frontiers | Frontiers in Sustainable Cities

TYPE Original Research
PUBLISHED 21 November 2022
DOI 10.3389/frsc.2022.898079

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to Urban Resource Management, a section of the journal Frontiers in Sustainable Cities

RECEIVED 16 March 2022
ACCEPTED 18 October 2022
PUBLISHED 21 November 2022

CITATION
Hamrita A, Jiménez DF and Rejeb H (2022) Peri-urban agrifood systems and a landscape project in the southern Mediterranean. The case of the urban agglomeration of Sousse (Tunisia).
Front. Sustain. Cities 4:898079.
doi: 10.3389/frsc.2022.898079

Peri-urban agrifood systems and a landscape project in the southern Mediterranean. The case of the urban agglomeration of Sousse (Tunisia)

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Peri-urban agrifood systems are often subject to urban pressure and other territorial factors, which justifies a detailed study and analysis from multiple points of view. The main objective of this work is to analyze the periurban agri-food systems of the urban agglomeration of Sousse (Tunisia), one of the most important in the country, from a landscape perspective. This work adds to the literature on policies and strategies for the planning and development of Tunisian cities, which are currently facing several environmental and social challenges, of which climate change, food security and sustainable development are the most important. This research focuses, as mentioned above, on the case of the urban agglomeration of Sousse (Tunisia), where the concurrence of different factors (political, environmental, economic, etc.), together with clearly deficient regulations and uncontrolled urban development, is threatening the survival of a traditional, largely family-based agricultural model, based on a mixed or polyculture production system, with olive groves predominating. The latter is vital to ensure the economic maintenance of many families and to actively contribute to food security, with the consequent production of varied, fresh, and quality food. In this sense, we present a specific method that, based on the integrative and strategic significance of landscapes, and on the Landscape Character Assessment methodology, employs the so-called "landscape project" as a tool to strengthen the resilience and sustainability of peri-urban agriculture and to prevent the loss of a landscape heritage that has always been considered crucial for the identity of the local population. The document highlights the importance of the concept of green infrastructure, which, when properly integrated into land-use planning instruments, can contribute to enhancing local and sustainable agri-food systems. It also points out the need to promote Agricultural Parks, a protected status already recognized in Spain and other countries, as instruments for management, promotion, and development, and puts forward some specific proposals for the enhancement and activation of peri-urban agricultural landscapes in the Sousse conurbation. In relation to this last aspect, it insists on the need to modify the current forms of governance,

which would require greater leadership and involvement of the main actors in peri-urban agriculture.

KEYWORDS

peri-urban agricultural landscape, agroecology, green infrastructure, landscape character assessment, food security, Sousse

Introduction. Peri-urban agricultural landscapes in urban agglomeration of Sousse: General issues

In general terms, peri-urbanization is to be understood as a dynamic involving the spread of the city toward the surrounding rural areas, which generally entails the gradual occupation of fertile agricultural lands and the resulting degradation or loss of agrological or productive capacity (Nilsson and Bernhard, 2011; Janvier et al., 2015). Peri-urbanization in urban agglomeration of Sousse, which constitutes the specific object of the present paper, has generated a complex mesh of fragmented and fragile agricultural landscapes; all this is the result of a deficient regulatory system and poor urban planning (Hamrita et al., 2021b). Despite the conflicts that have been identified, many of Sousse's peri-urban agricultural landscapes, based upon small- and medium-sized holdings and on inherited labor and knowhow, persist, thus providing witness to the success of the model of these family farms (Hamrita et al., 2021a), based on olive cultivation, mosaics of crops and short food supply chains.

The growing interaction between Sousse's urban sprawl and the proximity of agricultural areas is giving rise to conflicts relating to the use and ownership of the land, with new commercial, tourism, and industrial facilities making an appearance. Under these complex circumstances, with resistance and change at loggerheads, Sousse's peri-urban agriculture is manifesting multifunctionality and capacity to provide new environmental (Lovell et al., 2010), sociocultural, and landscape (Termorshuizen and Opdam, 2009) services, and guaranteeing the local production of fresh prime-quality foodstuffs. This experience can be extrapolated to other similar contexts in the country and in the Maghreb. Since its independence (1956), Tunisia's town planners have considered these peri-urban agricultural spaces as spheres of production (Morgan and Sonnino, 2010) that make a significant contribution to food security (Aubry et al., 2012), but they have simultaneously been seen as potential land reserves for future urban development projects. On the contrary, in many western countries, peri-urban agricultural spaces are garnering attention due to the increasing importance being given to food in the context of energy and climate crises; these areas become especially relevant in the new urban agendas of what is known as the "new food equation" (Sanz Sanz, 2016). By definition, peri-urban agriculture is "proximity agriculture" (Vidal, 2011; Grimonprez, 2016) and is capable of responding to the need to shorten the food chain (Aubry and Chiffoleau, 2009); moreover, it plays diverse roles, among which is the maintenance of the agricultural territorial matrix and therefore, protection of the landscape, regulation of land prices and many others (Geniaux and Napoléone, 2011), obviously as long as suitable town and spatial planning are in place (Delattre et al., 2014). To this urban pressure and the competition for use of the land or of other resources can now be added, paradoxically, public decisions relating to conservation of agricultural land to be included in open space systems and for the design of green infrastructures (particularly necessary in peri-urban spaces), by means of land planning instruments or other formulae that are yet somewhat unclear (Mata Olmo and Yacaman Ochoa, 2015).

In the last two decades, many farmers, agronomists and researchers around the world have responded to the extractive industrial model with their interesting ecologically based alternative approaches that try to optimize and stabilize production with minimal impact on the territory (sustainable agricultural systems). Interestingly, agroecology not only addresses the environmental and ecological aspects of the crisis of modern agriculture, but also the economic, social and cultural ones (Rickerl and Francis, 2004).

European countries are paying more attention to the green infrastructure (GI) following the European Commission's Communication to the European Parliament in 2013. It seems that if properly integrated within land management instruments, this properly implemented concept can provide comprehensive solutions at different scales to strengthen the ecological and social resilience of open spaces, especially those affected by urban sprawl processes that present dynamics of agricultural abandonment and processes of territorial fragmentation of habitats and agricultural spaces (Mell, 2008; Yacamán Ochoa et al., 2020). The concept of green infrastructures introduces the idea that cities and their surroundings are ecosystems that are part of a green and blue network and that must be protected and enhanced to ensure the production of essential ecosystem services for society (Liao, 2012). The various experiences in Europe and North America, in which the concept of green infrastructure has been realized, have promoted a greater integration of ecological functions within the urban and peri-urban territory.

Specifically, in agri-food systems, the green infrastructure (GI) has proven to be capable of creating opportunities for innovation and for opening new forms of planning and development (Gunderson and Holling, 2004; Berkes et al., 2009). It is therefore believed that the green infrastructure can provide a series of benefits for the construction of a local and sustainable agri-food system: proximity, quality, short food supply chains and fair prices of agricultural products. For this reason, it is understood that green infrastructure could be a tool of interest in the case of peri-urban agriculture in the urban agglomeration of Sousse.

Currently, the synergies between agroecology and green infrastructure appear to be evident, thus enabling an innovative approach for the management of peri-urban agricultural areas, with a gradual and progressive acceptance and use throughout the world, particularly in urban and peri-urban environments, since these spaces are especially vulnerable to extreme climatic events and the associated risks. The adoption of the green infrastructure in Europe and North America appears to have opened a path for better integration of ecological functions in these spaces (Li et al., 2019) and for the maintenance of the territorial matrix and the multifunctionality of agricultural landscapes (Pappalardo et al., 2017).

The rest of the article is structured as follows: a first part reserved for materials and methods, second part showing the main research results, and the last part reserved for the discussion and conclusions.

Materials and methods

Study area

The urban agglomeration of Sousse constitutes a favorable field of research for several reasons. Firstly, it is an archetype of peri-urbanization processes due to its demographic and urban dynamism. In addition, the urban agglomeration is a geographically rich space as it integrates urban, agricultural, and natural landscapes (Table 1). Finally, the study area has seen a change in the use of its peri-urban agricultural landscapes, which has led to the emergence of new perceptions on the part of the actors in this territory and of new ecosystem and landscape services.

This research focuses on the peri-urban agricultural area of the urban agglomeration of Sousse, located on the eastern coast of Tunisia, about 140 km south of the country's capital (Figure 1). We have chosen this case study due to several concurrent factors, to develop and assess the potential and problems of the proposed methodology. This peri-urban agriculture presents the largest area of olive groves in the Tunisian Sahel. The characteristics of the territorial matrix and agricultural landscapes are quite unique, and the dynamics of progressive degradation of agro-ecosystems and loss of fertile soil constitute a reality that highlights the need to develop appropriate territorial planning, management and governance.

TABLE 1 Distribution of land uses by type and municipality in "Grand Sousse" (ha).

Municipality	Arable land	Forest and rangeland	Non-agricultural land	Total
Sousse city	928	3	2,205	3,136
Sousse Riadh	2,961	111	710	3,782
Sousse Jawhara	-	-	-	-
Sidi Abdelhamid	-	-	-	-
Hammam-Sousse	942	9	745	1,696
Akouda	3,891	82	520	4,493
Kalaâ Kebira	22,455	1,799	650	24,904
M'Saken	28,926	4,272	1,268	34,466
Kalaâ Sghira	6,637	3,541	442	10,620
Zaouia/Ksiba/Thrayet	-	-	-	-
Total	**66,740**	**9,817**	**6,450**	**83,097**

Source: CRDA (2018).

The administrative region of Sousse comprises a total of 16 municipalities (of which only 10 corresponding to the "Grand Sousse" have been analyzed for this article) covering a total area of 2,669 km^2 (∼1.6% of the country's total) with a population amounting to 584,875 inhabitants, who are mainly concentrated in the coastal municipalities of the urban agglomeration, Akouda, Kalâa Kébira, Kalaâ Sghira, and M'Saken (CRDA, 2018). This vast territorial and administrative unit has a long agricultural and livestock farming tradition, and the main agro-ecological systems are woody crops and rain-fed herbaceous species (olive groves and fodder crops 126,000 ha) and irrigated crops (1,804 ha); horticultural crops and trees (especially fruit trees) are also included (Tables 2, 3).

The relief, the result of long geomorphological processes, typically presents three main units: the Kalaâ Kébira and Kalâa Sghira hills, the Oued Laya depression, the Sousse-Moureddine hills and the Oued Hamdoun basin. The whole area has a relatively homogeneous topography (plains, depressions, and hills), with an altitudinal range from 160 to 25 m asl. Forests and grasslands (with an area of 264,619 ha, 7.14%) play a key role in protecting against erosion and desertification phenomena, which are quite intense; they also contribute to mitigating the negative impacts of climate change. These public lands present a forest cover and some wetlands and infrastructures (CRDA, 2018).

Olive cultivation has been, to date, of great economic and social importance, constituting one of the principal pillars of Tunisia's economy in general terms, and of agriculture and

FIGURE 1
Location of the urban agglomeration of Sousse. Own source.

TABLE 2 Distribution of irrigated areas (public) per municipalities (ha).

Municipality	Irrigable areas	Irrigated areas	Cultivated areas
Akouda	781	603	603
Kalaâ Kebira	607	571	571
Kalaâ Sghira	0	0	0
M'Saken	211	150	150
Zaouia/Ksiba/Thrayet	205	175	175
Total	**1,804**	**1,499**	**1,499**

Source: CRDA (2018).

TABLE 3 Distribution of irrigated areas (private) per municipalities (ha).

Municipality	Irrigable areas	Irrigated areas	Cultivated areas
Akouda	300	179	150
Kalaâ Kebira	400	374	300
M'Saken	200	297	180
Kalaâ Sghira	150	78	100
Total	**1,050**	**928**	**730**

Source: CRDA (2018).

the agri-food industry in particular (Hannachi et al., 2007). At the national scale, olive production represents ∼10% of total agricultural production, and 70% of the product undergoes a transformation of (olive oil) for export (Bayoudh, 2014). The sector employs 20% of the active agricultural population (Karray et al., 2009; Gharbi et al., 2014). About the urban agglomeration of Sousse, olive cultivation provides 50% of total agricultural production, and almost two-thirds of the holdings (60%) are based upon traditional production systems. This activity is very much influenced by highly variable climatic conditions, a high degree of fluctuating productivity, low planting density, and aging of the olive trees (25% of these are over 70 years old). Other characteristics of Sousse's peri-urban agriculture are the notable urban pressure, the weight of the sun and beach tourism model, the development of dispersed residential urbanization and the development of commercial, industrial and infrastructural facilities (Figure 2), which is leading to the emergence of new functions and services.

Landscape character assessment methodology

Landscape Character Assessment (LCA) is a British methodology developed by the Countryside Agency that allows an informed judgment to be made about the "landscape character" (of each landscape), an aspect resulting from natural and human factors and their interrelationships through history. This methodology allows moving from the initial characterization of a given landscape to action for its subsequent planning and management, giving great weight to public participation throughout the process. It has been

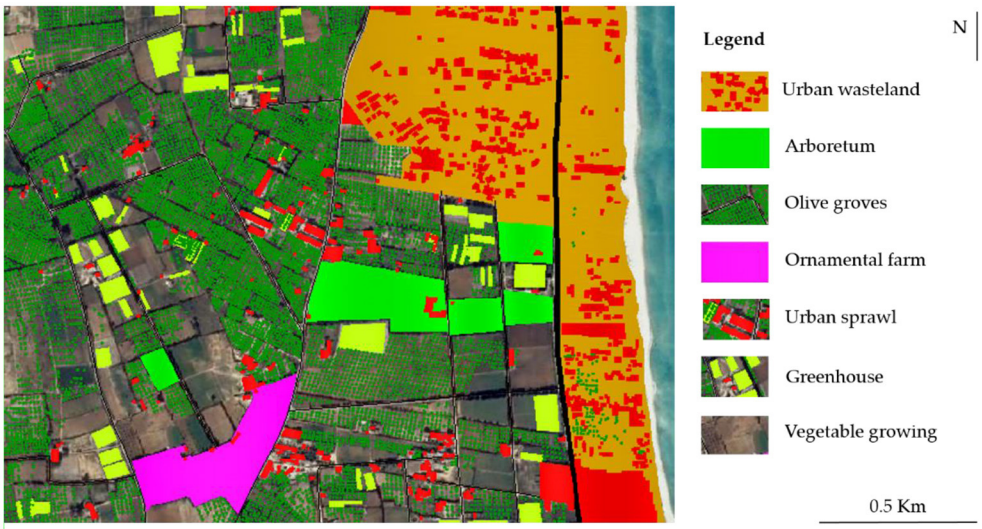

FIGURE 2
Land use and urban sprawl in the irrigated public areas of Chott-Mariem (Sousse Municipality). Own source.

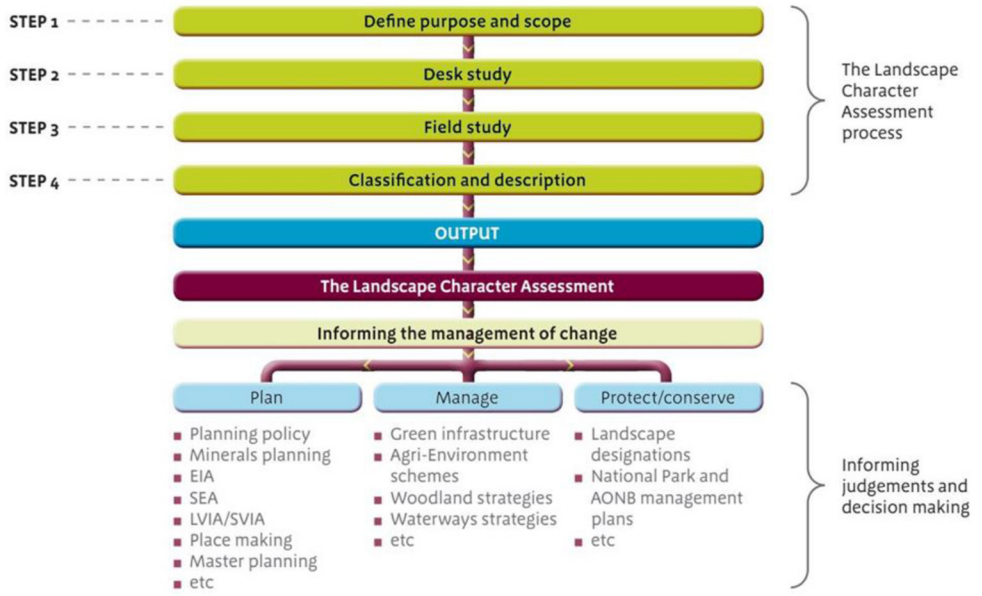

FIGURE 3
Landscape Character Assessment process. Source: Natural England (LI Technical Information Note, 2015).

applied systematically in Spain for the identification and characterization of the landscapes of the Villuercas massif, in the region of Extremadura (Fernández álvarez, 2015), and for the first time in Tunisia within the framework of this research. The methodology "recognizes the fundamental role played by agriculture and forestry and the different forms of development in shaping the landscape" (Swanwick, 2002).

The procedure implies an understanding of the natural and socio-cultural variables which interact to create the landscapes. There are two main iterative stages in the process of Landscape Character Assessment. The first one "Characterization" embraces the practical steps involved in identifying areas of distinctive character, classifying, and mapping them, and describing their character and the second

one "Making judgment" is based on the results of the characterization process and involves making judgments about landscape character to inform decisions related to the type of application (Tudor, 2014) (Figure 3). Adoption of the above-mentioned methodology has enabled us to establish the landscape diversity existing in the study area, which can be seen in many parts or areas (or "units") of the peri-urban agricultural landscape, which are demarcated according to their specific physiognomy and homogeneity, related to their past and present elements and processes. Evaluation of the landscape character helps to support the decision-making process (Ambroise et al., 2000; Ambroise and Toublanc, 2015) and contributes to reaching certain goals relating to sustainable development; this, in turn, gives rise to new environmental, sociocultural, and landscape functions, and to renewed models of conflict management. Thus, the peri-urban agricultural space falls within a project of landscape coherence, involving the real participation of the stakeholders; therein, the landscape character endows agri-food production with a meaning and a brand linked to its historical evolution, its territorial identity, and to the perception thereof. This method attempts to consider landscape as a new implement for assisting in the development of intervention measures (Ambroise et al., 2000; Ambroise and Toublanc, 2015) based on the needs of the agriculture and the farmers, of the landscape, and of the population (Mata Olmo, 2006). This systematic methodology can be adapted to the necessary scales of public and operational activities for the implementation of land and landscape management, as a complement to the traditional system of zoning.

Results

Pertinence and contribution of the landscape character assessment methodology in the construction of peri-urban agricultural landscape areas

Based on field work, exhaustive knowledge of the territory and the use of Geographic Information Systems (GIS), it has been possible to recognize the diversity of production systems (Dugue et al., 2016) in the urban agglomeration of Sousse and to establish a typology (Derioz, 2008; Derioz et al., 2008) of homogeneous agro-landscape units with their own

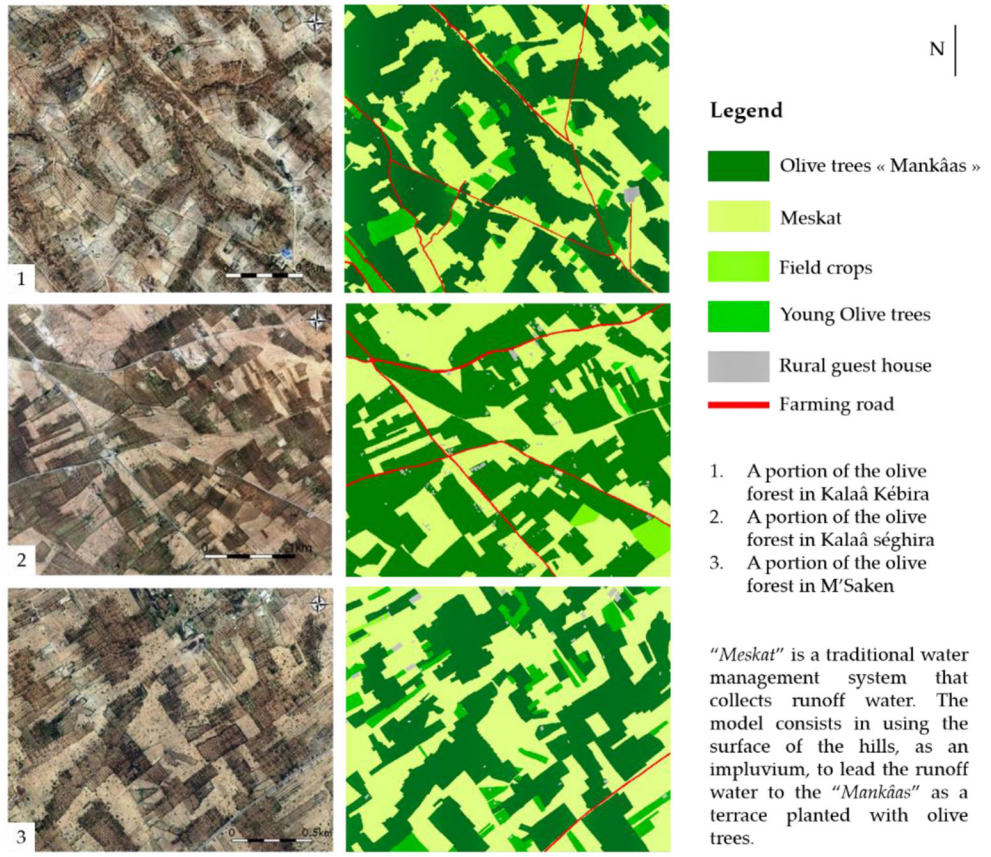

FIGURE 4
Land uses in PALA "Ghaba" (partial images of the olive groves in Kalaâ Kébira, Kalaâ Sghira, and M'Saken). Own source.

characteristics. These units have been referred to by the authors as "Peri-urban Landscape Agricultural Areas" (PALAs).

We have differentiated the following six agro-landscape units, which generally comprise small to medium-sized private family farms: "Senia", characterized by traditional polyculture and low-intensity livestock farming; "Ghars", which features traditional production systems dominated by rain-fed woody crops; the "Chott Mariem public irrigated area", which comprises the horticultural areas of the north-eastern fringe of the agglomeration and is dedicated to early crop production; the "Chott Ro-maine public irrigated area", with intensive tree and horticulture in open fields or under olive trees; "Zaouia-K'siba-Thrayet", with olive groves and fodder crops and low-intensity livestock farming; and lastly, "Ghaba", with its traditional production system of olive groves and extensive livestock farming (Figures 4, 5).

Characteristics of the production system

Three main production systems were characterized, namely, the classical olive growing systems, the mixed production systems, and the specialized systems. The classical olive growing systems is the spatial expression of the association of olive productions and techniques implemented by the local society and the ancestral hydraulic system "meskat". The specializations concern almost 10% of the farms visited during the interviews. These farms are specialized in the production of flowers and ornamental plants, as well as the production of young plants.

The mixed production system, traditionally oriented toward self-consumption, is the dominant one in the study area and is clearly characterized by the combination of two or more crops (three or even four) within the same farm unit or property. The most common practices involve olive and vegetable production (the latter outdoors or in greenhouses); olive groves with fodder crops; olive groves combined with livestock farming; oil, vegetables, and fruit production or olive groves together with fruit trees and livestock farming (Figure 6). About peasant production, the combination often involves four activities: olives, fruit and vegetables, and livestock farming, thus constituting the most original mosaic of the agricultural system (Houdart et al., 2012), a fact that also ensures self-consumption by the families themselves. This type of holding is easily recognizable in all the areas of peri-urban agriculture, with the notable exception of the "Ghaba" area, where olive groves clearly dominate. Interestingly, olive cultivation is the basis of all the combinations observed in Sousse's peri-urban agriculture. The small family farm for self-consumption (Figure 7) has played an essential role in the historical configuration of peri-urban agricultural landscapes in Sousse (85% of farms are <5 ha) and is of vital importance in terms of food security, resource conservation and the maintenance of biodiversity (Jouili, 2016). Be that as it may, this type of landscape is located within the urban sprawl and is currently under pressure from urbanization, which threatens its survival.

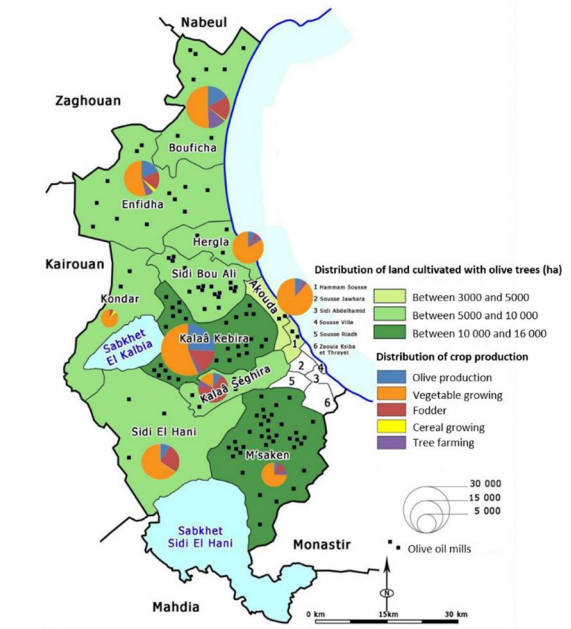

FIGURE 5
Distribution of agricultural lands and croplands in the urban agglomeration of Sousse. Source: CRDA (2018).

For this reason and obviously others (climate change), strategies of resistance of peri-urban agriculture have been established by farmers to respond to economic and social needs, in particular, the diversity of agricultural activities (market gardening, arboriculture and animal husbandry), the search for an additional urban activity and, in some cases, the association of cultural and touristic activities with peri-urban agriculture, in view of the increasing awareness of farmers of the multifunctionality of peri-urban agriculture and the growing demand for nature in the city by citizens.

Products are marketed by means of direct or indirect sales. The farmers and/or livestock farmers sell their products in proximity markets, more informal street markets, or they offer them to small local shops or in neighboring areas; they sometimes choose to sell their products on the farm itself to eliminate transport costs (Figure 7). The success of these short food supply chains is an indicator of the high level of relationships established between the city and its surroundings (Chaffotte and Chiffoleau, 2007), although both environments differ greatly in nature, configuration, and functions (Herault-Fournier, 2010). The agri-food chains are established within a radius that never exceeds several tens of kilometers (Sarrazin, 2012) and that marketing is always formalized, directly or indirectly, through one single intermediary.

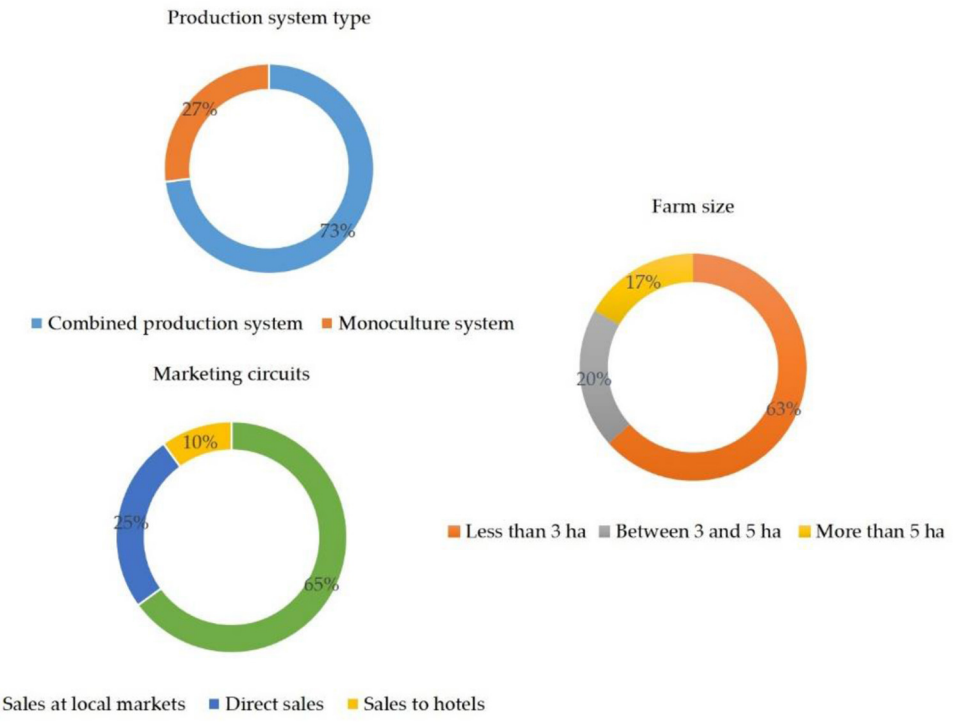

FIGURE 6
Characteristics of the agricultural production system in the urban agglomeration of Sousse. Own source.

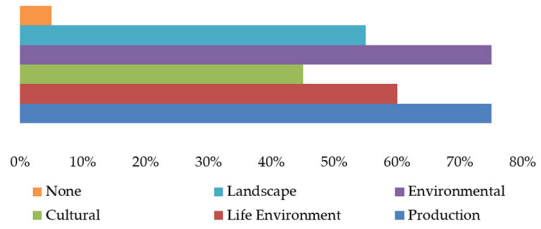

FIGURE 7
Opinions regarding the importance of peri-urban agricultural landscapes in the urban agglomeration of Sousse. Own source.

Proposal for the valuing and activation of peri-urban agricultural landscape areas

Despite the virtues that are currently recognized in landscape projects as a form of planning and sustainable development of the territory, only 30% of the institutional actors and social agents involved in the case study are aware of this reality, as can be deduced. of the surveys and interviews carried out in previous unpublished studies (doctoral thesis of the main author). For this small group, the "partial knowledge" of the advantages of the landscape project is due to personal concerns and, also, to the knowledge of different projects developed in other countries, in particular France and Spain. The remaining 70% showed total ignorance about this type of experience.

Another important idea provided by the surveys and interviews suggests that agriculture should persist in the peri-urban areas of the urban agglomeration of Sousse since these constitute a vast "green space", being the only non-urban territorial reality in a region that lacks policies aimed at the conservation of the environment or the landscape. In addition, the interviewees showed a strong attachment to the landscape of the olive groves, since they consider it an identity heritage. On the other hand, there is a broad consensus that it is necessary to promote alternative tourism (rural tourism, agrotourism, ecotourism) to make agricultural landscapes more attractive and apply ecological labeling systems to local production (Figure 8).

Agricultural park in peri-urban agricultural landscape areas: A project of agroecology, and landscape

The landscapes of Sousse's peri-urban agriculture constitute an important reservoir of resources, providing multiple ecosystemic services (particularly in relation to food supply) which strengthens country-city relations and endows the urban environment with identity and quality. The problem is that,

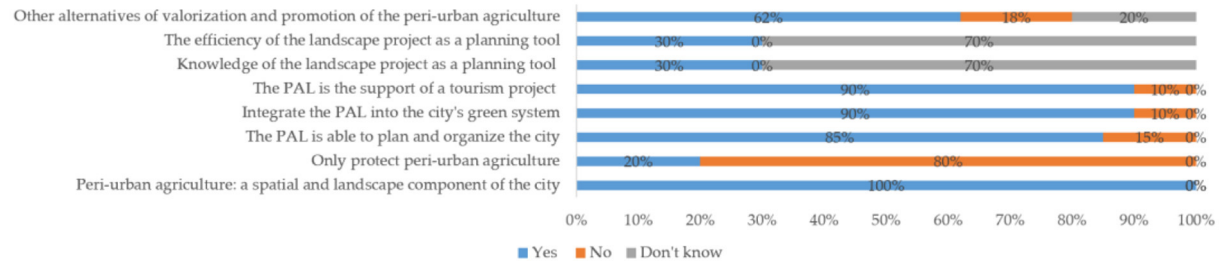

FIGURE 8
The future of peri-urban agricultural landscapes according to the main stakeholders in the urban agglomeration of Sousse. Own source.

in these territories, there is no concurrence, at least at present, of land planning and management strategies aimed at rendering them more dynamic and protecting them from the pressures they face. In this context, it can be seen that the involvement of the stakeholders in peri-urban agriculture in the formalization of an agricultural park, with bottom-up initiatives, could be a valid formula for landscape action and land management, and for strengthening the territorial matrix, the peri-urban agriculture and maximizing the economic, environmental and socio-cultural potential of the territory by means of agro-ecological practices. The principal goals of the present research involve supporting and promoting the existing traditional agricultural and professional activities and strengthening the role of the main actors, i.e., farmers and livestock farmers, in accordance with the principles of participation, cooperation, equality, and sustainability. Indeed, the strategic lines of the project are intended to promote best agricultural practices, innovation, agroecology, and proximity agriculture, and to intensify distribution and direct sale through the aforementioned short supply chains. The ultimate goal involves meeting the growing needs of a society that requires a space combining the provision of environmental and cultural services, and of quality proximity food products.

Participation of the main stakeholders, particularly farmers, the competent institutions in agriculture and land planning, and, basically, civil society as a whole, is considered to be vital with regard to promoting this project; the latter could provide solutions to many of the problems detected and could also strengthen the sustainable use of endogenous, social, economic, natural and cultural resources. Prior to addressing the explanatory part of the project, its objectives, and forms of management, we propose addressing two fundamental questions: the importance of constructing a landscape culture as a basis for the territorial project, and how to get this initiative moving, given that it requires activating a landscape policy.

Between landscape mediation and landscape policy

The chances of a "landscape project" arising spontaneously for peri-urban agriculture in the agglomeration of Sousse and in the case of Tunisia, in general, are highly unlikely. Experiences studied in different countries give an idea of the importance of Landscape as a mediator between societies and their environment by means of a research-action approach involving several disciplines and actors (Derioz, 2008). Mobilization and involvement of the key stakeholders in a collective landscape project (participation) in peri-urban agriculture calls for a type of "cultural revolution". Thus, prior to any landscape action, there is a need for awareness, meditation, or "project culture" (Lazarev, 2009). To address private actions by local actors, there is a need for convergence around a "common vision" and for "global shared action" in peri-urban agriculture and landscape. But undoubtedly, the social actions identified in these spaces do not appear to be moving in this direction, and the behavior of the actors is still, to a great extent, highly individualistic and/or conditioned by the existence of a paternalistic State which provides certain allowances for given activities. In view of this reality, there is a pressing need for the institutions and organisms participating in landscape studies and policies to begin to establish a network of communication and exchange of information with regional and local authorities and associations to finally operate at the scale of each farm and farmer. The most important part of the landscape mediation approach involves, precisely, shared know-how and the training of the local actors to prepare them for management and get them committed to the project. This long-waited-for landscape policy calls for a noteworthy collective effort to afford a better understanding thereof and to promote participation, develop a culture in the material, and integrate landscape in town planning and land management instruments; all this is intended, ultimately, to include consideration of landscapes within the major national policies.

The blueprint for an agricultural park

The implementation of the Regional Agricultural Park of the Olive Grove (PARO) strategy responds to the interests of the regional and local community, in order to strengthen and modernize the agricultural system in the context of the challenges of multifunctionality, preserving the peri-urban agricultural landscape and the activity on which it is based, promoting the consumption of local products and improving the quality of life of the inhabitants. These more general objectives give rise to a series of strategic objectives that are adapted to the reality of the regional and local sectors of the Sousse agglomeration and its peri-urban space, from a metropolitan perspective. These strategic objectives contribute to the generation of public assets (Donadieu, 2008) in the economic, environmental, cultural and landscape fields (Hamrita et al., 2021b) and are inspired by some experiences in the northern Mediterranean (Italy and especially Spain) that study the "Landscape Itinerary" as a model for the preservation and enhancement of the landscape (Hamrita et al., 2016). The so-called "periurban agro-cultural landscape areas" (PALA) identified in this work could serve as the basis for a future network of local agricultural parks in the framework of a large Regional Agricultural Park of the Olive groves, conceived as a landscape project encompassing all the landscape areas and all the landscape subtypes, the peri-urban "olive groves", which constitute the core of the richness and character of the peri-urban landscape of Sousse (Hamrita et al., 2021b). Considering that the main stakeholders are aware of the need to adapt to the new paradigms and needs of the concept of peri-urban agriculture in metropolitan contexts, the network of local agricultural parks seems to be a rather comprehensive concept (Fanfani et al., 2008; Perrotti, 2012); it is valid in terms of revitalizing an agriculture that suffers from different problems, such as the reduction of production capacity and changes in the landscape caused by the geophysical proximity to the city (Moratalla and Ochoa, 2015). The network of local agricultural parks (conceived on a smaller scale than that of the Parc Agricole Régional des Oliviers) would consist of the "PPI Chott-Mariem", the "PPI Chott-Romaine" and the "PPI Zaouit-K'siba-Thrayet", spaces that could well be considered as nodes of a future green infrastructure that would have a dual function: promoting the connectivity and ecological permeability of the territory and maintaining and enhancing productive ecosystems.

The reference studies consulted establish 5 conditions for a peri-urban agricultural area to be managed as an Agricultural Park (Moratalla and Ochoa, 2015), namely:

1. Political will and support, which must arise from the decision to conserve the peri-urban agricultural area in question.
2. Active collaboration of civil servants who are committed to and involved in the project.
3. Support from the agricultural sector.
4. Establishment of strategies and concrete actions, by means of a management body that provides a global, creative and proactive vision.
5. Militancy, which means a long-term commitment to achieve the objectives.

Discussion

The Landscape Character Assessment (LCA) method has made it possible to understand the evolving dynamics of landscape character and to develop practices for the development, enhancement, and preservation of peri-urban agricultural landscapes that can be emanated by the actors concerned. The PALAs areas support the landscape action and the prescriptions on access to land in peri-urban agricultural spaces and enhance the landscape elements and motifs in the context of a project of territorial coherence in order to replace the simple zoning of safeguarding agricultural spaces, and encourage the developers and planners of the territory to adapt this methodology to respond to the concerns of food security and the integration of peri-urban agricultural landscape in new modalities of action, responding to the challenges of sustainable development.

The peri-urban agricultural landscape of Sousse (Tunisia) is characterized by a mixed agricultural production system, based upon olive and fruit cultivation and horticulture (mainly open-air), with some of the abovementioned variants on small- or medium-sized holdings (a high degree of land division) managed by the farmers' families. Diagnosis of the agricultural landscapes and their dynamics, along with the agrological study, highlights the persistence of this three-crop system and of the predominantly family-run holdings; thus, quite an accurate view is provided of their capacity for resilience to the numerous pressures that they face (town-planning tensions, speculation, climatic and edaphic issues, changes in the markets, etc.). These landscapes have long been considered as land reserved for future urban growth, but in recent times, perceptions have changed; their strategic nature has been accepted by some, although not by public policies or legislation.

It could be said that there is currently quite a general consensus with regard to identifying other values contained in Sousse's peri-urban areas, beyond the mere production or supply functions. The multifunctionality of these spaces is recognized for the agglomeration in relation to their ecological, environmental, and landscape functions in the broader sense. In the present paper, we examined the different landscape models pertaining to the peri-urban agriculture in the urban agglomeration of Sousse in order to identify some lines of action that could contribute to valuing the benefits of landscape

projects in relation to sustainable land planning, endogenous development, and enhanced quality of life. The effectiveness of this new vision has been demonstrated by well-established experiences in European countries such as Spain, France, or Italy, wherein certain cases of peri-urban agriculture have been incorporated into some land-management and town-planning strategies and instruments. However, in Tunisia to date, no consideration has been given to landscape projects as an effective tool for sustainable land planning and development, and no attempts by certain administrations to protect agricultural land by other means have had any success. The traditional neglect of production and agricultural landscapes in metropolitan contexts places them in a difficult situation. Nonetheless, one can feel a certain optimism on observing a change in attitude and an incipient tendency to consider landscape projects as an effective instrument for managing and revitalizing the local peri-urban agri-food system in Sousse and in other functionally similar areas.

The Regional Agricultural Park of the Olive groves is a tool for the activation of Peri-urban Agricultural Landscape Areas of Sousse. This approach makes it possible to propose a structuring and equitable project for the territory and the territorial community, which can bring an added value perceived by society. Thus, the integration of the quality and/or diversity of agricultural landscapes in the process of construction and promotion of the territorial identity aims to improve the peri-urban agri-food systems and contribute to sustainable development. Today, production values in Sousse are increasingly important to ensure the food security of society. The implementation, at the local, regional, and national levels, of policies and measures to protect, manage and develop peri-urban agricultural landscapes, in order to conserve or improve their quality and to ensure that people, institutions, and local authorities recognize their value and interest and participate in the relevant public decisions, is now urgent. The planning of Regional Agricultural Park of the Olive groves based on these values is starting to be a major political issue, in order to build a sustainable agri-food system and to review the public policies mobilized for the governance of peri-urban agricultural areas, in particular, the policy of the protection of agricultural lands. Policies that stipulate these types of local decentralized projects and small-scale strategies could open up new perspectives for the development of peri-urban agricultural territories in Tunisia. In this sense, public action must be developed in a participatory manner based on governance to propose a peri-urban agricultural food and green infrastructure in complementarity with the global agri-food system.

Conclusions

The present research attempts to propose and implement the Landscape Character Assessment as a systematic methodology for identifying and characterizing the peri-urban agriculture landscapes of the Sousse agglomeration, in Tunisia's Sahel, with the main goal of contributing to their evaluation and management in terms of town planning and landscapes, and of reorienting and valuing them. We have contemplated landscape in its double dimension: the one referring to its morphological, territorial, and functional materiality, and the one that refers to perceptions. From this perspective, landscape, therefore, constitutes both an object of research and study and a methodological instrument for analyzing and understanding the territory, its elements, components, and interrelations. The second objective refers to the landscape project itself, which can and should be developed upon the basis of multifunctionality and the new expectations and demands by users of peri-urban agriculture and their produce.

In view of the numerous challenges facing peri-urban agriculture, and the evident relationships between this agri-food activity and landscape, the landscape approach provides a global, systematic, and specific methodology in favor of peri-urban agriculture and attempts to endow it with the important strategic role it merits in the territory. The focus of the landscape analysis, based on one hand upon the dimension of the multiple functions of each territory (environmental, economic, historical, morphological, and cultural) and, on the other, upon the dimensions relating to perception and identity, constitutes a powerful tool at the service of territorial projects and which serves to recognize, communicate, and value the local natural and cultural resources that are synthesized and expressed in the landscape. Any question referring to the quality of agricultural landscapes, which pay witness to a vivacious agricultural and agronomic farming culture, inevitably leads to the farmers themselves; it is they who have secularly organized and managed the local agri-food system and space, shaping a landscape that displays great heritage values that currently constitute a fundamental component of the environmental quality of metropolitan areas, together with the function of production.

Synergies between landscape and development are favored by the proposal and the renovation of the paradigm of the landscape itself, with the displacement of the concept of "landscape as an object" to "landscape as a tool"; this idea is inevitably linked to action and intervention in the territory and to the improvement of the living conditions of its inhabitants. The landscape project, from a certain scale of intervention, cannot be separated from the territory project (practically synonymous), considering the different problems and involving multiple stakeholders in the search for consensual solutions. The principal objective, therefore, of integrating the quality and/or diversity of agricultural landscapes into the construction and promotion processes of territorial identity, in the case study, involves improving production systems and promoting the sustainable development of the territory.

The policies of decentralization initiated in Tunisia during the 10 years following the revolution create a framework

that is much more suitable with regard to providing local inhabitants with new alternatives and land-management tools, in order to gradually eliminate the technocrats and meet the specific needs of the territory and the community. Additionally, a great opportunity can also be seen in the increasing recognition of peri-urban farmers and the transcendence of the food question, which is coming to the fore in the new urban policies in response to the "new food equation".

In short, the landscape is presented as a method for renovation, integration, and participation in management and development through the proposal for agro-urban projects that protect agriculture from the metropolitan standpoint, in the shape of an agri-food green infrastructure (agricultural parks and other formulae), thus guaranteeing the territorial planning of food, as well as the innumerable services provided by ecosystems and by the landscape through a process of local territorial governance.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for this study in accordance with the local legislation and institutional requirements.

Author contributions

Conceptualization: AH and HR. Methodology and writing—review and editing: AH, HR, and DJ. Writing—original draft preparation and supervision: AH. All authors have read and agreed to the published version of the manuscript.

Funding

This research was funded by Ministry of Science and Innovation, National Project I+D+i 2019, Multifunctional and Territorialized Agri-Food Systems in Spain. Conceptualization and governance. Analysis of cases in Madrid and Castilla-La Mancha, ID2019-105711RB-C61/AEI/10.13039/501100011033.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The handling editor declared a past co-authorship with the authors AH and HR.

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References

Ambroise, R., Bonneaud, F., and Brunet-Vinck, V. (2000). *Agriculteurs et paysages: Dix exemples de projets de paysage en agriculture*. Paris: Dijon Éducagri éditions, 205.

Ambroise, R., and Toublanc, M. (2015). *Paysage et agriculture pour le meilleur*. Paris: Dijon Educagri éditions, 144.

Aubry, C., and Chiffoleau, Y. (2009). Le développement des circuits couts et l'agriculture périurbaine: histoire, évolution en cours et questions actuelles. *Innovations Agronomiques INRAE.* 5, 53–67.

Aubry, C., Ramamonjisoa, J., Babat, M.-H., Rakotoarisoa, J., Rakotondraibe, J., and Rabeharisoa, L. (2012). Urban agriculture and land use in cities: An approach with the multi-functionality and sustainability concepts in the case of Antananarivo (Madagascar). *Land Use Policy*, 29–2, 429–439. doi: 10.1016/j.landusepol.2011.08.009

Bayoudh, C. (2014). *Bilans oléicoles de la Tunisie.* Tunis: Réunion du comité économique du COI. p. 31

Berkes, F., Colding, J., and Folke, C. (2009). *Navigating Social-Ecological Systems Building Resilience for Complexity and Change.* Cambridge University Press. doi: 10.1017/CBO9780511541957

Chaffotte, L., and Chiffoleau, Y. (2007). *Vente directe et circuits courts: évaluations, définitions, typologie.* Montpellier: Les cahiers de l'observatoire CROC.

Commissariat régional au développement agricole (CRDA). (2018). *Le gouvernorat de Sousse en Chiffres.*

Delattre, L., Chanel, O., and Napoleone, C. (2014). Determinants of local public policies for farmland preservation and urban expansion: A french illustration. *Land Econ.* 90, 411–433. doi: 10.3368/le.90.3.411

Derioz, P. (2008). *L'approche paysagère: un outil polyvalent au service de l'approche opérationnelle et interdisciplinaire de problématiques environnementales. Interdisciplinarité et gestion environnementale : Partage d'expériences autour de la psychologie environnementale.* Universités de Nîmes-ARPEnv-Eco-Psy. p. 23.

Derioz, P., Laques, K., and Beringuier, N. (2008). *Présentation typologique des paysages du Parc Naturel Régional du Haut-Languedoc et analyse de leurs dynamiques – identification des enjeux pour le territoire*, 138.

Donadieu, P. (2008). Paesaggio, urbanistica e agricoltura. Dalle logiche economiche agricole alle logiche paesaggistiche urbane. Contesti. Città, territori, Progetti. *Agricoltura e paesaggio.* 1, 39–50.

Dugue, P., Soulard, C., Marrachini, E., Houdart, M., Michel, I., Rhaidour, M., et al. (2016). "Systèmes Maraîchers urbains et périurbains en Méditerrannée: Une Comparaison entre Meknes (Maroc), Montpellier (France) et Pise (Italie)," in *Organisation des agriculteurs et des systèmes agricoles dans les territoires urbains et périurbains*, eds H. Rejeb, and C. Soulard (Sousse: Ouvrage universitaire transdisciplinaire à comité de lecture international), 57–78.

Fanfani, D., Poli, D., and Rubino, A. (2008). *Pour un modèle d'aménagement et développement intégré des zones agricoles et périurbaines. Le parc agricole en Toscane centrale et occidentale.* Territoire(s) wallon(s) o Séminaire de l'Académie Louvain, Université de Florence. p. 10.

Fernández álvarez, R. (2015). La aplication de Landscape Character Assessment a los espacios de montaña media: el paisaje del macizo de las Villuercas. *Ciudad Y Territorio, Estudios Territoriale.* 185, 499–518.

Geniaux, G., and Napoléone, C. (2011). AY J-S. A spatial hedonic approach on land use change anticipation. *J. Reg. Sci.* 51, 967–986. doi: 10.1111/j.1467-9787.2011.00721.x

Gharbi, I., Issaoui, M., and Hammami, M. (2014). La filière huile d'olive en Tunisie. *Oil Crops Supply Chain Africa* 21–2, 6. doi: 10.1051/ocl/2013040

Grimonprez, B. (2016). *Vers un concept juridique d'agriculture de proximité. Benoît Grimonprez; Denis Rochard. Agriculture et ville : vers de nouvelles relations juridiques, Presses universitaires juridiques de Poitiers, Collection de la Faculté de droit et des sciences sociales de Poitiers.* Actes Colloques.

Gunderson, L., and Holling, C. (2004). Understanding transformations in human and natural systems. *Ecol. Econom.* 49, 488–491.

Hamrita, A., Mata Olmo, R., and López-Estébanez, N. (2021a). Paisaje agrario en contextos periurbanos mediterráneos: el caso del Gran Sousse (Túnez). *Boletín De La Asociación De Geógrafos Españoles* 90, 32. doi: 10.21138/bage.3143

Hamrita, A., Mata Olmo, R., and López-Estébanez, N. (2021b). "Farmers and periurban micro-farms. An interpretation of the diversity and logics of adaptation to climate change and the periurban context based on the case of Sousse (Tunisia)," in *Les innovations transformatrices en Horticulture, 4ème Congrès Panafricain de l'Horticulture AAHC2021*. Daker, Sénégal, Mars.

Hamrita, A., Mata Olmo, R., and Rejeb, H. (2016). "Proyecto de paisaje para activar el regadío periurbano en aglomeraciones turísticas. El caso de la Gran Sousse (Túnez)," in *Treinta años de Política Agraria Común en España. Agricultura y multifuncionalidad en el contexto de la nueva ruralidad*, eds Ruiz Pulpón A-R., Serrano De La Cruz Santos-Olmo M-A., Plaza Tabasco., J. (édi.). (España: Castilla La Mancha), 697–711.

Hannachi, H., Msallem, M., Ben Elhadj, S., and El Gazzah, M. (2007). Influence du site géographique sur les potentialités agronomiques et technologiques de l'olivier (Olea europaea L.) en Tunisie. *Sci. Direct. C. R. Biol.* 330, 135–142. doi: 10.1016/j.crvi.2006.11.005

Herault-Fournier, C. (2010). Les circuits courts: définitions et enjeux. *Les Carnets Pro de Liproco* 1, 1–10. Available online at: http://liproco-circuits-courts.com

Houdart, M., Loudiyi, S., and Gueringer, A. (2012). L'adaptation des agriculteurs au contexte périurbain. Une lecture des logiques agricoles à partir du cas de Billom-Saint-Dier (Auvergne). *Norois Environ. Aménag. Soc.* 224, 35–47. doi: 10.4000/norois.4265

Janvier, F., Nirascou, F., and Sillard, P. (2015). *L'occupation des sols en France: progression plus modérée de l'artificialisation entre 2006 et 2012.*

Jouili, M. (2016). "Changements structurels, politiques publiques et petite agriculture familiale en Tunisie," in *Fifth International Conference from African Association of Agricultural Economists* (Addis Ababa), 18. doi: 10.22004/ag.econ.249308

Karray, B., Msallam, M., Ksantini, M., Boujnah, D. M., and Kamoun, N. G. (2009). *Programmes et acquis de recherches pour la rénovation de la filière huile d'olive et l'amélioration de ses performances.* Tunisie: Institut de l'olivier. p. 20.

Lazarev, H. (2009). Promouvoir le développement des territoires ruraux. *Mediterra* 5, 183–210. doi: 10.3917/scpo.cihea.2009.01.0183

Li, C., Peng, C., Chiang, P. C., Cai, Y., Wang, X., and Yang, Z. (2019). Mechanisms and applications of green infrastructure practices for stormwater control: a review Author links open overlay panel. *J. Hydrol.* 568, 626–637. doi: 10.1016/j.jhydrol.2018.10.074

Liao, K. (2012). A theory on urban resilience to floods—a basis for alternative planning practices. *Ecol. Soc.* 17, 48. doi: 10.5751/ES-05231-170448

Lovell, S., Desantis, S., Nathan Chloe, A., Olson Meryl, B., Ernesto Mendez, V., Kominani Hisashi, C., et al. (2010). Integrating agroecology and landscape multifunctionality in Vermont: an evolving framework to evaluate the design of agroecosystems. *Agric. Syst.* 103–5, 327–341. doi: 10.1016/j.agsy.2010.03.003

Mata Olmo, R. (2006). "Métodos de estudio del paisaje e instrumentos para su gestión. Consideraciones a partir de experiencias de planificación territorial," in *El paisaje y la gestión del territorio. Criterios paisajísticos en la ordenación del territorio y el urbanismo,* eds Mata Olmo, R., Tarroja, A., éd. (Barcelona, España: Diputació de Barcelona-UIMP), 199–239.

Mata Olmo, R., and Yacaman Ochoa, C. (2015). "Gobernanza para una agricultura viva en un paisaje periurbano de calidad. Estudios de caso en la huerta Metropolitana de Madrid," in *XXIV Congreso de la Asociación de Geógrafos Españoles, Universidad de Zaragoza, España*, 10.

Mell, I. (2008). Green Infrastructure: concepts and planning. *FORUM E J.* 8, 69–80.

Moratalla, A. Z., and Ochoa, C. Y. (2015). "Estado de la cuestión de la figura de Parque Agrario en el Estado Español," in *El parque Agrario, una figura de transición hacia nuevos modelos de gobernanza territorial y alimentaria*, eds C. Y. Ochoa, and A. Z. Moratalla (Madrid: Heliconia), 13–26.

Morgan, K., and Sonnino, R. (2010). The urban foodscape: world cities and the new food equation. Cambridge Journal of Regions. *Econ. Soc.* 3–2, 209–224. doi: 10.1093/cjres/rsq007

Nilsson, K., and Bernhard, S. (2011). *Peri-urban land-use relationships –strategies and sustainability assessment tools for urban-rural linkages.* PLUREL projet. Final activity report.

Pappalardo, V., La Rosa, D., Campisano, A., and La Greca, P. (2017). The potential of green infrastructure application in urban runoff control for land use planning: a preliminary evaluation from a southern Italy case study. *Ecosyst. Serv.* 26, 345–354. doi: 10.1016/j.ecoser.2017.04.015

Perrotti, D. (2012). La ruralité urbaine: de plateforme d'expérimentation a lieu de la mise en scène d'un nouveau modèle de durabilité: Les territoires périurbains du Parc Agricole Sud de Milan à l'épreuve de l'Expo Milan 2015. *Environ. Urbain/Urban Environ.* 6, 100–117. doi: 10.7202/1013715ar

Rickerl, D., and Francis, C. (2004). *Agroecosystems Analysis.* Madison, WI: American Society of Agronomy. p. 12.

Sanz Sanz, M.-E. (2016). *Planification urbaine et agriculture: Méthodologie systémique de caractérisation de l'agriculture périurbaine à partir d'une recherche empirique en France et en Espagne.* Thèse de doctorat en Géographie et Études urbaines, UAM et EHESS.

Sarrazin, F. (2012). "L'Echange social plus fort que l'échange marchand," in *Au plus près de l'assiette pérenniser les circuits courts*, eds Prigent-Simonin A.-H., Herault-Fournier, C. (Coord.). (Versailles: Editions Educagri), 63.

Swanwick, C. (2002). *Landscape Character Assessment. Guidance for England and Scotland.* The Countryside Agency and Scottisch Natural Heritage, United Kingdom. p. 82.

Termorshuizen, J., and Opdam, P. (2009). Landscape services as a bridge between landscape ecology and sustainable development. *Landscape Ecol.* 24, 1037–1052. doi: 10.1007/s10980-008-9314-8

Tudor, C. (2014). *An Approach of Landscape Character Assessment.* p. 57.

Vidal, R. (2011). Entre ville et agriculture, une proximité à reconstruire. *Métropolitiques.* https://metropolitiques.eu/Entre-ville-et-agriculture-une.html

Yacamán Ochoa, C., Ferrer Jiménez, D., and Mata Olmo, R. (2020). Green infrastructure planning in metropolitan regions to improve the connectivity of agricultural landscapes and food security. *Land* 9, 414. doi: 10.3390/land9110414