



The role of the jessour system for agrobiodiversity preservation in Southern Tunisia

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Abstract

Mediterranean countries are still characterized by a great variety of historical cultural landscapes, as a result of the millenary human presence that has shaped the territory through agro-silvo-pastoral practices. In the arid regions of south eastern Tunisia, the land use is predominantly olive trees cropping and, because of the difficulties related to water scarcity, local population have developed a peculiar water harvesting technique ensuring the cultivation activities and minimising the risk from droughts. Jessour consist of small dams built across gullies and wadi thalwegs, creating a succession of terraces that partially retain the surface water and sediments required for crop growth. These structures are commonly built inside the watercourses to intercept runoff and sediments or at the foot of slopes. Considering that the biodiversity associated to traditional agricultural practices is important, especially in difficult environments, for ensuring food and nutrition to local communities, it results fundamental to preserve these peculiar practices. Moreover, taking into account that the presence of these water harvesting techniques allows the existence of a wide variety of flora and fauna species it result to be even more important to identify and maintain them from an ecological point of view. The research focused on the jessour identification and mapping in order to define their distribution nearby Douiret, in south of Tunisia, and describe the wide variety of species cultivated thanks to this traditional water harvesting solution. Moreover, using QGis software it was possible to analyse both jessour structure and peculiarities as well as their distribution according to the local morphological structure.

Keywords Traditional water management system · Jessour · Agrobiodiversity · Traditional knowledge

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Introduction

Traditional agricultural systems are receiving increasing attention at the international level due to their multifunctional role contributing to preserve and protect local practices and cultures as well as the surrounding environment (Agnoletti 2014; Plieninger et al. 2006). In fact, the maintenance of traditional agricultural activities contributes to preserve the balance between inhabitants needs and nature respect (Singh and Singh 2017). Moreover, traditional farming systems are characterized by a lower degree of specialization and the use of more environmentally friendly farming practices than modern systems (Marini 2011). In traditional agroecosystems people have adapted farming techniques to their environment, which has had, in many cases, positive effects on wildlife richness and abundance (Selmi and Boulinier 2003). Traditional systems are the result of centuries of coadaptation between man and nature being an example of how local populations have been able to exploit environmental assets to satisfy their needs while respecting nature peculiarities (Marten 2001; Vos and Meeke 1999). Considering this, a wide range of systems has been created which are characterized by a high variety both in terms of landscape structure and biodiversity. The complexity of these realities has contributed to create a diversified landscape structure which is able to host different flora and fauna species.

In semi-arid regions, competition for water resource between upland and lowland areas is a recurrent problem as population and water needs increase (Labombe et al. 2008) for that reason water harvesting techniques play an important role in water resources conservation in (semi-)arid environments. In many semi-arid and arid regions in Mediterranean countries, such as southern Tunisia, water harvesting techniques have a long history (Fleskens et al. 2005). A commonly applied water harvesting technique in Tunisia is the jessour (jessr = singular), in which runoff and associated sediments from a micro catchment, called impluvium, is collected on a terrace in order to increase water availability for vegetation (Schiettecatte et al. 2005; Castelli et al. 2019). Playing an important role in aquifer recharge and encouraging water infiltration thanks to the terraces system they contribute to flood control protecting not only the cultivations but also the infrastructures and buildings. In addition, jessour contribute to wind erosion control, by preventing sediment from reaching the downstream plains, where the wind is very active (Abdelli et al. 2017); they are also effective in increasing soil moisture storage, prolonging the growing season for natural vegetation, and decreasing the amount of supplemental irrigation required for growing fruit trees (Al-Seekh and Mohammad 2009). The Jessour are traditional water harvesting techniques widely used for growing crops and fruit trees, allowing the cultivation of olive, almond and fig trees beyond their climatic zone (Calianno et al. 2020).

In this framework it is clear that the jessour presence contributes to diversify both the landscape structure and the variety of species cultivated. This second aspect is particularly important as it helps to maintain a high level of agrobiodiversity creating a diversity of habitats and complex ecosystems in harsh geomorphological conditions.

The study conducted has had the aim to analyse jessour structure and distribution in a sample case of study near Duiret in south Tunisia and to evaluate the agrobiodiversity correlated.

Materials and methods

Study area

The study area is located in the south of Tunisia, at 570 km from Tunis city and at 21 km from Tataouine (Fig. 1). The area is hard to be delimited by natural features or administrative borders: the surface doesn't offer any features to clearly find a contour, while the administrative borders—the imadats of Douiret and Nouvelle Chnini—includes a vast area of sandy desert. Due to these reasons, the border of the site has been delimited with a circular area, 4 km radius, covering the jessour area nearby Douiret.



Fig. 1 Location of the study area in Tunisia

The study area covers a total surface of 5026 hectares. The surface is rough, furrowed by many riverbeds (dry for the most part of the year), characterized by a rocky desert landscape interrupted by numerous jessour. The altitude ranges from 394 m msl and 650 m msl (mean sea level), with an average of 515 m msl. The surface is pretty rough, with an average slope of 16% and a max slope of 68%.

The region of Tataouine is located in the south-eastern part of Tunisia, which has a pivotal position on the borders of two opposite meteorological action centres:

- The Western Sahara which is subjected to a hot and dry sub-tropical Saharan climate
- The gulf of Gabes in the Northeast which enjoys a Mediterranean climate, temperate, hot and relatively wet.

The climate of the region is a factor favouring desertification. The general features of this climate can be summarized in the following points (MINEDD 2006):

- Rains that are rare and irregular, falling during the cold season; the average annual rainfall in Tataouine is 123 mm/year, with an average of 22 days of rainfall per year, 37 days maximum and 6 days minimum. On average, one in five years that is dry and nearly one in 10 is very dry;
- A very contrasting thermal regime marked by mild winters and hot to very hot summers;
- High evaporation, especially during the period October-May, when there is water in the soil;
- The almost absolute drought between May and September;
- Warm, dry winds (sirocco)

The study area includes the villages of Douiret, both the old one and the new one. According to the Institut National de la Statistique the new village host approximately 600 inhabitants, while the old one—carved in a mountain side—has been abandoned since the mid-1980 during a process of modernization, promoted by the authorities, aimed to renew the country (Bessioud and Mazouz 2017).

The jessour

The traditional water conservation system of the jessour is widely spread in the region of the Matmata mountains (Hill and Woodland 2003). This very old and laborious form of earthworks ravines is used for the cultivation of olive, figs and date trees; sometimes, cereals and vegetables are grown partially intercropped in small areas. These structures are built inside the watercourses to intercept runoff and sediments (Figs. 2 and 3), or at the foot of slopes.

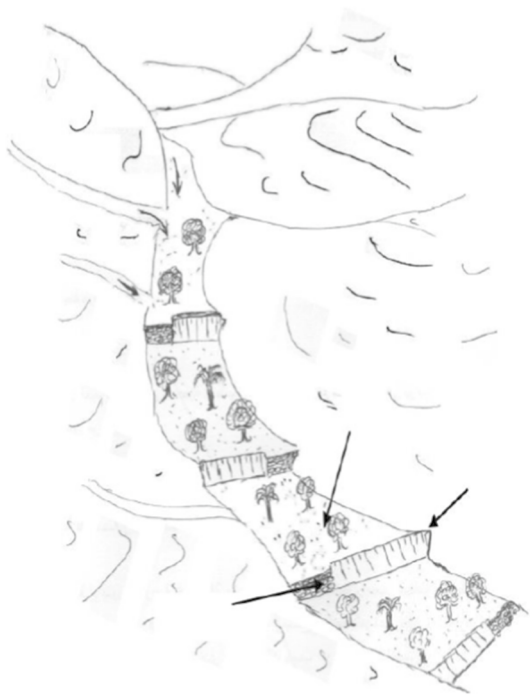
This system is composed by three main components:

- The dike (*tabia*): made by a small earth embankment sometimes consolidated with stones in the thalwegs to retain runoff and thrust materials. Due to sedimentation after each flood, new layers of soil settle behind the dikes. Over time, a levelling of the initial slope of the thalwegs is done naturally. After a few layers of sedimentation, it is necessary to raise the dike to exceed in some cases the 5 m height. The excess water is discharged through a lateral weir (*menfess*) or central (*masref*) reinforced with dry stones whose threshold is about 30–80 cm below the jessr level.



Fig. 2 The jessour system in a watercourse

Fig. 3 The sketch shows the different part of jessour structure: the dike, the weir and the arable land behind the dike (the terrace itself)



- The terrace: it is the reservoir where the fertile runoff accumulates. This is where the local population practice arboriculture (olive trees, fig trees, almond trees, palm trees) and annual crops (barley, bean, lentils, wheat).

- The *impluvium* (latin word commonly used in English for watershed): as a natural lateral border of the jessour.

Normally, the jessour have a very small cropping area. This system has three main function:

- Soil moisture increase for cropping
- Groundwater conservation
- Flood control and protection of the downstream infrastructure

The jessour is the main source of food of the region since it's the only system that allows cultivation of the barren land. Thanks to this system, the rocky desert can be grown as a garden, and it can host a wide variety of crops, trees and vegetables, allowing a strong and resilient agrobiodiversity managed by the experience of the local population (Altieri and Toledo 2005).

Methodology

The present study has had the aim to analyse the landscape structure of a sample area in southeast Tunisia and its link with the variety of species characterizing it. To do that the research has been developed in parallel tracks: the analysis of local landscape and its features; primary and secondary data collection on existence of flora species that are part of the studied system.

In detail the first part of this research focused on studying the jessour system that characterises the area considered. To do that a map of the dikes was created to both identify them and explain their distribution on the land. This map is the results of photointerpretation of the google satellite images. Furthermore, the mapping analysis made possible the identification and classification of two different types of jessour adopted in the local system: the ones along the watercourses and the ones on the slopes. Thanks to this it was also possible to observe their distribution in the study area and analyse their features. In the second part, we show how this system have allowed an incredible variety of agrobiodiversity, in a place otherwise impossible to cultivate. The number of varieties found in the site is the proof of his viability not only for food security, but also to maintain and preserve the local biodiversity. To obtain information about all the species characterizing the site some field surveys have been carried out. The data obtained about the local agrobiodiversity have been collected thank both to field surveys and local producers' interviews. This second step played a fundamental role in order to obtain a complete frame of all the species locally cultivated with all the varieties related. Both the field surveys and the interviews focused on collecting information about the species cultivated to better understand the species diversity characterizing the study area; they were carried out during the summer period between the months of June and August 2019. In particular, the interviews were done through the administration of questions to local producers aimed at obtaining the list of species cultivated by each farmer. Considering that the bibliographic research turned out to be insufficient, the field visits and the local producers' interviews were fundamental, providing the opportunity to collect and list all the species characterizing the area considered for the present study.

The dike distribution has been mapped using QGIS, identifying their length in a linear shapefile. Only the dike inside the area has been mapped. The data have been elaborated

to obtain detailed information to better explain the system. A Digital terrain model (DTM) map have also been used to elaborate more data about the jessour typology and spatial distribution. The map has been downloaded from an online repository, it has a resolution of 30 m and it has been also used to elaborate the slope map to better explain the geomorphological distribution of the jessour.

Results

As shown in Fig. 4—distribution of jessour in the study area 4, the chosen study area doesn't have clear boundaries, thus a circle of 4 km radius has been selected to include the interesting features. The jessour are spread on all the site surface and it is possible to subdivide them in two types: the ones built inside the watercourse and the ones built at the foot of the slopes.

From the Fig. 5 it is possible to see the differences between the two types of jessour. The picture on the left shows the watercourse type, the most common found in the area. The dikes (in yellow) are built to catch the waterflow directly, thus are short and arranged in series one after the other. The distance between this type of jessour is variable, and it depends on the slope of the watercourse: the higher the slope, the closer the dyke. The cultivated area between the dikes is relatively small, and the plant density is usually modest, with very few plants per jessr (sometimes even a single tree).

On the other hand, in the second kind of jessour, the dikes are built along the riverside, catching the water coming from the hill slopes. Since the slope is lower than the previous type, this kind of jessour have long, C or L shaped dikes, not as tall as the first type. The cultivated areas are wider, with a high plant density. This kind of jessour is less common, and their presence is mostly in the plains near the village.

Tables 1, 2, 3 characterize existing jessour systems.

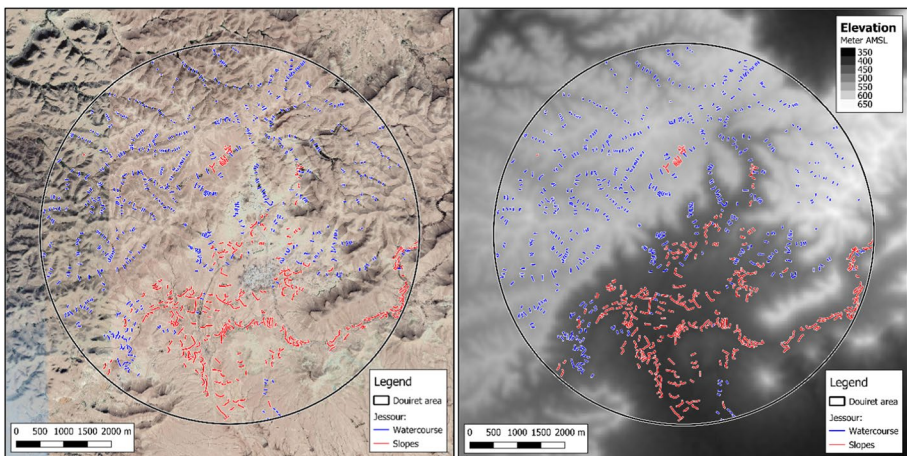


Fig. 4 Distribution of jessour in the study area. The map on the left shows the jessour distribution with a satellite picture in the background while the map on the right identifies a trend in the type of jessour distribution. This second map has been developed with the utilization of the digital terrain model so that is possible to understand that the major part of the watercourse jessour (in blue) is distributed in higher altitude areas than the jessour built on the slopes (in red) which are more common on the lowlands

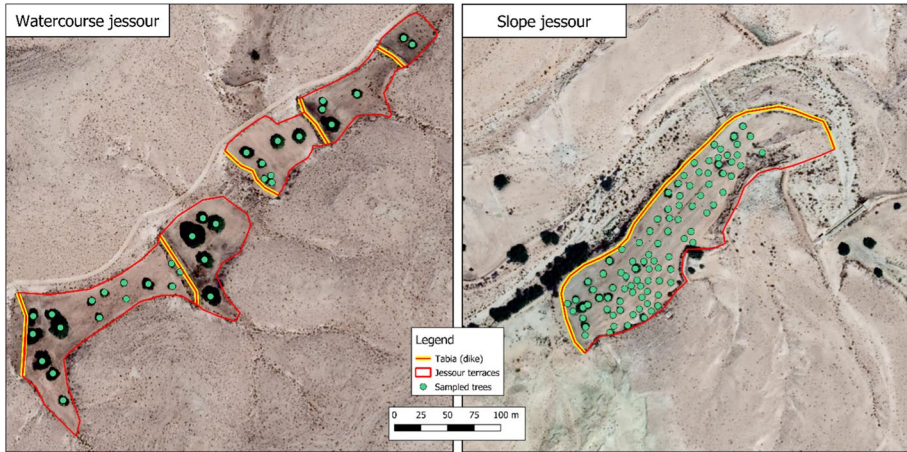


Fig. 5 Types of jessour. The map is divided in two sections: on the left the picture shows the watercourse jessour, with a low-density implant and consequent short dikes intercepting the river course; on the right slope jessour are mapped highlighting the presence of a wider arable field, with higher density of implant and a single, long dike that embrace all the useful surface, capturing the water flowing from the hill above

Table 1 Number of jessour identified in the study area, divided by type

Jessour	Number of jessour		Total count
	Type of jessour		
	Watercourse	Slopes	
Uncultivated	36	29	65
Cultivated	586	231	817
Total count	622	260	882

The data obtained highlight also how many are still cultivated in 2020, indicating that the major part of the jessour are still cultivated and that there are no particular differences among the ones built in the water-courses and the one on the slopes

Table 2 Data about the jessour length divided by type

Total length of jessour (meters)			Average length of jessour (meters)				
Jessour	Type of jessour		Jessour	Type of jessour		Avg. length	
	Watercourse	Slopes		Watercourse	Slopes		
Uncultivated	1.561	3.165	4.726	Uncultivated	43,36	109,14	72,71
Cultivated	28.197	28.985	57.183	Cultivated	48,12	125,48	69,99
Total Length	29.758	32.150	61.909	Avg. length	47,84	123,65	70,19

In the left table total jessour length is reported while, on the right, reports information about the average length which highlight the differences between the two type of jessour: the one built in the watercourses are shorter than the ones on the slopes due to the territory morphological features

Table 3 The two tables above give information about altitude (amsl-above mean sea level) and inclination

Altitude of jessour (meters amsl)			Inclination around the jessour (%)				
Jessour altitude	Type of jessour		Overall	Jessour slope	Type of jessour		Overall
	Watercourse	Slopes			Watercourse	Slopes	
Average	529	449	506	Average	6,56	4,78	6,04
Maximum	613	565	613	Maximum	23,56	18,26	23,56
Minimum	404	397	397	Minimum	1,21	0,63	0,63

On average the watercourse jessour are located in areas with higher altitude than the ones built on the slopes (on the left) as well as they are built on more sloping surfaces (on the right)

From the data presented in the previous tables, is clear that most of the jessour are currently cultivated. The most frequent kind of jessour are the watercourse ones, with a count nearly three times the slopes jessour. On the other hand, since the average length of the dike is significantly higher in the slopes jessour (123 m compared to 47 m of the watercourse ones), the total length of the two kind of dikes in the study area is similar, with a slightly higher value for the slopes jessour.

The geographic and geomorphologic location of the two kinds of jessour also reflects some differences: while the watercourse jessour are placed at higher altitude and slopes, with an average of 530 m amsl and 6% of inclination, the slope jessour lie in a lower altitude (565 m amsl) and lower inclination terrains (4% average inclination).

The presence of jessour in the area sustains a wide variety of cultivated species, among all olive and figs trees which are the principal cultivations of the area. The area also hosts a large variety of other fruit trees, like almond, pistachio, peach tree, grape trees and date palms, in addition due to the presence of this water conservation mechanism, many herbaceous plants grow spontaneously or are cultivated as a secondary resource. The most common ones are Alfa (*Stipa tenacissima*), Drian (*Stipagrostis pungens*) and rem't (*Hammada scoparia*) for forage, Roman Chamomile (*Chamaemelum nobile*), Wild rocket (*Diplotaxis tenuifolia*) and Lazole for food (Fig. 6).

The population that cultivates these arid lands allows the presence of livestock in the area, furthermore increasing the biodiversity of the region thanks to many breeders. Sheep, goats and camels are the most common livestock found in the area, and many farmers have chickens for personal consumption.

Olive trees

The main cultivation in the area is the olive trees, and it's possible to find lots of varieties cultivated in Douiret region. A brief description of the cultivar identified in the area follows.

Chemlali Tataouine ('Chemlali Aberan' in Berber's language)

The Chemlali Tataouine is, with Zarrazi, one of the main oil varieties of the Tataouine region. The posture of the tree is sagging with elongated fruits. This variety is grown both for oil and as a pollinator for Zarrazi.



Fig. 6 Example of vegetation watercourse jessour. From the picture it is clear the drystone walls distribution along the water course and the way they are built. Most of the tree trunks are buried under layers of soil which have settled over the years

Zarrazi ('Azarezi' in Berber's language)

The Zarrazi variety is confronted with the problem of homonymy. Indeed, this denomination gathers at least two morphologically and biochemically different varieties: the southern Zarrazi and the Zarrazi of Gafsa. The southern Zarrazi, which is the most widespread in Tunisia, it is cultivated in the region of Medenine and the jessour of Matmata and Tataouine. This variety have sterile male which means that it is always cultivated next to the pollinating varieties called 'Dhokkar' or with the varieties Zalmati and Chemlali. The fruits of this variety are quite large which makes it a double purpose variety used for both oil production and canning. The variety is vigorous with early maturity; the fruits are spherical while the cores are oval.

Fakhari and Toffehi ('Afaker' and 'Tédéfouit' in Berber's language)

Cultivated in the region of Douiret in Tataouine, these varieties are found in reduced specimens where they meet the varieties Chemlali Ontha, Zarrazi and Chemlali Tataouine. The fruits from these varieties are oval-shaped and large enough to be suitable for both oil production and canning.

Jemri

Under the name of Jemri several varieties that have in common the colour of the pulp, which is bright reminiscent of ember, are included. Three different types have been identified in the area, namely Jemri Dhokkar, Jemri Bouchouka and Jemri.

The Jemri Dhokkar variety is widespread in the area, serving as a pollinator of the Zarrazi variety. The tree is of medium vigour with erect habit; the density of the foliage is medium and the width between nodes is average. It has lanceolate-shaped leaf of medium width and length. The blade is flat with a dark green colour on the upper side and light green on the other side.

Limouni

The tree of this variety has a weak vigour and spread, with a loose density of the foliage. The leaf has an elliptical lanceolate shape of length and average width. The blade is flat green on the upper side and light green on the other side. During our field trips in the area, we encountered only one specimen.

Zarrazi Injassi

The variety Zarrazi Injassi is a diffuse variety of the area, it has good vigour and medium density of foliage. The leaf has a lanceolate form.

Dhokkar

It is one of the most dispersed variety of the area. Under this denomination we could distinguish two different varieties: Dhokkar and Dhokkar Ontha.

The Dhokkar, that serves as a pollinator, is planted alongside the variety Zarrazi. The tree has a strong vigour with spreading habit to drooping, the density of the foliage is compact. The leaf has a green colour on the upper face and yellow on the other side.

Another variety, named Dhokkar Ontha, can also be found in this region. The tree of this variety has a medium vigour with spreading habit, the density of the foliage is loose, its leaf has a green colour on the upper face and yellow on the other face. According to the farmers the oil of this variety is sweet, and its olives can be directly eaten without salt.

Fig trees

Another widespread cultivation of the area are the fig trees, again with many different varieties briefly described below. The different cultivar of fig trees come in different types, that define the production and the way to cultivate them. In Douiret area we can expect to find two types, the Smyrna Figs and the San Pedro Figs. For the first type, the pollination is mandatory, otherwise the fruits will drop from the tree before they're fully developed. The second type produce two crops of fruit each season; the first crop (breba crop) grows on old branches and develop without cross-pollination; the second crop comes from the new growth, but the fruit will usually drop from the tree before it matures if pollination hasn't occurred. From the following varieties, only the Bither belong to this type.

Bither

This cultivar is widespread in Tunisia and cultivated in all regions as a crop as well as a garden tree. It presents a large morphological polymorphism. During our surveys through traditional fig-growing regions in Tunisia, more than 5 different accessions were collected. The Bither accession grown in the mountainous desert regions (as the study area) has

shown large-scale fruit for the first crop, which is intended primarily for fresh consumption. The fruits are soft, rich in water and less sweet. The second production produces fruit of medium size mainly for drying, but often are also consumed fresh because they are rich in sugars, with excellent taste and robust skin that leaves their manipulations very easy on the local market. This variety is widely multiplied in commercial nurseries next to the Zidi variety that will be mentioned later.

Tayouri Akhdhar

Tayouri Akhdhar is an accession of the Smyrna type, with mandatory pollination. It is characterized by a ripening that matures from late August to early September. This accession is moderately productive and intended for direct consumption as well as drying. The fruits are medium large in light colour after drying and very good taste.

Rogabi

It is an accession of the Smyrna type, therefore unified. Thus, in the absence of pollination, the autumn figs wrinkle and fall before maturation. The harvest of autumn figs is abundant, the fruits are of good taste quality and intended mainly for consumption in fresh. It is characterized by a long period of production, which runs from mid-July to early September.

Also, this accession is demanding for access to water and distinguished by significant productivity. The cultivation regions are the mountainous desert, the southern coast and the lowland southwest. It shows that it is a successful accession to produce fresh figs in the centre and the south, it requires to be multiplied in the commercial nurseries and to propagate it on a large scale.

Wedlani

For the production of fresh autumn figs, Wedlani is among the most important; Smyrna type, with obligatory caprification. The fruits become ripe from the end of July and continue until early September. This accession is moderately productive, but the figs are of great calibre and excellent quality, they are recommended for direct consumption. Drying is possible, but the figs become dark in colour. Accession widespread in the southern desert (Douiret) and the coastal-south (Zarzis) because of its water requirements and in caprification.

Zidi

It is a variety of the type Smyrna, therefore requires caprification. Its maturation period is from mid-July to early September according to the natural regions of Tunisia. It is very productive. Zidi is a polyclone variety, which is cultivated in the mountainous desert, the lowland southwest, the northern valleys and the northern coastal. In addition, it has retained almost the same pomological characters of trees, leaves and fruits. With the exception in the oases of Tozeur where the oasis conditions are somewhat specific, there has been a slight phenotypic variability under the effect of the environment. The Zidi variety is the most abundant in national nurseries. In southern Tunisia, this variety has shown a good adaptation. It is the most productive of all other accessions investigated, large to very large

fruit, which are widely marketed fresh in the market. These figs are also used for the production of dried figs. Surplus and waste are delivered to the processing industries.

Discussion and conclusion

Mankind has largely modified the surrounding environment taking advantage of its potentialities in order to fulfil his needs. Undoubtedly the human actions in modifying the natural features have contributed to shape unique landscapes which are an example of human and nature coevolution during the centuries according to local traditions and cultural values (Santoro et al. 2020). In many arid countries, runoff water-harvesting systems support the livelihood of the rural population and Southeast Tunisia provides a typical example of the intensive management of scarce water resources in southern Mediterranean drylands (Ouassar et al. 2009). Throughout history, Tunisians have implemented several types of water harvesting techniques (Adham et al. 2016, 2017) and jessour are an ingenious way developed by local communities to make agricultural activities possible in harsh environments. Their construction has clearly shaped the territory creating a unique landscape while contributing to community's sustenance. Moreover, the land diversification has created a diverse landscape which is also important from an ecological point of view. In fact, through a centenarian and complex interconnection between techniques and knowledges, the jessour system has transformed an arid and difficult territory into a farmable garden with a wide agrobiodiversity. The presence of different cultivated species has clearly contributed to create diversified habitats, making possible the coexistence of different flora and fauna species both raised and spontaneous. It is thus clear that the traditional jessour system has deeply influenced the surrounding environment contributing also to enrich its ecological value. The harsh features of the area do not facilitate the presence of a wide variety of species, particularly the flora, especially due to the water scarcity, but thanks to the development of the jessour system during the centuries it was possible to create good conditions for cultivation and livestock. In addition, as widely described before the jessour technique, being developed for the production of various agricultural commodities, plays additional roles like aquifer recharge, via runoff water infiltration into the terraces; flood and wind erosion control while being also effective in increasing soil moisture storage.

According to the results obtained it is clear the wide spread of jessour in all the area analysed. They are a fundamental component for both landscape structure and traditional knowledge resulting, even today, an essential part to sustain local community economy and livelihood security. Due to the small size of these structures and the limited access to their location, their inventory and monitoring are very difficult (Abdelli and Ouassar 2012) but even only from the satellite images it is clear their distribution and features. From the analysis conducted two different kinds of jessour have been identified and, considering the map overlap with the digital terrain model (DTM), it is clear that their distribution is affected by morphological features. This difference implies a further layer of landscape diversification due to the dissimilarities between the two kind of jessour existing in the area. Moreover, the two jessour types denote also different planting system which contribute to further diversify both the system and the area as a whole.

Considering the data obtained, we conclude that the traditional jessour system contributes to maintain a high variety both in terms of landscape structure and cultivated species. The drystone walls constituting the jessour structure allow the creation of a complex landscape mosaic diversifying the arid region around Douiret while contributing to preserve

the water resource needed for cultivation activities. In addition, the traditional agricultural system characterizing the area enable the preservation of a complexity fundamental to preserve a good level of agrobiodiversity, allowing the cultivation of different species and creating environmental conditions favourable for the existence of flora and fauna spontaneous species. It has to be considered that in the present study the wild species of fauna and flora characterizing the system have not been listed being not enough the data collected to support the paper purposes. This could constitute a further analysis of this particular system.

The results obtained from the analysis of all the jessour of the area highlight that the majority of them are still cultivated representing a fundamental part of the local economy and that the density of cultivated species changes in function of the jessour structure. The ones in the watercourses, which are also the most representative of the area, are characterized by a lower number of plants cultivated on their surfaces than the ones built along the riverside, catching the water coming from the hill slopes, because of the less available surface to be used. The results also highlight the fact that there is not a significant difference between the watercourse and the slopes jessour in terms of abandonment: only 65 jessour (36 watercourses and 29 slope) out of 882 are classified as uncultivated. This demonstrates the fundamental importance of this kind of system in the local current economy.

Taking into consideration that one of the most urgent priorities in biodiversity conservation and management is the assessment of landscape conservation conditions, as well as the analysis of landscape changes (Martinez et al. 2010), this study might constitute a starting point for a more in-depth research on landscape structure change dynamics in order to promote a restoration process with the aim of protecting and managing this reality and the related agrobiodiversity.

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Code availability Not applicable.

Declarations

Conflict of interest The authors declare no conflict of interest.

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Consent for publication Not applicable.

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