

## **Evolutions and threats to land management in the peri-urban area of the city of Sidi Bel Abbes (Algeria) - an analysis based on spatial cadastral data**

### **Evolucija gospodarenja zemljištem u periurbanom području grada Sidi Bel Abbessa (Alžir) i prijetnje s kojima se suočava – analiza temeljena na prostornim podacima iz katastra**

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DOI: 10.15291/geoadria.4145

Prethodno priopćenje / *Preliminary communication*

Primljeno / *Received*: 14-2-2023

Prihvaćeno / *Accepted*: 9-1-2024



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Sidi Bel Abbes, the capital of Mekerra, a city of the interior plain, where agricultural land has experienced urban spillover at the expense of peri-urban land. The accelerated sprawl between 1987 and 2019 is expressed by threats to peri-urban state land, the pressure on agricultural activity on the peripheries of the city, and a relaxation of respect for planning policies at the local level. How can peri-urban land be better protected, and consequently encourage agricultural use, without abandoning it? This work analyses the legal nature of the land taken for the benefit of urban construction and characterizes its spread using Landsat multispectral satellite

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data. Our approach is based on the following question: Does urban sprawl impact the management of land and its legal nature? What is the future of this land in the face of current threats and future planning and urban development orientations? The cartographic analyses with the actual practices of the different social groups in the field have made it possible to evaluate the relationship between agricultural policy, and implementation and to situate the conflicts or threats about urban sprawl. The north of the city of Sidi Bel Abbes (cadastral section n°3, 324.74 ha), is where 45% of state land is acquired for building purposes. A reorientation of the peri-urban land is currently presented by a new management mode of an individual type, as a means of freezing and/or preserving the land: the creation of hedges and fences, the introduction of arboriculture (olive tree or other). Observations on site made it possible to explain these practices, which are at the origin of these current representations. The crops practice is linked to the profit drawn on compensations, and the plantations are a source of good remuneration.

**Keywords:** agricultural land; peri-urban; urban sprawl; threat; planning policies

Sidi Bel Abbes glavni je grad Mekerre. Smješten je na ravnici u unutrašnjosti gdje je poljoprivredno zemljište zahvaćeno nekontroliranim urbanim širenjem na račun periurbanoga zemljišta. Ubrzano širenje između 1987. i 2019. vidljivo je kroz prijetnje periurbanom državnom zemljištu, pritisak na poljoprivredne aktivnosti na periferiji grada i slabije poštovanje politika planiranja na lokalnoj razini. Nameće se pitanje kako se periurbano zemljište može bolje zaštititi i posljedično potaknuti poljoprivredno korištenje, a da ga se ne napusti. Ovaj rad analizira pravnu prirodu zemljišta koje je uzeto za potrebe izgradnje grada i karakterizira njegovu rasprostranjenost primjenom multispektralnih podataka satelita Landsat. Rad razmatra sljedeća pitanja: Utječe li nekontrolirano širenje urbanih područja na gospodarenje zemljištem i njegovu pravnu prirodu? Kakva je budućnost ovoga zemljišta u odnosu na današnje prijetnje i buduće planske i urbane razvojne orijentacije? Kartografske analize sa stvarnim praksama različitih društvenih skupina na terenu omogućile su procjenu odnosa između poljoprivredne politike i provedbe te lociranje sukoba ili prijetnji zbog nekontroliranoga širenja gradova. Sjeverno od grada Sidi Bel Abbese (katastarski odsječak br. 3, 324,74 ha) nalazi se mjesto gdje je 45 % državnog zemljišta pretvoreno u građevinske svrhe. Preorijentacija periurbanoga zemljišta trenutačno je predstavljena novim načinom gospodarenja individualnoga tipa, kao načinom zamrzavanja i/ili očuvanja zemljišta i to postavljanjem živica i ograda, uvođenjem arborikulture (maslina ili dr.). Terenska opažanja omogućila su objašnjenje tih praksi koje su

pozadina ovoga prikaza. Praksa uzgoja povezana je s dobiti iz naknada, a plantaže su dobar izvor zarade.

**Ključne riječi:** poljoprivredno zemljište; periurbano; nekontrolirano širenje urbanih područja; prijetnja; politike planiranja

## 1. INTRODUCTION

Independent Algeria inherited a conflicting situation in terms of land management, where customary modes and modern regimes established during colonization overlapped. When the Algerian state wanted to plan activities and centralize decision-making through agrarian reforms in the mid-1970s, the then government clearly stated its intention to do so. The government openly displayed its tendencies toward political openness and economic liberalization in the late 1980s (Semroud, 2009). The restructuring of land gave rise to the socialist agricultural estates (DAS). This legal situation lasted until the end of 1987 when a decision was taken to replace the DAS with Collective and Individual farms (EAC and EAI), and consequently, the reorganization of the private sector of the state, created a dynamic which resulted in new forms of working the land, given the new provisions of Law 87/19 concerning the sale or lease and Law 90/25, concerning land management.

In Algeria there has been a very complex situation of agricultural land, which is translated in practice into a diversity of legal statuses (Marouf, 1999; Semroud, 2009). It is true that our agricultural lands have undergone multiple owners who have marked both their distant history and their present. This postulate is true for the case of the municipality of Sidi Bel Abbes. The work of Ali Daoudi and Jean-Philippe Colin, Hichem Amichi and others in particular (Amichi et al. 2015; Colin & Daoudi, 2022; Daoudi et al. 2017a; Daoudi et al. 2017b; Souiah, 1998) have largely demonstrated the complete discrepancy between these virtual farms that exist only in the law and the reality of the informal division of collective farms (EAC) into family farms or leased land.

In this context, the hidden transactions, the general abandonment of lands by excessive fragmentation, the limited role of cadastral and land conservation, and the weakness of the administration of the sector of agriculture, compromise any effective assumption of responsibility to protect the agricultural land and even any will to organize it, which influenced, in particular, the peri-urban agricultural land (Baouche, 2014). Studies on the peri-urban space have been the

object of interest of several scientific papers, such as the increase in daily mobility, the difference between places of residence and work (Bédrani & Bouaita, 2003; Bendraoua & Souiah, 2008; Boudjenouia et al. 2008; Maachou & Otmame, 2016; Rebouha & Pochet, 2009; Semmoud & Ladhém, 2015).

In recent decades, we have witnessed tensions and conflicts of use on the peripheries of large cities. The city becomes predatory and consumes the stock of agricultural land in a frantic way to enlarge its urban perimeter. We are witnessing a continuous decrease of the Utilised Agricultural Area (UAA) per inhabitant, caused by the advance of cities into the peri-urban fringe, which in most cases bypasses legislation related to planning<sup>1</sup> (Souiah, 2012). The UAA<sup>2</sup>/capita was about 0.80 ha/capita in 1939 against 0.20 ha/capita in 1998 (Elloumi & Jouve, 2003). Thus, social needs in terms of housing directly involve local decision-makers in a process of choosing land pockets to satisfy social demand, which has made peri-urban agricultural land vulnerable to compromises made by several actors at the local level. As a result, the state has taken the initiative to regulate and manage land and urbanization through strategies to preserve them according to the legal provisions in force<sup>3</sup> (Cherif, 1982).

In Sidi Bel Abbes, the reorganization marked a decisive turning point in the management of the agricultural sector, characterized on the one hand by the abolition of the discrimination maintained in favour of the public sector farms and on the other hand, by the restitution of the lands nationalized within the framework of the application of the agrarian revolution to their legitimate owners. In turn, the Socialist Agricultural Domains (DAS), formerly composed of large blocks, were divided into collective farms (EAC) and individual farms (EAI). A very heterogeneous geometric plot structure was created in 1987. It was the first reorganisation of the land structure, which resulted in a number of beneficiaries almost equal to the number of illicitly created properties. The splitting up of the DAS into EAC and EAI, to which private property fragmented as a result of inheritance was added, led to a division where the spirit of

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<sup>1</sup> Law n°90.29 of 1 December, 1990, amended, relating to the development and the urban planning. Executive decree n°91.177 of 28 May, 1991, amended, fixing the procedures of elaboration and approval of the Master Plan of Urban Development (PDAU).

<sup>2</sup> Useful Agricultural Surface.

<sup>3</sup> Law 87-19 on the creation of the national office of agricultural land, as well as Law 90-25 of 18 November, 1990 on land orientation and Law 08-16 of 3 August, 2008 on agricultural orientation regularize the agricultural land.

collaboration and coordination no longer existed. This new legislation has been concretized geographically, by a new agricultural landscape, which has resulted in:

- An influence on the agrarian structure, which resulted in encroachment on agricultural land following the restitution of nationalized land and the liberalization of the land market; after the promulgation of Law 90-25 of 18 December 1990 on land orientation.

- The farms on the outskirts of the city, which were farms from the colonial era, were taken by the self-management sector following the development processes until now are illegally occupied by dwellings (proliferation of informal housing around the city now).

It is in this context, what we propose in this paper is to proceed to an analytical approach of the legal nature of land taken for urban construction in order to characterize urban sprawl using Landsat multispectral satellite data. Our approach is based on the following question: does urban sprawl have an impact on the management of land and its legal nature? And what is the future of this land in the face of current threats and future urban planning and development orientations? These analyses were conducted in several situations, particularly in the context of coastal areas (Tarik & Bouziane, 2010). Coastal cities such as Algiers (Otmani et al. 2019; Rabehi et al. 2020) and Oran (Missoumi et al. 2018), have experienced urbanization pressures through the taking of land omitted from its legal nature and construction in areas protected by the coastal law<sup>4</sup>. This pressure is not limited only to the coastal areas, but it has also spread to the agricultural activities in coastal areas and inland (Rabehi et al. 2020; Chaib & Mezner, 2008).

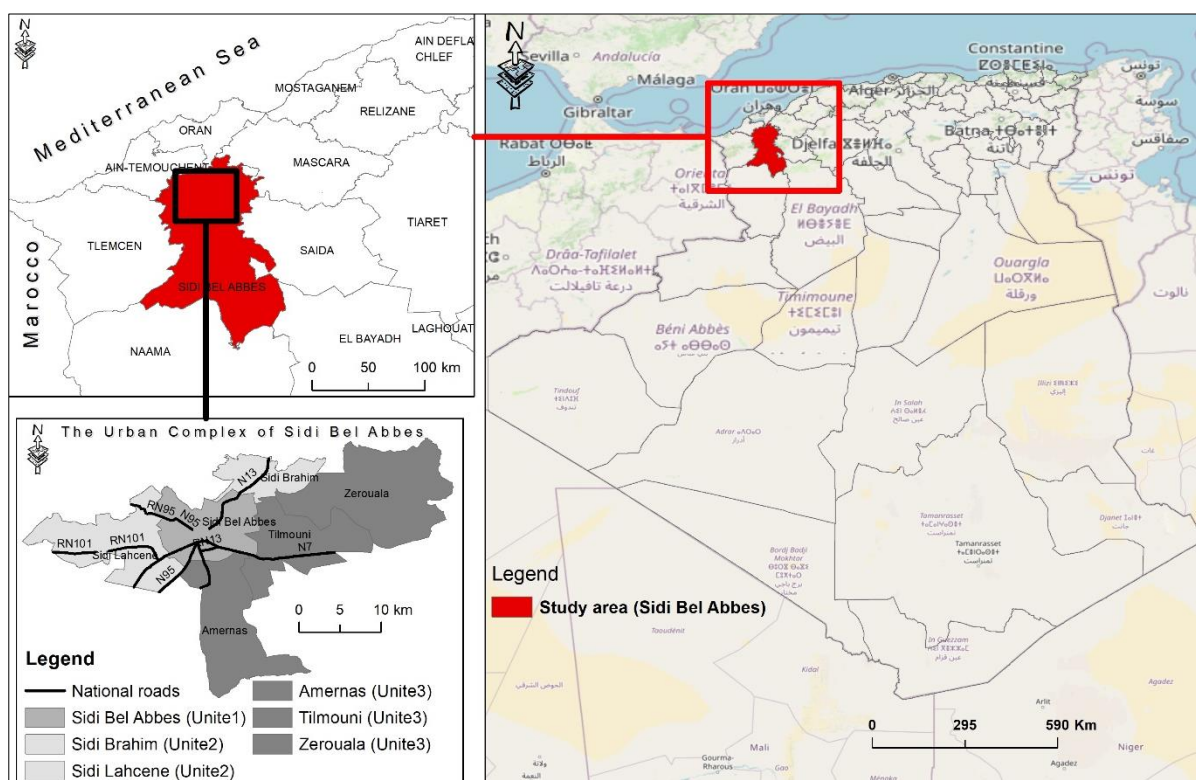
Our analysis is based on various publications (books, articles, communications, reports, laws, etc.) that deal with agrarian reforms and their evolution in Algeria and are related to our field of study in particular. The Landsat data of the city of SBA (archives) and the cadastral section (period of the break-up of the DAS) allowed us to understand the urban dynamics of the agglomeration as a whole and to target the mutations of the newly urbanized peripheral areas in the northern part of the city of SBA.

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<sup>4</sup> Law N° 02-02 of 5 February, 2002, on the protection of the littoral. Official Journal of the Algerian Republic, n° 10 of 12 February, 2002.

## 2. DATA AND METHODS

Sidi Bel Abbas is the capital of a highly agricultural region located 90 kilometres from Oran. This province has 15 sub-divisions and 52 departments. Its territory covers an area of 9150 km<sup>2</sup>. At the local level, the urban grouping of Sidi Bel Abbas includes 5 departments: Sidi Lahcen, Sidi Brahim, Amarnas, Zerouala and Tilmouni (Fig. 1). On a smaller scale, Sidi Bel Abbas, Sidi Lahcen and Amarnas are now in permanent interaction where social developments and economic issues arise (Fig. 1).



**Figure 1** The geographical context of the department of Sidi Bel Abbas

Spatially, the grouping is structured as follows:

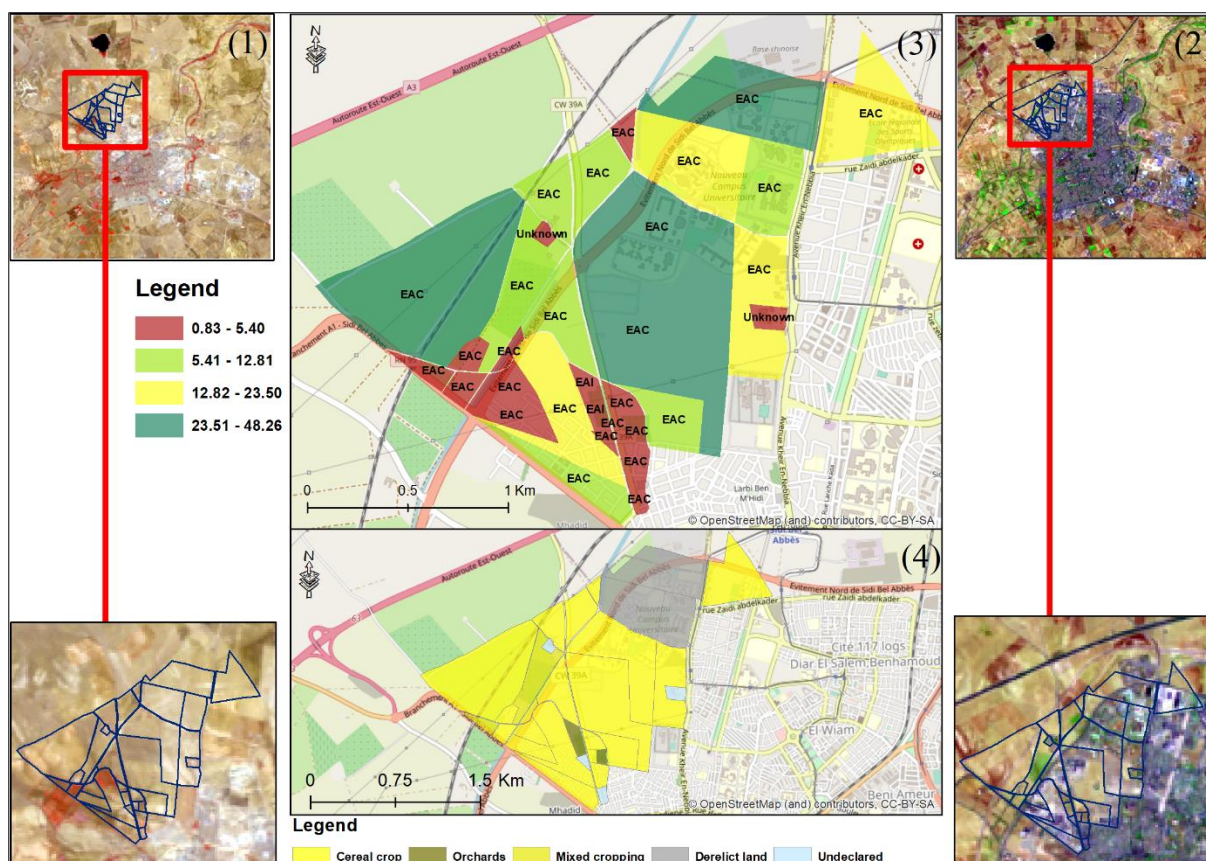
The first unit encompasses the urban centres of Sidi Bel Abbès which is presented as a compact urban fabric in the centre of the grouping towards which a set of multidirectional roads that connect it to all points of the territory of the grouping converges (see Fig. 1).

The second unit, the peripheral zone, includes the rest of the municipality of Sidi Bel Abbès, the municipality of Sidi Lahcène and part of the territories of Sidi Brahim (see Fig. 1).

The third unit, the east zone, includes the rest of the territory of Amarnas and Sidi Brahim, the communes of Tilmouni and Zerouala (see Fig. 1).

### ***2.1. Data collection and processing***

In this study, Landsat satellite from 1987 to 2019 were used, with a 30 m resolution covering the entire study area. In the territory of Sidi Bel Abbas, the cropping systems are characterized by small-scale fragmentation (Fig. 2 (1) and (2)). A multi-date analysis of Landsat images will allow us to correctly characterize the urban sprawl of the city of Sidi bel Abbas (revisit every 16 days). In this paper, we referred in our research results to built-up area extraction using Landsat images (Djamel & Djerriri, 2020). Through this research, we have used the results obtained on the basis of a comparison between different methods of supervised classifiers for built-up areas extraction using multi date Landsat imagery (Maximum de likelihood, Random Forest, Support Vector Machine, k-Nearest Neighbor, Neural Networks Binary Random Forest (RF), OC-Support Vector Machine (OCSVM), and Presence and Background Learning (PBL). The three types of classifiers were tested on the basis of 1000 samples (Urban/non-Urban), and statistics were also performed to evaluate the classifiers (the estimated Cohen's Kappa statistic (k), and the F1-score) (Djamel & Djerriri, 2020; Mansour et al. 2023).



**Figure 2** Peri-urban land from 1987 to 2019: City of Sidi Bel Abbes, seen by Landsat satellite at different dates (cadastral plan in blue), (1) Landsat (TM5) 1987, (2) Landsat (8) 2019, (3) Agrarian structure and spatial distribution of the legal status (Cadastral Section n° 3, 1987), (4) Land use (cadastral section n°3, 1987)

An extract of the cadastral section (the north side of the city of Sidi Bel Abbes 1987), indicates the number of parcels, their contents, and identification of the property. It corresponds to the time of the splitting of the Socialist Agricultural Domains (DAS) into Individual and Collective Agricultural Exploitation (EAI and EAC), perimeter in yellow: Section n°3. The information collected from the land registry is very useful concerning the fragmentation of land intended for cereal crops, orchards, or tree growing (Fig. 2 (3)). This is also true for unworked and abandoned land. During our investigation to the land registry office, we had to search the cadastral archives for the legal nature of agricultural land between 1960 and 1987, unfortunately, this land was not plotted during this period. This made historical information on the land and its legal nature difficult to obtain in order to conduct spatial analyses during this work.

The cadastral data were exploited to show the legal nature consumed by the built-up area during this period. This observation brings out two situations, the first represents the purely



agricultural zone and the second visualizes the current state of the agricultural land taken by urbanization. The information collected includes:

- Number of DAS with a plan and surfaces (Tab.2);
- Breakdown of the large socialist estates into collective farms (EAC) and individual farms (EAI) (Fig.2 (4)).

One of the main elements for characterizing the land structure is the size of the properties. The legal ownership of land and the size of farms in the study area can be summarized as follows, including all types of legal status (EAC, EAI, melk, unknown ...) (Tab.1). There is a significant gap between small farms (52%) and large farms (13%). This type of gap highlights the state of fragmentation and division between owners, particularly for small areas (fig.2 (4)).

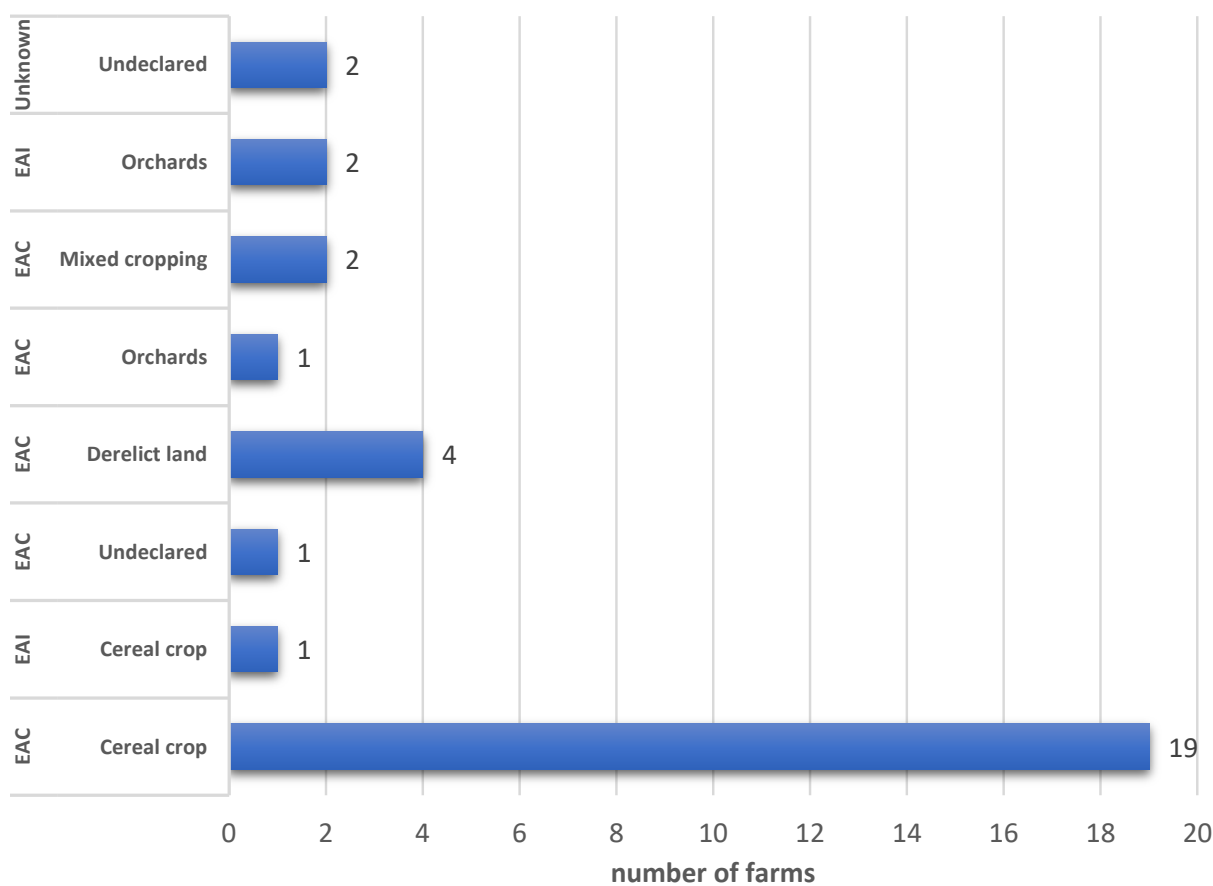
**Table 1** Agrarian structure of the study area

Area in hectares	Number of parcels	%
0.83-5.41	12	51.17
5.41-12.81	4	17.39
12.81-30.55	5	21.73
30.56-48.26	3	13.04

Source: Thematic analysis using attributes table of cadastral section n°3

Table 1 reveals the difference in the size of the farms. In Figure 4 (4), we note the irregular shape of the plots. The parcels of land are very variable depending on the farms, which are still very fragmented (the fragmentation represents the state of division of the parcels between the owners).

Table 1 reveals the difference between the size of the farms. In Figure 2 (3,4), we note the irregular shape of the plots. The plots of land are vary considerably depending on the farms, which are still very fragmented (the fragmentation represents the state of division of the plots between the owners).



**Figure 3** Distribution of plots by legal status across land use

The analysis in Figure 3 shows a fairly wide variety of farm types (Fig. 4):

- 19 holdings are concentrated in collective farms dominated by cereals;
- 4 collective farms are abandoned farmland;

Then we find the other farms among collective and individual which represent:

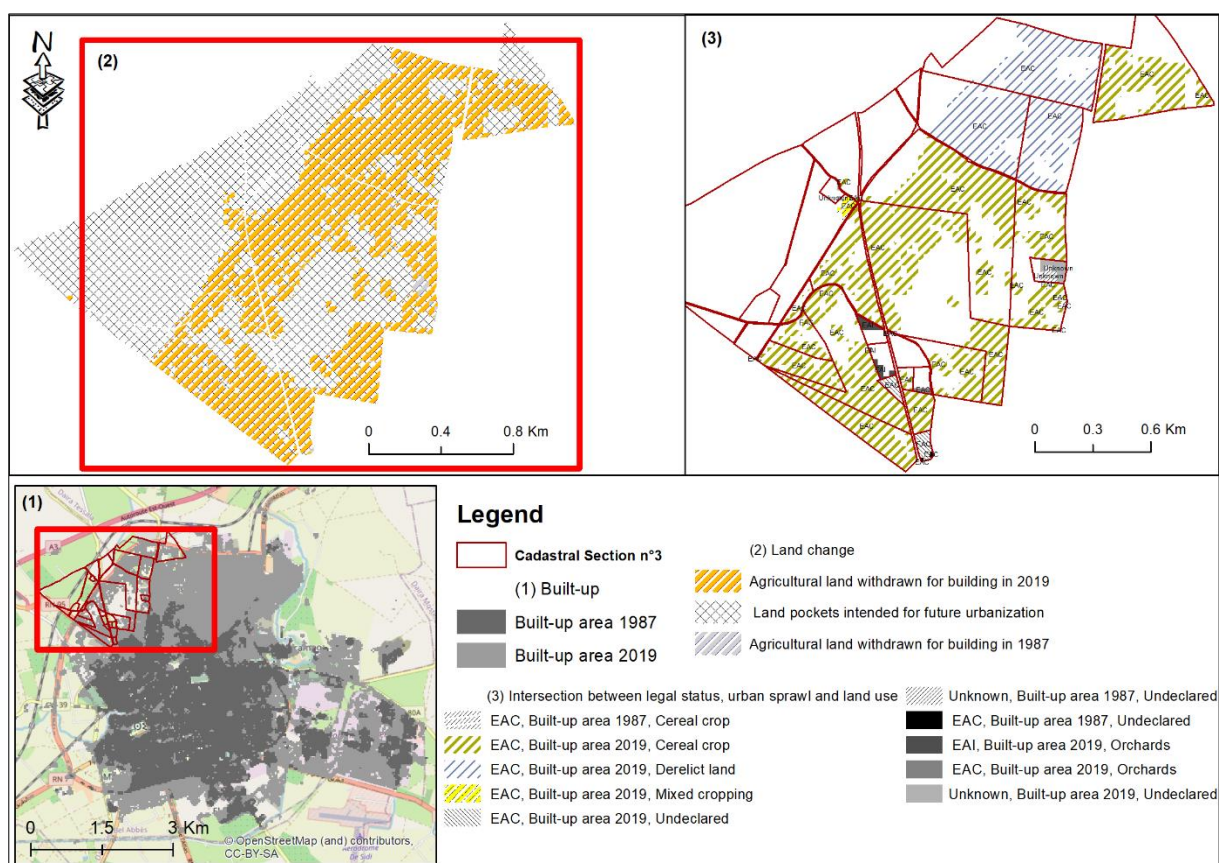
- Two individual farms occupied by plantations and one by cereals;
- Two unknown farms occupied by mixed crops;
- The remainder are collective farms with two mixed crops, one plantation and one undeclared land.

### 3. RESULTS

Spatially, the extension of urban areas shows a strong revival of artificialization between 1987 and 2019 in the periphery of the city of SBA (Fig. 3). This urban sprawl is intended for housing, infrastructure and soil artificialization programs, including activities areas. These spaces are completely approved by the urban planning instruments via the Urban Planning Master Plan (PDAU). The urban perimeter of the SBA city was around 1,090.28 ha in 1987, and

2,760.99 ha in 2019 (Fig. 4). The map of changes between 1987 and 2019 shows significant conversions that have happened in the peri-urban agricultural land of the SBA city. The northern part of the city has seen an increase in the loss of collective farms. (Fig. 3), which shows a significant evolution to the detriment of agricultural land peripheral to the municipality of SBA, especially in its northern part which recorded a great loss of land for agricultural purposes.

The map of changes between 1987 and 2019 shows significant transformations that have occurred in the peri-urban agricultural land of the city of SBA. The northern part of the city has seen an increase in the loss of collective farms (EAC). This pressure on state-owned land has led to partial fragmentation of farms, even to their disappearance, particularly the EACs and EAI (Fig. 3).



**Figure 4** Land use patterns vs legal status: assessment and impact, zoom on the parcels affected by urbanization (example: Section n° 3 - Northern periphery of SBA city)

**Source:** Cartographic intersecting between legal status, land use and urban areas 1987 and 2019

Table 2 shows the proportion of land use and legal status converted to urban areas between 1987 et 2019 (Fig. 5). The first reading indicates that the section n°3 was urbanized by 0.97 ha in 1987 and 148.47 ha in 2019. That urbanization caused pressure on cereal crops, mainly on

collective farms. Table 2 shows that the total area of section n°3 was 324.67 ha, dominated by cereal crops with an area of 224.23 ha (69.06%, Table 2, Fig. 5). The urban sprawl gained almost 95.63 ha for cereal crop in 2019, which is about 29.45% of the total area of section n°3. This decrease is explained by the increase of threats on national domain properties (Tab. 2 and Fig. 4 and Fig. 5). The derelict land (collective farms) covers 59.81 ha, with 39.92 ha registered as urban areas in 2019, representing 12.30% of the total area of the section. Other categories corresponding to the collective farms, represent an area of 0.86 ha, 1.15 ha and 14.96 ha for undeclared land, orchards and mixed crops respectively. For each of the categories mentioned above, the urban areas were not over one hectare (Fig. 5).

**Table 2** Distribution of land use, legal status and urban areas

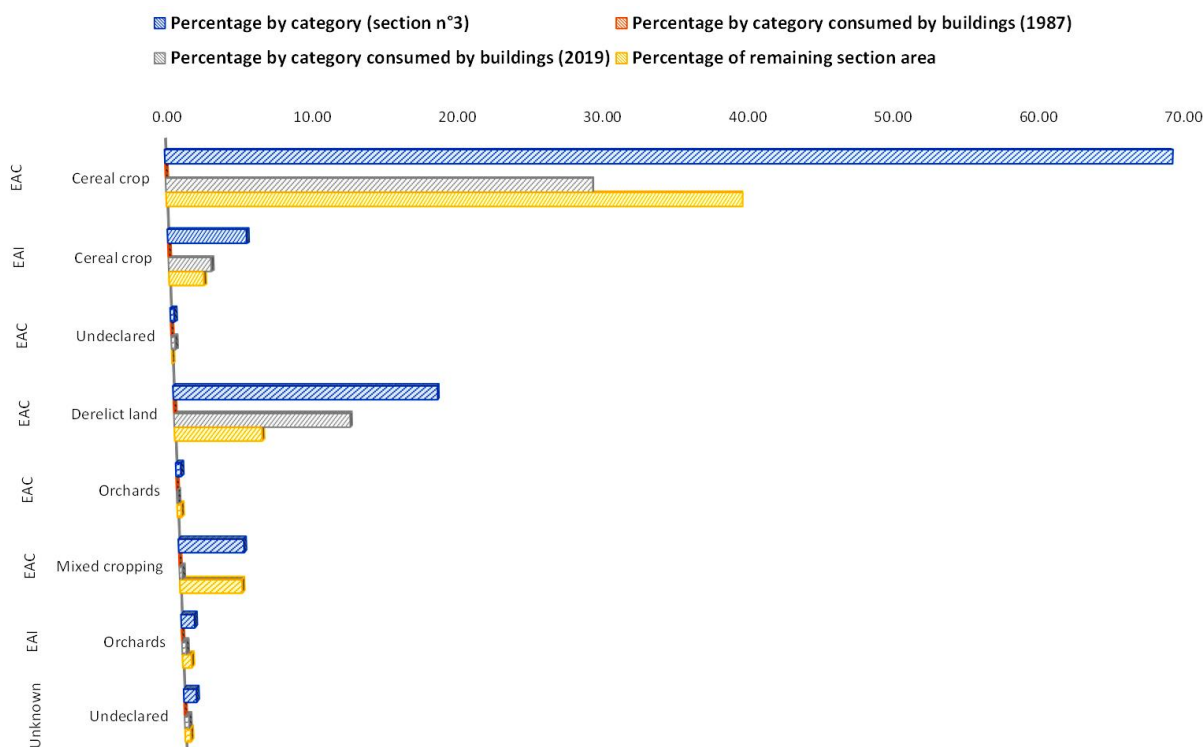
Legal status	Crop type	Total section area (ha)	Section area (%)	Area per category consumed by urban areas in 1987 (ha)	Area by category in relation to the total area of the cadastral section 1987 (%)	Area per category consumed by urban areas in 2019 (ha)	Area by category in relation to the total area of the cadastral section 2019 (%)	Remaining area by category	Total section area (%)
EAC	Cereal crop	<b>224.2</b>	<b>69.1</b>	0.0	0.00	<b>95.63</b>	<b>29.45</b>	<b>128.60</b>	39.61
EAI	Cereal crop	<b>17.67</b>	5.4	0.32	0.01	<b>9.56</b>	<b>2.94</b>	7.77	2.39
EAC	Undeclared	0.9	0.3	0	0.00	0.86	0.26	0	0.00
EAC	Derelict land	<b>59.8</b>	<b>18.4</b>	0.08	0.00	<b>39.92</b>	<b>12.30</b>	<b>19.86</b>	6.12
EAC	Orchards	1.2	0.4	0	0.00	0.23	0.07	0.91	0.28
EAC	Mixed cropping	<b>14.9</b>	<b>4.6</b>	0	0.00	0.68	0.21	<b>14.27</b>	4.40
EAI	Orchards	3.1	0.9	0	0.00	0.97	0.30	2.07	0.64
Unknown	Undeclared	2.9	0.9	0.57	0.00	1.03	0.32	1.29	0.40
Total		<b>324.67</b>	<b>100.0</b>	<b>0.97</b>	0.30	<b>148.47</b>	<b>45.73</b>	<b>174.77</b>	<b>53.83</b>

Source: Results of cross-mapping

According the information in Table 2, individual farms had an area of 17.67 ha for cereal crops and 3.07 ha for orchards. Individual farms show a lower consumption of built-up areas than collective farms, mainly for cereal crops. An area of 0.32 ha was recorded in 1987 and 9.56 ha in 2019. For orchards, the loss was nearly one hectare in 2019.

The urban sprawl led to conversion of agricultural land during the period studied, resulting in an estimated remaining area of 174.77 ha, which has become threatened in large part by the

collective farms with 128.60 ha of cereal crops, 19.86 ha of derelict land and 14.27 ha of mixed crops.



**Figure 5** Distribution of urban areas according to legal status and land use (1987-2019)

Figure 6 presents details according to the legal status and the land use consumed by urban areas between 1987 and 2019. The first group is related to the farms that were owned by many farmers. 2019 showed a big decrease of farms which can generate effects on the disappearance of segments of collective property and affects the owner and his future in terms of farming land. The second group represents smaller areas. The trend has a significant impact on the future of remainder areas, mainly for the first group (Fig. 6).

A more in-depth examination of the results obtained by category, taking into account the total area of the municipality, population trends, and the distribution of agricultural land, reveals clear trends. 1987 saw an urban area of 1090.28 hectares and a population of 154 147.

At the time, useful agricultural area per inhabitant was 380 m<sup>2</sup>. By 2019, the situation had changed significantly. The urban area increased to 2760.99 hectares, and the population reached 248 170. This led to a significant decline in the size of the useful agricultural area per inhabitant, which fell to 170 m<sup>2</sup>, representing a reduction of 210 m<sup>2</sup> per inhabitant over this period.



decades. This trend underlines the importance of taking measures to preserve the remaining agricultural land and guarantee food security in the municipality of SBA.

A closer look at the results reached above, taking into account the total department area and the declining share of cereal-growing land, reveals a worrying trend. At the same time, this trend has also had an impact on other types of farmlands, notably land dedicated to planting trees, as well as land used for mixed crops. A detailed analysis reveals that ownership of both collective and individual cereal-growing land was converted to built-up areas, with consequences for the situation of the owners and their future contribution to local agriculture. (Fig. 5). This is particularly worrying in the case of collective ownership.

#### **4. DISCUSSION**

Our analyses focus on a small geographical area, where the scale of change and the threats to peri-urban farmland are considerable. Thus, we focused on the changes observed in land use and legal status in the northern part of the city of SBA, where almost half of the agricultural land was included in the urban area. These developments testify to a significant transformation of the agricultural landscape, characterized by notable changes in plot size and management practices. The highest rates of urbanization of agricultural land in Sidi Bel Abbas revealed by this study are similar to those observed in other European cities, as identified in the cases of Greece, Serbia, Italy and Spain. We note that our approach differs in that it focuses on land ownership and the spatialization of cadastral data as important parts of our work. However, these earlier cases enrich our context by highlighting the management challenges of peri-urban areas and addressing various dimensions of urbanization and sustainable development.

Regarding the study of the metropolitan areas of Madrid and Oviedo in Spain, which involves a territorial analysis, it is in line with discussions on peri-urban land management. The analysis of metropolitan areas such as Madrid and Oviedo provide a better understanding of the complexities of urban sprawl, land-use planning and the complex relation between urban and rural areas. That study enriched our understanding of urban sprawl by examining changes in land use, although it did not delve into land tenure, legal status and land use dynamics in these metropolitan areas (Alonso et al. 2017). It is relevant to note that the study did not address the

legal aspect of land, which distinguishes it from our own research. This distinction highlights the importance of considering the legal aspect of land, as in our own work, in order to obtain a more comprehensive overview of peri-urban area management.

Our analysis fits perfectly into the systematic review of peri-urbanization in Europe achieved by Shaw, and relates to our discussions on the complexity of peri-urbanization processes (land use change, socio-economic factors and the state of planning). Our work addresses how land use and land tenure are affected by urbanization and policy changes in peri-urban areas. Similarly, the systematic review highlights the multidimensional nature of peri-urbanization, where different factors interact in different ways in the case studies (Shaw et al. 2020). Both analyses underline the importance of adopting a holistic approach to the management of peri-urban areas. Our analyses highlight the need to consider legal and land aspects, while the systematic review suggests that managing peri-urban areas require addressing socio-economic, and spatial aspects in response to the diverse demands of stakeholders. Both analyses recognize the challenges posed by the dynamic and sometimes unpredictable nature of peri-urbanization, underlining the need for understanding strategies and plans (Shaw et al. 2020).

While there are some similarities noted in the global analysis covering the cartographic and landscape metrics analysis to examine the connection between land use changes, land management practices, and planning strategies in the urban fringe over a 20-year period in case of Estonia (Roose et al. 2013). The paper on peri-urban forests in Greece reported the importance of conserving peri-urban forests and green spaces in and around urban areas to meet a range of environmental, social and economic objectives. Both discussions also focus on the need for effective planning, management and institutionalization of land use policies to address these issues. So, the study from Greece represents the importance of peri-urban forests in mitigating the problems associated with urbanization.

Based on the study of peri-urban areas in Perugia, it could be concluded that the results of the analysis in Italy are similar to ours. Both highlight the challenges resulting from increasing urbanization, including land use change and governance issues. Issues relating to spatial planning, farmland conservation and the multifunctionality of agriculture are common



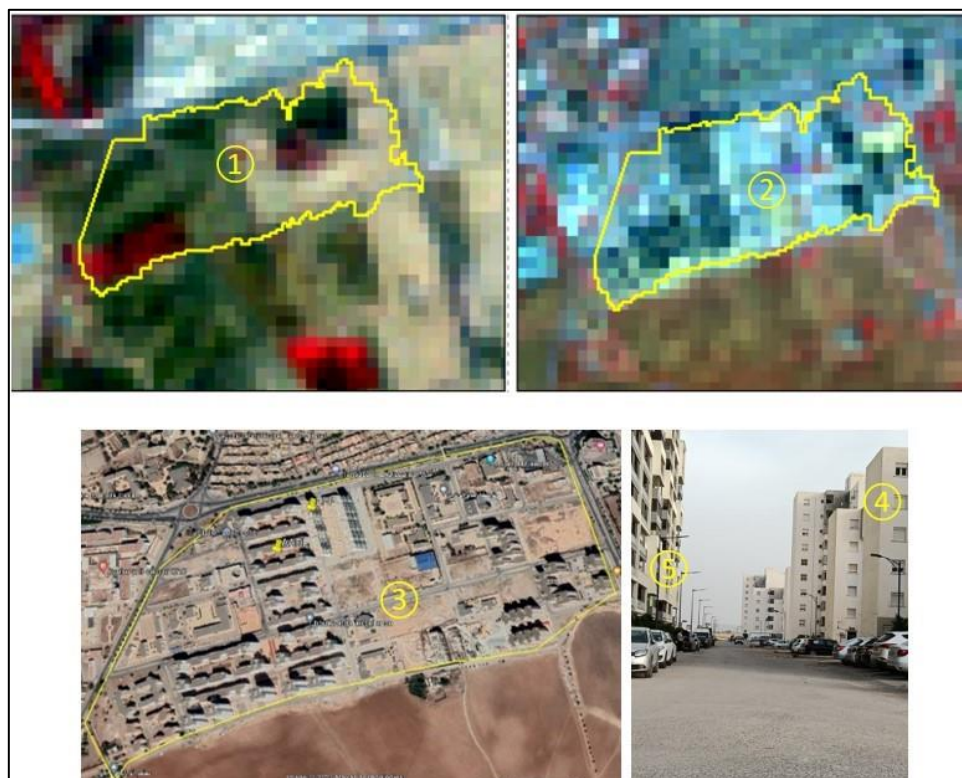
concerns. However, there are differences in the geographical context and specificities of the peri-urban areas studied, which may lead to slightly different approaches and conclusions. In addition, each study highlights unique elements of its own study region, while recognizing the general importance of peri-urban areas in sustainable urban development. Overall, both discussions underline the importance of taking a holistic approach to managing peri-urban areas, and ensuring that policies and practices align with the needs of local societies and the environment (Vizzari, 2011).

Our study was carried out in the context of the research conducted by Jank (2016), according to land use transitions and information provided by the agricultural land acreage in Central Europe, particularly in the Czech Republic. Jank (2016) completed an analysis of the reduction in agricultural land from 1966 to 2013, with a focus on the significant loss of arable land at a rate of 25 hectares per day. He mentioned a discrepancy between the actual built-up areas and the records in the cadastral register, suggesting that the actual reduction in arable land could be even greater. Our analyses are quite similar to those adopted in the case of Central Europe, except for the evaluation of soil quality and the estimation of financial losses linked to urbanization. That debate revolves around soil quality and the quantification of losses in financial terms, which was not addressed in our work.

Van der Molen (1999) underlines that land tenure and land administration in Western Europe are crucial for promoting sustainable social and economic development, but there is a need for improvement in various areas such as legislation, strategic goals, financial systems, accessibility, and procedural efficiency. Van der Molen (1999) highlights the similar prospects for collaboration between the public and private sectors, and for advanced use of geospatial technologies (GIS).

In light of the agricultural policies we have reviewed above, as well as the practices of farmers, when investigating examples in the field it can be observed that farmers responded and improved their practices. The cases studied underline the conversion of agricultural land in peri-urban areas. In the first situation, vineyards were converted into urban areas. This change has raised queries around the fluctuating legal status and land management (Fig.7 (1), (2) and (3)).

The second case concerns cereal crop, where farmers have difficulties in working their land due to drought (arid climate), financial limitations, and deficiency of legal protection. The third case focuses at olive trees, whose cultivation is well-developed in the region (Fig. 7 and 8).



**Figure 7** Current urbanization area, (1) in 1987 seen by Landsat TM (Vineyard) (2) Built area in 2019: highlighted by Landsat image in 2019, (3) Current urbanization seen from the filed visit in May 2022, (4) promotional housing program, (5) AADL program (The National Agency for Housing Improvement and Development)

Source: Field work, May 2022

However, in comparison with the two cases highlighted above, it can be noted that the olive trees on the periphery are exploited mainly to generate seasonal income, but are not considered of high production quality. Instead, they are considered frozen property, with a view to their ultimate conversion into construction projects for inevitable compensation (Fig.8 (1), (2) and (3)).



**Figure 8** Private initiative by new practices on the fringes of the city, (1) Location plan of the targeted area, (2) Plan of cadastral section n°3, (3) New olive tree plantation (area programmed for urban building of the city - north of the city - Section 3 plot n°4), (4) Current situation of the same olive tree plot, hedge observed bordering on the northern periphery of the city

Source: Field work, May 2022

The remaining area in section No. 3 is still subject to conversion in urban areas. Based on our field visit in August 2023, the major observation stands out depending to current revision of Master Plan. To this end, farmers have chosen their practices. Some of them used their abandoned collective farm land to plant trees, notably olives (Fig. 9, EAC1), while another group made cereal growing their main choice (Fig. 9, EAC2). This dynamic was also observed in another collective farm, which was still growing cereal crops on its plot in 2022 (Fig. 10, EAC3).



**Figure 9** Current agricultural practices are as follows: (EAC1) the creation of new olive tree plantations (EAC2) the reconversion of a plot abandoned in 2011, and cultivated with cereals in 2022, and (EAC3) the continuing cultivation of cereals on the plot, as observed in 2022

**Source:** Field survey in May 2021, conducted by Mansour Djamel

These cases highlight the complexity of the relationship between urbanization, agriculture, and land management in peri-urban areas, and underline the need for appropriate policies and measures to protect the land's agricultural potential while meeting the needs of urban development.

#### 4.1 Agricultural policies and their impact on land management

The changes in the legal status of the land have started a crisis in the use of arable land. They are characterized by a succession of several agricultural policies, notably the self-managed domains of the ex-colonial period, the agrarian revolution of 1970, the restructuring and reorganization of the socialist domains. However, things seem to have progressed since the promulgation of Law 90-29 of December 1990, the revision made in April 2004 and the adopted regulation related to land governance, land use and urban planning.

The distribution of land use and legal status in the northern part of the SBA city disturbed agricultural landscape, in terms of size and manner of exploitation of the plot, which led to the abandonment of the most lucrative state-owned land with 12.30% of the urbanized area at the level of section n°3 (Tab. 2 and Fig. 4).

Consequently, the practices of different modes of tenancy, especially the indirect mode (sharecropping), which is presented in several forms. Namely, the half or full tenancy mode, the three-way partnership, at the rate of 1/3 per partner and the monetary rental, are cases that were encountered on the public property. Since the 1970s, these practices have become commonplace, expressing a transformation in the ownership of land (Bouchemal, 2009). They have led to a much greater abandonment of state-owned land, which has made land disputes difficult to manage. Since then, a feeling of insecurity has set in among farmers, expressed by a total or partial abandonment of the land (which leaves the land bare-see section n°3, Fig. 4).

This situation had a direct impact on agricultural activity, following the restitution of nationalized land, which led to the emergence of new practices such as the purchase of undivided shares, or simply to the detriment of certain collective farms whose beneficiaries rent the land and become traders or entrepreneurs (Berrahi, 2001). The reorganization that began in 1987 definitively sealed the cooperative structure (the collective spirit) since all farmers opted for individualization of the farm (individual farms and even for the collective farms on the virtual level). This situation, which dates back more than a decade, has finally led to a rental market for land. All these investor farmers rent their land and thus build up virtual land capital.

The illustration presented in Fig. 9 was used to evaluate the effect of centralization process on land management, highlight overlapping agricultural and planning policies. The policymaking generated from the central level a complex path characterized by relations between policies and actors. In this context, decisions are influenced by different actors, they may fruit of elaborate negotiations linked to conflicts of interest, conflicts of use, and public utility considerations.

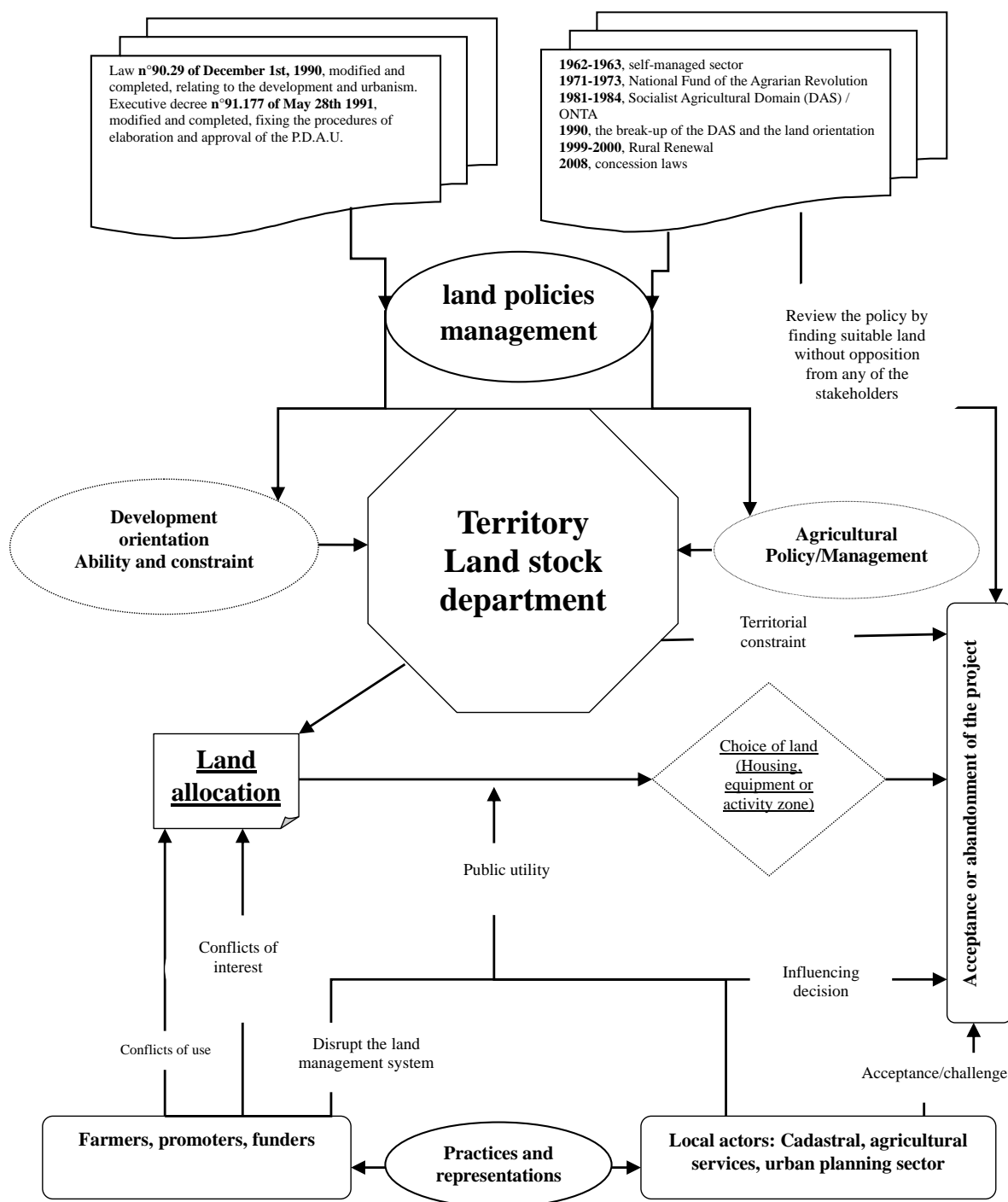
As for the SBA region, the strategy of the owners was to freeze investment and land during the reorganization period and during the bloody decade (Souiah, 2012). Subsequently, at the end of this decade, the owners invested in agriculture by specializing in strategic productions such as potatoes and/or arboriculture, ensuring a high value-added income. During our field observations (June 2019 and November 2022), we noticed the emergence of a new strategy among farmers, which consists of essentially resisting the tools and laws implemented for the taking of peri-urban agricultural land for the benefit of the city development. And this will have

strong repercussions on the management and production apparatus. By disposing of their own resource for agricultural use, these farmers have become independent, and consequently, they realize their own development corresponds to a form of resistance to protect their property through hedges or fences (Fig. 8). What is remarkable is that the land is under threat because of this bad management (Fig. 9), and that pressure groups (promoters, financial backers) have influenced the orientations of local decision-makers by starting processes of conflict and bypassing urban planning instruments (Master Plan) (Fig. 9).

In light of previous discussions on the effect of agricultural policies on the management of agricultural land, it appears that this may provide an explanation for our observations concerning the transformation of legal status into urbanized land. This interpretation is enhanced by an analysis of the strategies adopted by the actors involved in the context of the evolution of urbanization on agricultural land. The diagram shown in Figure 9 was designed to assess the impact of policy centralization on the management of land subject to overlapping agricultural and planning policies. It highlights the decision-making process generated from a central level and illustrates a complex path characterized by interactions between policies and stakeholders. In this context, decisions are influenced by potential land uses, both agricultural and urban, and stakeholders may be involved in negotiations linked to conflicts of interest, conflicts of use, and public utility considerations. After our fieldwork in November 2022, two specific cases emerged in the context of public utilities, concerning state-owned land in the peri-urban area of Sidi Bel Abbes. These specific situations were not included in the study of the master plan for development and urban planning approved in 2009. More specifically, they concern a tram station project (7 hectares, Collective farm<sup>5</sup>) and a national housing project (AADL).

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<sup>5</sup> Official Journal (2012), page 13.



**Figure 10** Practices and representations between public authorities and local actors in a context of reforms and modalities of land governance in Algeria

Source: Field work, observations and interviews with local actors, flowchart designed by authors

Overall, our observations and interviews with local actors reflect the pattern illustrated in Fig. 10, corresponding to (Perrin et al. 2018) findings regarding changes in the governance of agricultural land protection in the Montpellier and Rome regions under the impact of

decentralization. Decentralization initially posed challenges to centralized governance, but also favoured local initiatives, giving rise to the adoption of alternative modes of governance, notably co-governance in Montpellier and self-governance in Rome. These changes reflect a general trend towards decentralized decision-making. By following the arrows and connections in Fig. 9, we can see a management system that is considerably different from that of Montpellier and Rome. This system is characterized by the centralization of decision-making with regard to agricultural and land-use policies. The example given above concerning public utility projects clearly shows the weight of centralized decision-making, resulting in the use of peri-urban agricultural land without prior consideration. This perspective highlights how national policies interfere with local actors, generating a complex competition between decision-making and action.

## 5. CONCLUSION

This work has enhanced our understanding of the relationship between urban expansion, legal status, and land use within a cadastral section located on the northern periphery of Sidi Bel Abbes city. The analysis of the cadastral information offers an assessment of the features of cadastral status in peri-urban areas related to urban expansion. In addition, the process has enabled local evolution to be visualized more precisely, highlighting subtle but significant changes that can help local authorities anticipate wider transformation trends in the peri-urban area and assess their impacts.

However, it is important to note that this significant agricultural potential is facing land conflicts, disputes between owners, and the complexity of land tenure structures, notably undivided plots or unmarked divisions in collective farms. This situation has led to a diversity of practices, such as tenant farming, direct purchase (particularly when decommissioning state-owned land), and sometimes mixed arrangements (with collaborating owners).

In addition, innovative practices are emerging among farmers on the urban fringe, such as hedges and tree planting, which have become acts of land preservation in the face of current land-use changes. These practices illustrate farmers' efforts to maintain the agricultural activity of peri-urban land while resisting the pressures of increasing urbanization.



However, despite these local dynamics, insufficient coordination persists between agricultural policies and urban planning instruments. Spatial analysis of this data reveals the complexity of the challenges which the municipality faces in terms of agricultural land use, food security, and changes in farming practices. The decrease in available agricultural land per inhabitant and the growing dependence on external actors underlines the importance of developing strategies for preserving agricultural land, promoting sustainable practices, and strengthening local food production. It is essential to closely monitor the evolution of land ownership and farming activities in order to guarantee sustainability of food production and food security. Decisions taken in this area will have a sustainable impact on the quality of life of residents and the sustainability of peri-urban agricultural areas. It is essential to consider developing a smart land management system for a more strategic urban planning while ensuring that land use mapping is regularly updated. This will help identify local agricultural resources more effectively, with a view to optimizing the management of future urban developments.

**Author contributions:** All authors participated in the creation of this paper in their respective research areas, and in total contributed equally to the final design of the article.

**Data availability statement:** Data are available upon request to the authors

**Conflict of interest:** The authors declare that there is no conflict of interest.

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