heterogeneous, they represent, a unique reservoir of biological diversity, knowledge and know-how held by the local population (Boualem & Idder, 2006; Senoussi et al., 2017). Than they have a great potential for the preservation of biodiversity, better than the so-called modern palm groves hit by various plagues affecting the production of dates quantitatively and qualitatively (Amrani, 2021). On the other hand, it is the origin of a traditional small-scale agriculture, renowned for its diversification and its ability to manage complex systems. It allows not only to diversify the monetary resources of the oases, but also to contribute to the preservation of natural resources (Toutain, 1999).

The old oasis system has undergone considerable changes that have generated imbalances in the homogeneity of its components. These upheavals are not only the result of agricultural activity, they are also and often the result of other human activities. We note among others an atomization of the heritage, the advance of urbanization, soil salinity, the non-control of the water factor and genetic erosion (Bouammar & Bekhti, 2008; Chaouch, 2018; Idder et al., 2011; Idder, 2005; Salhi, 2015).

Unfortunately, today, the oasis system in the Ouargla basin shows a decline of agricultural production systems, a sustained degradation of palm groves and a remarkable ecological imbalance where several constraints aggravate these imbalances.

But this decline seems to us not irreversible since in the one hand, governments are taking action (renovation of drains, palm trees rejuvenation, fight against pests and weeds, ..) as part of different development programs and reform to stem the ecological imbalance. In the other endogenous dynamics "spontaneous" are particularly committed by farmers could lead to an improvement of the situation of palm groves and rehabilitate the main agricultural, economic, social and ecological functions in this oasis.

Several studies have investigated the problem of functioning and sustainability of agricultural system in the oasis of Ouargla and address the main inquiry, what are the reasons behind the continuous deterioration of the old oasis in Ouargla?(Amrani, 2021; Bouammar, 2010; Boumadda, 2014; Boumadda, 2019; Senoussi, 1999). Other studies have highlighted the constraints that threaten the sustainability of the Oasis of Ouargla and the possibility of development (Boualem & Idder, 2006; Faci et al., 2017; Idder et al., 2011; Idder, 2005). Likewise, others have attempted to compare the oasis system in the region of Ouargla by the agricultural system in other regions (Bouammar, 2010; Boumadda, 2019; Chaouch, 2018, 2019). Amrani (2021) identified the major problem in the old oasis of Ouargla as the lack of interest or disinterest of the population in working in the palm groves. Not only in the oasis of Ouargla, the lack of interest in working in the agriculture sector is a global issue(Qin & Liao, 2016). Structural changes in agriculture impacting labor and the low attractivity of employment and working conditions in this sector are the major issues for the permanence and renewal of the rural workforce (Malanski et al., 2021).

A model has been proposed to motivate the population's interest in phoniciculture in the old palm grove through projects of common interest. However, these projects face a lack of cohesion between the operational technicality on the field and the responsible implication of the users (Amrani, 2021).

Nevertheless, understanding the multiple functions within the ancient oasis and their dynamics over time and space is important to ensure its preservation.

Therefore, this study aims to comprehend the function of agricultural production systems in the basin oasis of Ouargla and analyses their diversity. In a second step, it aims to understand the dynamics that characterize them.

Several questions have arisen regarding the sustainability of the Ouargla basin's oasis agro-ecosystem amidst current socio-economic and ecological changes. Specifically, is the system still adapted to these changes or is it a dying system? Additionally, how can the system maintain sustainable profitability and sustainability given the cost and scarcity of resources? Finally, how does the traditional oasis farmer organize their activities and manage their resources within the palm groves to achieve their objectives? What diversity is present in this agroecosystem?

To answer these questions, this study delved into the palm groves to identify the constraints and problems, and to determine the assets that classify these palm groves into types. This leads to a more accurate understanding and control of the agroecosystem, enabling better intervention for rehabilitation purposes.

Materiel and methods

The study was conducted in the Oasis of Ouargla basin, located in hug desert in the north-east of the Algerian Sahara, 850 km from the capital Algiers between 31° 57′ 47″ N and 32°00′ N, 5° 15′ 31″ E and 5° 24′ E (Figure 1). The palm groves cover an area of 4704.1 hectares, with a total of 627462 palm trees, of which 443482 are productive.

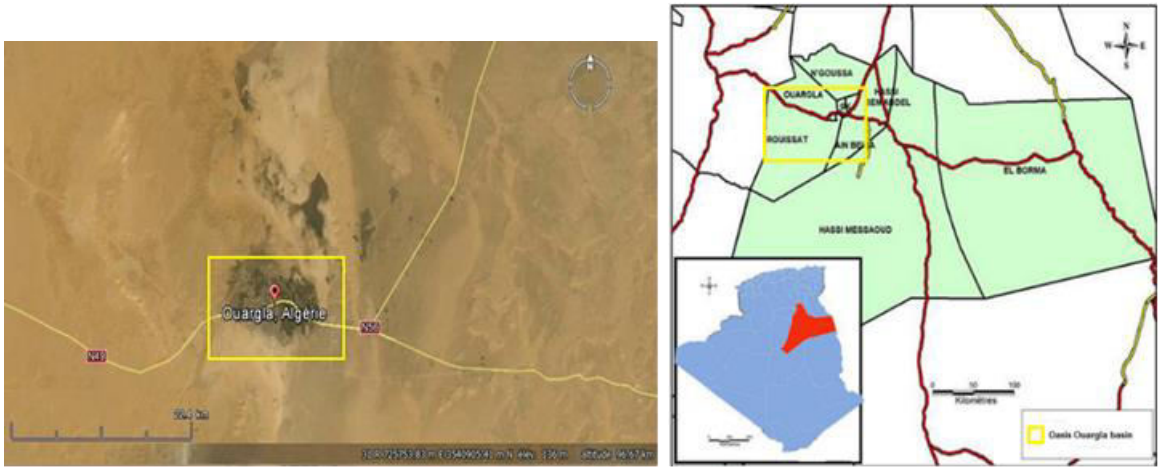


Figure 1: Localization of Ouargla Oasis, (a: satellite view showing the location of the Ouargla oasis in a vast sand desert, b : the administrative map of Algeria shows the location of the Ouargla oasis)

The work method is based on a survey of palm groves using a questionnaire. The questions were about the most important factors that have a direct impact on the functioning of the agricultural production system in the oasis. These factors include:

- The identification of the farmer within their social environment, such as their age, level of education, family situation, and household size.
- Additionally, the identification of the farm was examined, including the size of the garden, method of acquisition, year of creation, installations (such as windbreaks, fences, basins, wells, and runways), type of soil, and any soil-related issues.
- Identification of the cultivation system includes phoenicuture, arboriculture, and herbaceous cultivation. Phoenicuture involves monitoring the number and health status of palm trees, as well as their age. Arboriculture focuses on the number and health status of fruit trees, as well

as varietal diversity. Herbaceous cultivation involves monitoring the types of crops, the area cultivated, and the diversity of species.
- The question also covered the identification of the livestock management includes monitoring the type and diversity of livestock, as well as the size of the livestock. It is important to monitor the source of feed, as well as the destination of livestock products and by-products.
- The operation of the farm includes work in the garden such as ploughing, soil improvement, weeding, irrigation, and disease treatment. Additionally, it involves sourcing supplies and determining the type of labour required.
- The economic aspect of the garden encompasses the marketing of garden products and by-products, garden fees, and sources of finance.

In order to reach a representative number of different types of farms in the study area.
Firstly, the Ouargla basin was divided into homogeneous areas. The region was divided into three (3) areas, each containing palm groves that are among the oldest and have particular specificities of the old Oasis, although they share several common characteristics. We believe that these areas represent the old oasis system well, including its assets and constraints, and can address the purpose of this study (Figure 2).
The division has identified three distinct zones that are:
1- Zone 1: **Ksar** includes the areas of Ksar, Said Otba and Mkhadma.
2- Zone 2: **Chott** includes the areas of: Chott, Adjaddja, Ain Beida, and Benithour.
3- Zone 3 : **Bamendil l**ocated in the area of Bamendil.

The initial concern was to determine the appropriate number of farmers to approach to ensure representative samples and achieve our targeted objectives. Farms were selected for sampling based on their age and level of maintenance, as well as factors such as the resemblance, structure, and composition of the oasis space to ensure a diverse range of situations. Each transect began at a distinct source of heterogeneity, enabling scanning of the area in all directions.

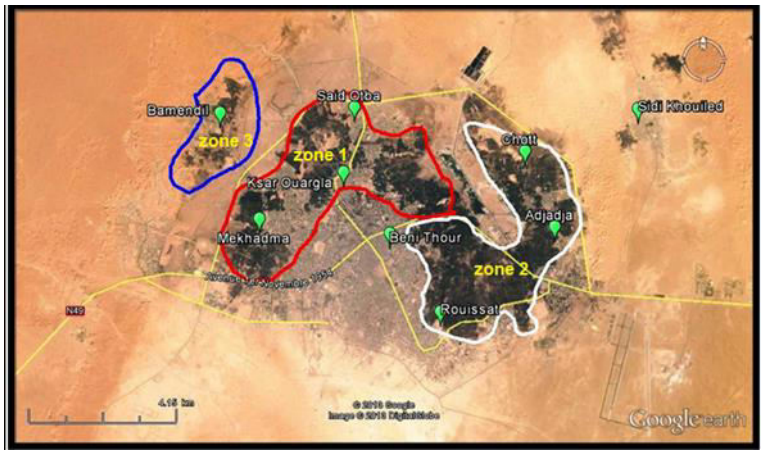


Figure 2: Zoning proposed by the study

The investigation was hindered by the absence of farmers on their farms. Therefore, we relied on the key element that Bouammar (2000)identifies as essential to understanding the oasis

space: water. When the water source is collective, we followed the water to investigate because irrigation ensures the presence of the farmer. Additionally, we targeted a key informant who is responsible for the collective water source.

Our observations during trips to the palm groves were also used. Observation is qualitative approach for collecting data by accessing the terrain (Olmedo et al., 2023). It results in deductions. Observing a phenomenon can provide complementary or confirmatory information, or even raise new questions(Blanchet, 1990; Boltanski & Thévenot, 1991).

The aim is to define the different types of existing agricultural production systems through a qualitative analysis (structure, function, evolution, etc.).

The total number of farms surveyed is 122 farm distributed according to the importance of each of the categories previously identified in the three zones (table 1).

Table 1: Distribution of farms surveyed by area

Zone	Abandoned system	System in regression	Stagnated system	System in progress	improved system	total
Ksar	10	13	13	4	3	43
Chott	17	10	10	8	4	49
Bamendil	0	7	10	6	7	30
Total	27	30	33	18	14	122

Results and discussion

Neither farmers nor farms should be considered as a continuum in order to propose solutions that could be applied everywhere; farmers in the same region do not all have the same resources and do not necessarily operate under the same economic conditions (Lavigne-Delville & Wybrecht, 2002).

On a larger scale and at the internal level of each unit in the primary division, it is therefore necessary to classify farms into categories and to establish a functional typology according to the function of the production systems.

Typologies and classifications are one of many ways of assessing the diversity and dynamics of production systems.

The functioning of these palm groves owes its diversity to the work (or maintenance of the palm groves), to the natural environment or to the socio-economic systems,...

The typology proposed by the study classified the gardens of the three zones into five (5) categories (Table 2).

Table 2: Palm groves typology in the Ouargla basin

The abandoned or almost abandoned system	**Regressing system**	**Stagnating system**	**System in progression**	**Improved system**
-Plurality of owners (undivided ownership),	- A reduced area of less than 0.5 ha - Weeds invasion,	-An area equal or greater than 0.5ha,	- An area equal or greater than 0.5ha,	- Large area equal or greater than 1ha,

- An extreme invasion by the weeds, - No or limited intervention of the owners only for the pollination and the harvest of dates, -Advanced state of degradation of the palm trees.	- Low investment - Absence of underlying crops, - Poor soil quality - A lack of fences.	-Presence of underlying crops, - Low investment, - Old palm trees, - Fenced gardens.	-Diversified underlying layers, - Healthy soil with absence of weeds, - Important investment for the improvement of the soil quality, - Rejuvenation of the palm trees, - Well-fenced gardens, - Area and/or livestock size in continuous evolution	- Heavy investments such as drilling, livestock building,.., - New techniques: drip irrigation, sprinkler irrigation, greenhouse under greenhouse... - healthy soil

Typology and analysis of agricultural production systems

We have tried to develop a simplified, rational and relevant presentation. This can be used by actors and stakeholders for the rehabilitation and development of agriculture in the region. This has been achieved through the five types of farming systems that we have identified: the abandoned or almost abandoned system, system in regression, stagnant system, system in progress, improved system (Table 2).

Figure 3: Real photos of the five agro systems identified is the oasis of Ouargla basin (a: the abandoned system, b: Regressing system, c: Stagnating system, d: System in progression, e: Improved system)

The abandoned system

This category refers to farms that have been neglected and are almost non-existent in the Bamendil area. Neglected farms can be identified by the poor state of palm trees, weed invasion, and lack of fences (Figure 3 a).

Over half of these farms are jointly owned, often due to disagreements over inheritance division or a lack of basic amenities such as water and electricity. In addition, the remote location of the farms poses a significant challenge for owners.

The farms under consideration are relatively small, with 59% of them being less than 0.5 hectares in size. They require minimal maintenance, and ploughing is not practiced. The borders of the plots are indistinct. These farms often lack access to irrigation, and even when available, the irrigation system is often obstructed by weeds. The presence of spontaneous herbs, particularly Phragmites communis, makes cultivation operations difficult, if not impossible, and hampers harvesting operations, causing considerable production losses (Benziouche & Chehat, 2010). These weeds also encourages the existence of diseases and provide an ideal breeding ground for pests (Idder et al., 2011).

The palm trees are typically very old and tall, and they only benefit from pollination and harvesting operations. They can be recognized by the many dry palms on the stem. The yield of the palm trees is less than 40kg per tree due to poor health and infestation by diseases and parasites such as date worm, white mealy bug, and Boufaroua (Idder-Ighili et al., 2015; Idder et al., 2011). The farms in this type lack underlying palm crops and do not receive any manure or sand amendments.

System in regression

This category comprises non-maintained farms. Farms in decline perform relatively better than the previous category, but they are still poorly maintained (Figure 3 b). Some

owners have multiple plots (64% of surveyed owners in this category have more than one parcel), which may be located remotely from each other. The remoteness of the owners' place of residence also poses a constraint, as 40% of owners live more than 3km away. The main cause of fire and theft of production is the low frequency of owner visits. This limits farmers' initiative, and even leads to the abandonment of underlying crops, especially fruit trees. As a result, farm profitability is low (Faci et al., 2017).

The majority of palm trees are old, with at least two-thirds being very old, resulting in low yield. The necessary cultural practices, such as irrigation, sand amendment, and manure supply, are rarely carried out, and plowing occurs every three years or less. The soil is affected by excessive salinity and weed invasion. The lack of water is one of the most serious constraints, caused by distant water sources and frequent pump breakdowns. The low investment to stop this decline can be attributed to low income among owners.

Furthermore, it should be noted that 43% of these farms are experiencing a reduction in area due to the advance of concrete.

The farm is experiencing regression, which is partly caused by the reduction of the area surface. In this type of farms, 77% have an area of less than 0.5 hectares.

Stagnated system

Stagnating farms are those that are in good condition but do not undergo any enhancements, neither in terms of surface area nor culture system (Figure 3c). This is due to the limited surface area, which hinders the development of the production system. In fact, 70% of farms of this type have a surface area equal to or less than 0.5 hectares. As noted by (Chaouch, 2019), the small size of farms is often the result of successive divisions through inheritance, a situation that can be discouraging for farming and can lead to regression of the farm.

Owners, in this type, spend considerable time on their farms: over 73% of owners visit their farms more than once a week. They take care of the cleaning and maintenance of cultures. Generally, these farms have a single owner (more than 68% of farms) whose age is the most suitable for the work in the garden. 61% of owners are aged between 40 and 60 years. 67% of owners reside at a distance of less than 3 Km.

The stagnating system is characterized by the presence of three strata of crops in most of the time, but they are not very developed and the production is mainly directed for family consumption.

Livestock is present on all farms, but it is small and dominated by goats, with no more than five heads.

The manure produced by the animals is sufficient to meet the farm's needs, and amendments are made annually. Manure heaps were observed at the entrance of the farm.

The palm trees are dominated by older palms, but there is some rejuvenation activity. The yield of the palms exceeds 40 kg per tree.

Fruit trees are present, but their number does not exceed ten. Herbaceous crops cover half of the underlying surface and are dominated by fodder crops intended for feeding domestic livestock.

Possible issues in such farms include water scarcity caused by remote water sources and frequent pump failures, invasion by Phragmites communis, and high salinity levels.

System in progress

The system in progress concerns those farms that show a trend towards a better situation. This includes farms that are undergoing rehabilitation due to changes in ownership, such as inheritance or sales, as well as farms that are expanding by purchasing neighboring land or changing their cultivation methods (Figure 3 d).

The system requires significant up injection of funds to cover all the costs of rehabilitation. The system in progress is not limited only to farming but also relates to animals husbandry and its evolution.

All farms surveyed in this type have a single owner and 80% of them are aged under 60 years. About 67% of owners reside at a distance of less than 3 Km, and 16% live in their farms so that the owner is present every day on the farm, working alone or with daily employees.

There is a certain level of mechanization used for plowing which is essentially to eliminate the weeds that invade the plot. The owners of this type are intended primarily to improve soil quality. For this purpose, the sand amendments and manure supply are very important every year.

Therefore, to be such farms done provide improved production but the technical system remains traditional.

Fruit trees are often present, the number of trees is important, and a part of the production is marketed. Herbaceous crops cover over 50% of the underlying surface. It is dominated by forage crops in most of the farms. The crop is intended for marketing and feeding cattle. Livestock are in 90% of farms. It is of relatively large size and dominated by sheep.

Excessive soil salinity, the invasion by weeds and lack of water are the most striking problems. Thefts and fires also hinder many fellahs as these gardens suffer from recovered water and wild boar attacks.

Improved system

The ameliorate system is perhaps the least in traditional system in this oasis, but its place in the environment is important. It can be evolved from the system in progress.

In these farms we find significant investments as individual drilling, shed for storage and agricultural machinery (wheel tractor, truck, ...). The generally important area exceeds 1 ha; it is the only land for most owners (Figure 3e).

Work at the farm is daily basis, either by the owner himself, for one who lives in gardens, or by a hired worker. According to surveys, 51% of the farmers interviewed live on their farms and 31% use a permanent worker.

The farming system is based on modern technology; with greenhouse, sprinkler irrigation for the forage and drip irrigation for fruit trees. Palm trees have reached their full capacity, which can exceed 80 kg.

Livestock is a large compound essentially by sheep which are intended for marketing, and cattle which are not high by the standards but provide some milk production and especially the production of calves for slaughter.

This type of farming requires many financial resources to deal with the problems of salinity of the soil and weeds, failure of well pumps and water back up due to malfunctioning drains.

The functioning of the agricultural production system in the oasis in the Ouargla basin

In summarize the figure 4 demonstrate how the Oasian agroecosystem (farm) is engaged in plurality of socioeconomic and ecologic relations(Ma et al., 2023). Oasian agriculture is the backbone of the oasis economic development, and the rationality of the agricultural cultivation structure directly affects oasis ecology (Huang et al., 2022; Huang & Ji, 2015; Lu et al., 2023). Furthermore, the agricultural transformation process is closely related to local farmers' livelihood system (Turner et al., 2014), nature ecological status (Silva et al., 2019), and the resilience of socio-ecological feedback (Tebboth et al., 2019). These factors determine the objectives and guide the decisions of the farm manager in his garden.

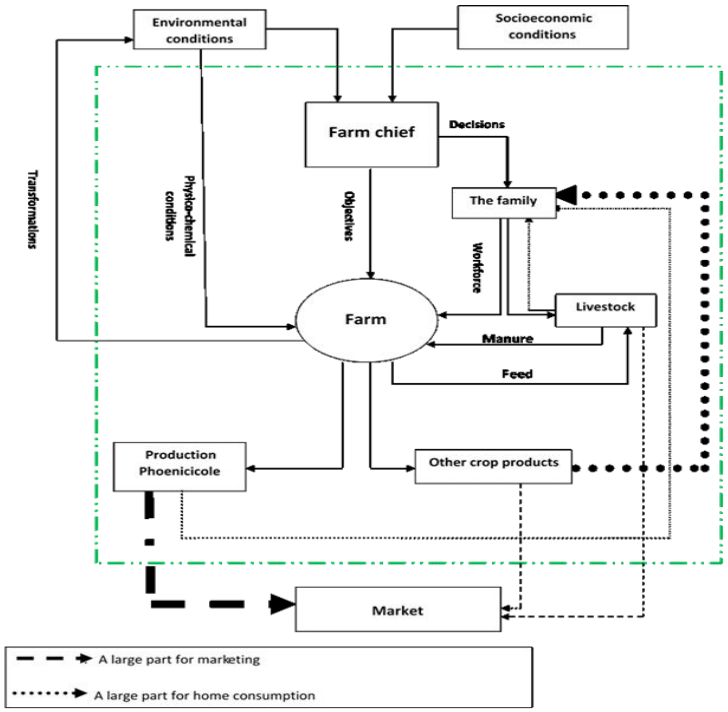


Figure 4: The functioning of the agricultural production system in the oasis in the Ouargla basin

1- Socioeconomic factors

Socio-economic factors include family composition, the number and ages of family members, and the diversity of sources of income. These factors determine the objectives and guide the decisions of the farm manager in their garden.

The family provides permanent labor for the garden, which is utilized throughout the year for irrigation, plot maintenance, herbaceous crop management, palm pollination, and date harvesting. For the last two tasks, the head of the farm can hire seasonal labour if the family does not have enough workers. According to surveys, over 50% of farmers rely solely on family labour. In the Ouargla oasis, women and children are no longer involved in these activities. Which explains the loss of non-inherited know-how, particularly in trades such as climbing date palms (Dadamoussa et al., 2022).

Livestock production is an essential part of the oasis production system and is family-based. In the Bamendil zone, 93% of felahs own livestock, while in the Ksar and Chott zones, 60% and 45% of felahs respectively own livestock. The livestock is small, with rarely more than 10 head. Only during winter do the felahs purchase additional feed in the form of barley or

maize. Instead of working in the garden, women assume full responsibility for livestock maintenance, whereas men allocate their time to other on farm occupations.

The relationship between livestock and gardens is mutually beneficial. Gardens provide feed, while livestock provide manure for the gardens. According to Faci et al. (2017), an association between oasis farming and livestock is crucial for improving the balance of family micro-holdings and maintaining soil fertility. The survey showed that 50% of farmers rely solely on their livestock for fertilizer needs. However, the use of organic fertilizer in the region is generally below recommended levels due to its high application cost, high labour wages, and lack of awareness of its usefulness. Moreover, the region suffers from a scarcity of organic fertiliser, which is frequently of substandard quality when available (Benziouche & Chehat, 2010).

Vegetable production in gardens is stratified, with the date palm being the first layer. It is primarily used for date production. The majority of date production is destined for commercial purposes. The economy of the southern Oasis relies mainly on the cultivation of date palms and the utilization of their fruit and by-products, which provides a significant source of income for the oasis inhabitants (Bouguedoura et al., 2015).

The second layer is the fruit-growing layer, which is present in only 16% of gardens in the Chott zone, 50% of gardens in the Ksar zone, and 75% of gardens in the Bamendil zone. The third layer consists of herbaceous crops, including fodder crops and vegetables. Farmers commonly grow alfalfa and fodder kale due to their tolerance to soil and water salinity. Vegetable crops are cultivated to meet the family's food requirements and fodder crops cultivated to cover the needs of livestock throughout the year.

Farmers produce their own vegetable and fodder crop seeds, leaving some crops to complete their life cycle until the seeds reach maturity, which they then store. The region's felahs have the expertise to select the best plants and preserve the seeds and pollen of the date palm.

2- Ecologic factors

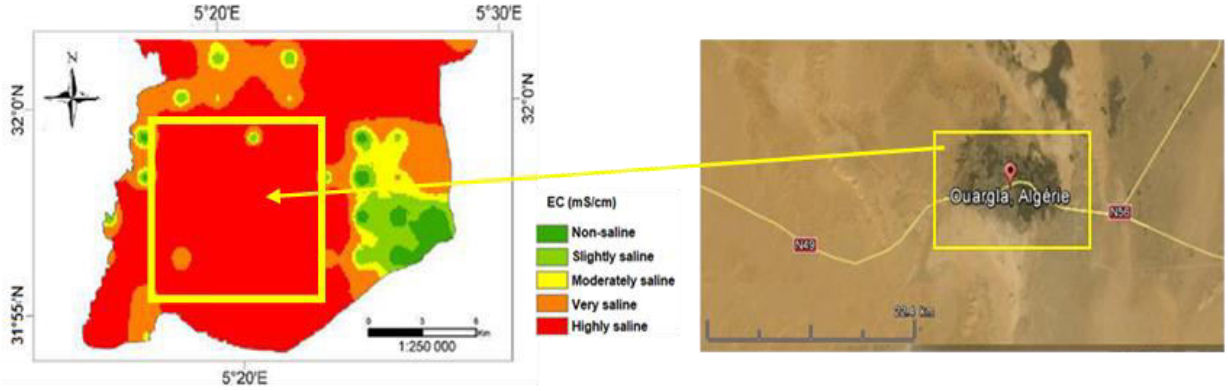
Oasis provides a means to explore the unproductive desert environment. The date palm creates a microclimate that is suitable for cultivating fruit trees, cereal crops, and vegetables (Bouguedoura et al., 2015). It also promotes the spread of biodiversity in a hostile environment.

Oasis agriculture takes place in a relatively fragile agricultural ecosystem. Farmers there face water resource shortages, ecological fragility, low soil fertility, and soil salinization (Wang et al., 2023). Therefore, the objectives of a farmer are hindered by the hard ecological conditions of arid environment.

In the old oasis, most palm groves have soil with a salinity level exceeding 12 ds/m. High levels of salts indicate low soil fertility or reduced agronomic potential, which, in turn, affect the microfauna and organic matter biomass. The conductivity map shows a central zone with high salinity (see Figure 5), mainly due to a malfunctioning drainage system (Amrani et al., 2023). In addition, the water is scarce and highly saline, making it unsuitable for irrigation (see Figure 6).

The Ouargla oasis is located in a depression, which makes it a favourable site for water accumulation and stagnation. As result, the natural environment in the Ouargla basin is rapidly deteriorating due to excessive hydromorphy and salinity caused by the constant use of saline water for irrigation and a shallow surface water table with high salinity levels. These

conditions can be damaging to crops. In summer, water scarcity caused by aridity and high salinity, and in winter, waterlogging due to difficulty in draining excess water, limit the cultivation of herbaceous crops and reduce the yield and quality of dates (Bouguedoura et al., 2015; Faci et al., 2017).



(Charikh, 2023)

Figure 5: soil salinity map of the Ouargla oasis

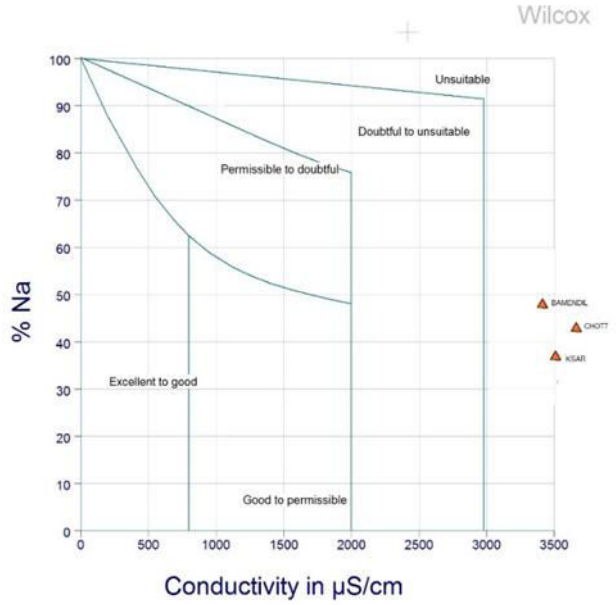


Figure 6: Water quality in the Ouargla oasis according to the WILCOX diagram

The dynamics of changing systems

Rural areas worldwide are undergoing constant social, economic, and environmental transformations (Qin & Liao, 2016). The basin of Ouargla's oasis has also experienced significant economic and ecological changes, with reduced agricultural production, yields, and farm incomes, as well as decreased vegetative cover and varietal erosion. The changes and developments in the Ouargla region are reflected in the various modifications made to agricultural space, significant transformations in terms of surface area and production, the management of water resources amidst concerns of scarcity and surplus, and the irreversible shift in the workforce of the agricultural sector (Chaouch, 2018). The oasis has gradually become more urbanized over time (Salhi, 2015). However, the transformation of the economy can manifest as urban growth and improved agricultural production in rural areas (Qin & Liao, 2016). Factors such as the fragmentation of agricultural production and the evolution of traditional concepts are crucial in influencing this transformation (Ge et al., 2020).

However, the resilience is the fundamental attribute of rural regional systems and plays an important role in promoting rural revitalization and development (Ma et al., 2023). Therefore, there is a dynamic that counteracts this trend, as shown in Figure (7), which illustrates how the different system types interact. This dynamic is mainly the result of internal and spontaneous movements that have been observed, such as agricultural land restructuring through the purchase and sale of land, and disposals for ownership reasons. Additionally, farm rehabilitation actions are taken for social and economic reasons, initiated by owners who have financial comfort.

The government interventions through the rehabilitation of drainage networks, the fight against weeds and pests, rehabilitation of access roads, palm trees rejuvenation, ... (table 3). Even if they have not achieved fully their objectives, they seem also to mark this dynamic. The study of Djelefaoui & Chaouch (2020) has reported that the profitability of the oases is improved and the projects with local initiatives have enabled a certain resumption of oasis activities by youth. This indicates a trend towards the possibility of improving socio-cultural criteria, and therefore the sustainability of Ouargla's palm groves.

Overall the vast palm grove of the region appears stagnant and does not present a development area, however, the aggregate parcels structure does not mean that there is no movement. Rather it has an internal movement; they alter them by the changing owners because of inheritance and sale or purchase decisions.
Farms in the palm grove of the region are mostly acquired through inheritance, followed by buying what makes areas reduced because of fragmentation (Figure 8).

The land in the oasis refers to the number of palm trees. The concept of surface area is absent in the oasis space. The palm groves have densities between 135 to 200 palms/ha. The property unit is the farm and the concept of ownership is closely linked to the availability of water. It is usually acquired by inheritance, that is what makes the condo between several heirs is widespread. Areas are reduced and less than 1ha. Currently, there is a dual trend in arming: on one hand, farms are becoming smaller due to fragmentation, while on the other hand, some owners are consolidating their land through purchases, resulting in larger farm sizes.
Over half of the farms in the region are of less than 0.5 ha of surface. This is the effect of fragmentation by inheritance which has nearly 50% of acquisition modes in the region. 16% gardens have an area between 0,5ha and 1ha. Farms that have a surface area of 1ha constitute 27% of farms.

We can say that the increase in farm acreage is mostly due to purchase, where 90% of farms have increased their acreage by buying in the Chott area and 75% in the Bamendil area and over 66% of farms in the Ksar area (Figure 9). Inheritance participates by only a small proportion. This movement of agricultural land is mainly observed when the parcels are contiguous (adjacent to each other).

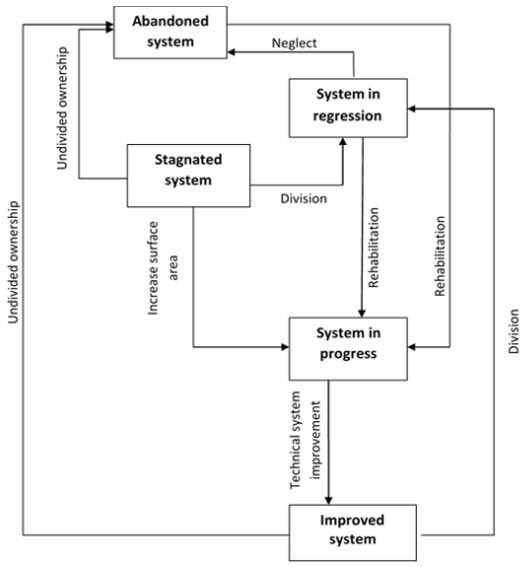


Figure 7: the dynamics of the evolution of systems in the oasis.

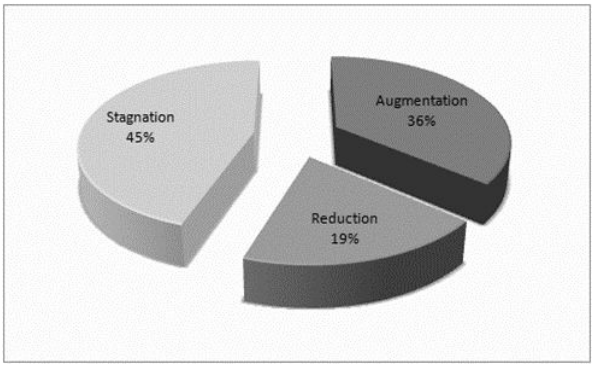


Figure 8: Evolution of the size of farms in the old oasis of Ouargla basin

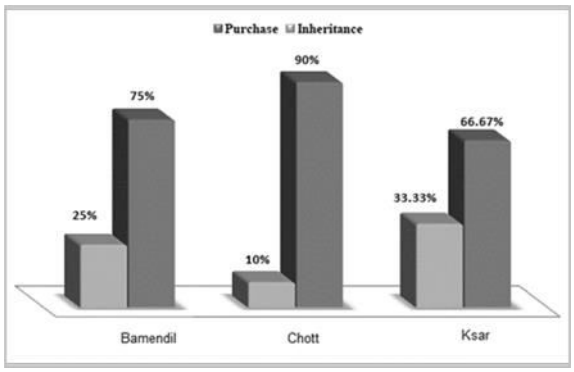


Figure 9: Evolution of the size of farms in the old oasis of Ouargla basin

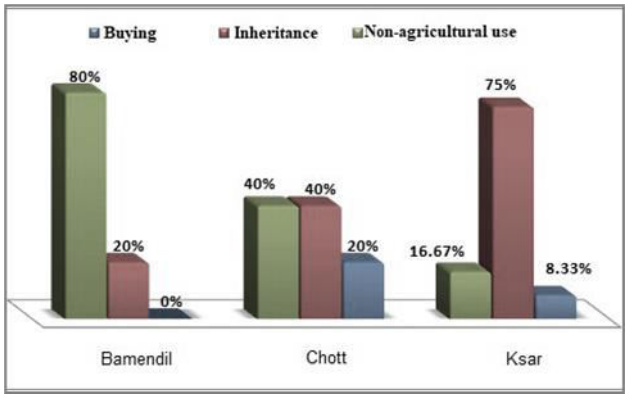


Figure 10: Evolution of the size of farms in the old oasis of Ouargla basin

Table 3: Rehabilitation of old palm groves qualifying for support from the National Fund for the Development of Agricultural Investment

Actions supported	**Definition**	**Terms and conditions of eligibility**
Grubbing up old plantations	Removing unproductive palm trees involves cutting them down, removing the root ball, and disposing of the resulting debris.	- Farmer seeking to rejuvenate his palm grove; - Appropriateness of uprooting approved by the agricultural subdivision; - Formal commitment to replanting.
Soil amendment with sand	Improving the physical properties of soils.	The farm is situated in an area with high salt levels and is displaying signs of deterioration as a result of increasing water levels.
Plantation of Djebbars	Creation of a palm grove to rejuvenate and increase the potential.	The farmer must have: - a minimum planting area of 0.5 Hectares - a proven water resources at a rate of 1 liter per second per hectare for the planned plantation. - the plantation must include 20% of plants from various local varieties, - the farmer must provide a formal undertaking to protect the plantation with a windbreak.
Destruction of palm trees infected by bayoud disease	Removal and burning of palm trees infected with Bayoud disease	- Report established by the Wilaya Plant Health Inspectorate (IPW). - Replanting is subject to authorisation from the IPW and can only take place one year after the palm tree has been uprooted.
Weeding palm groves	Chemical control of perennial weeds, using an appropriate approved herbicide	- Support subject to the formulation of a treatment project integrating all the farms in the homogeneous area concerned,

		- Project proposed by the applicants concerned and initiated by the Wilaya Technical Committee.
Protection of date bunches (Deglet Nour)	Protection of bunches from autumn rain by plastic film bagging	The appropriateness of the local initiative remains subject to the approval of the local agricultural authority.
International export promotion	Granting of a premium to encourage date exportation	Specific conditions defined by ministerial or interministerial decree
Packaging of dates for export (Acquisition of specialised equipment for new units or renovation of existing units)	Equipment for sorting, washing, moistening, packaging and storage	Opportunity subject to approval by the central administration after consultation with the local agricultural administration. - The promoter is required to contribute a minimum of 15% of the investment.
Processing of dates of low market value and date palm by-products (dried palms, cornafs, leaves	Specialised equipment for processing packaging and recovering by-products	- Project proposal, on local initiative, presented by a family, a group of families or producers with suitable premises and know-how. - Opportunity subject to validation by the central administration after consultation with the local agricultural administration.
individual or collective drilling, sinking wells and masonry work	- Artificial borehole with a diameter of up to 50 cm for lifting water for irrigation.	Geophysical and hydrogeological study of the point to be drilled. Water Authority approval
Construction of concrete storage tanks with a maximum capacity of 100 m^3	Artificial watertight reservoir in armoured concrete for storing irrigation water	Farmer with evidence of water resources with a view to the installation of a water saving irrigation system
Support for energy products	Financial support for energy products used in the production of strategic crops	Eligible crops: cereals, forage crops, potatoes and phoeniculture

Conclusion

Agriculture in the old oasis of Ouargla is subsistence type. The agriculture system that is based essentially on the association of three stages of culture where date palm is considered the main crop, often associated with domestic livestock. The three layers of the palm grove is a biological resource highly diversified and adapted to very restrictive conditions.

Degradation and neglect of farms in the region are due mainly to more social problems than ecological. Farmers have shown their ability to confront the difficult conditions of the environment where they live.

The results showed that the abandonment of the palm grove is often due to the same constraints: the indivisibility and the aging of the agricultural workforce.

For other agricultural systems: regressing and stagnated. It is the socio-economic and environmental constraints that hinder the activity of farmers.

However, systems in progress and improved systems the ecological constraints, salinity of soil and water, recovered water, lack of water, ... are the most significant problems.

We emphasize that by the concept of rehabilitation (a notion that is widely used by development stakeholders) we intend the actions of enhancement on the environment of farms or agricultural areas affected by degradation (degraded system, regression) while development operations concerns environments where there is an effort to improve agricultural production, or at least to maintain a situation of stagnation.

In light of the presented elements that characterize this dynamic, it becomes evident the need to consider development actions to rehabilitate some farms that do not have sufficient assets to begin sustained growth (low acreage, age palms, failure water, inadequate income, ...). For farms that contain more or less sufficient potential (areas of more than one hectare, sufficient water to grow crops underlying palm, sufficient financial resources) to form the "locomotive" of the dynamics of development in the basin, there should be more sustained and targeted actions accompanying this development. Just as we must hope for social and cultural changes that will integrate over the palm grove in the social dimension (valuation as heritage and social status) and also a higher value to agricultural products (increase in agricultural prices on the market).

Data availability: Data will be made available on request.

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