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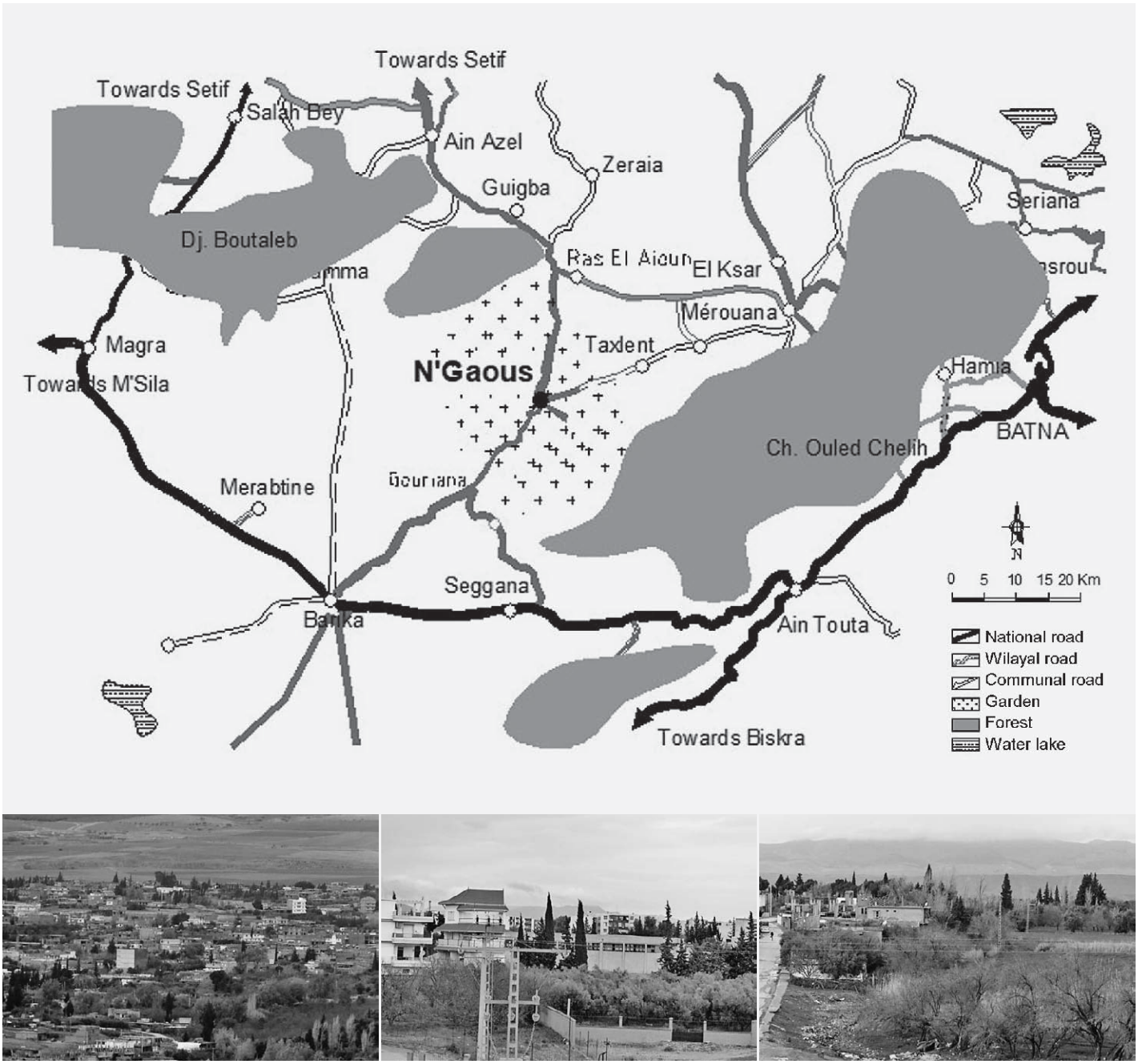

Fig. 1 The location of N'Gaous in the middle of a semi-steppe plain between two mountains

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Green City or Urban Countryside?

An Analytic Review of the Urban Sprawl Phenomenon in the City N'Gaous, Algeria

agrarisation
city
countryside
N'Gaous, Algeria
urban sprawl

Urban sprawl is a global phenomenon in which a city suffocates its surrounding countryside. These indivisible entities coexist in a field that juxtaposes and composes urban and rural traits. N'Gaous city in Algeria has experienced an astounding spatial expansion over the last 60 years, establishing a strong presence in its territory. Its land area expanded by more than ten times (from 33.7 to 379.7 hectares), while the population increased by more than six times (from 4,887 to 33,515 persons). The purpose is to ascertain the effects of urban expansion on peri-urban agricultural land, the primary economic activity in the area, and to chart its evolution. Accordingly, the article employs an analytical approach to assess the agronomic potential of soils in order to quantify and monitor the agricultural potential consumed by the construction. This method is supported by the use of Geographic Information Systems as a decision support tool for spatializing the city's growth. The focus of the article is to achieve the optimal agri-urban balance feasible. Hence, it will serve as a demonstration that the urban future is fashioned with the inherent potential to guide growth via the use of land assets.

Introduction

Urbanization has been an important worldwide phenomenon throughout history. Urban sprawl characterizes cities' increasing surface area and artificializing land faster than the population component alone (FNE-VEOLIA, 2017). Several studies explain that the dynamics of urban sprawl seen in an area are based on notions like density, fluxes, and temporal dynamics (Abrantes, 2010). Similarly, Robert (2016) stated that detailed knowledge of land usage is necessary for detecting agricultural land consumption due to artificialization. Recently, Vandermotten (2010) has stated that the countryside is being urbanized. Comby (2017) further notes that urban sprawl is an expansion of the periphery that, rather than pushing forward the urban-rural divide, crosses it. The method is translated by placing forms meant to transform urban positional values in rural areas.

Economic and social developments in Algeria have shifted the population's geographic distribution (Kateb, 2003). Batna is one of the country's fastest-growing metropolises. The extension of the urban perimeter has spawned peri-urbanization and the unplanned and uncontrolled spread of urban development into formerly undeveloped areas. Therefore, the impact of Batna city on the surrounding countryside has been studied extensively, from inadequate development to urban expansion phenomena (Dridi et al., 2015).

In the same region, N'Gaous city is an ancient town located in Batna. N'Gaous and its countryside present an opportunity for empirical research for urbanization analysis and urban sprawl control. The link between the city and its countryside is obvious since the city does not produce the means for it to feed itself. That is why city dwellers have been showing a stronger desire for nature than before. However, urban growth is imposing its own planning logic and threatening the natural spaces contained within the city's boundaries (Werquin, 2008).

The purpose of this article is to explore contemporary trends that herald the emergence of new socio-spatial, economic, and symbolic links. The growth of N'Gaous is resulting in a ruralization of the countryside. The situation of N'Gaous is questioned in particular because of the bangs caused by peri-urbanization and the installation of amenities, which result in the fragmentation and fragility of the agricultural domain. With the intertwined relationship between urban and rural, the possibility of new cities is proposed as a viable and practical alternative for balancing the urban frameworks of metropolises and small Algerian cities. The established technique employs an analytical evaluation in conjunction with Geographic information systems (GIS) as a decision support tool to spatialize the expansion of the city.

Materials and Methods

- **Description of the search field** – N'Gaous is a small Algerian settlement situated 750 meters northwest of Batna, on the axis linking Barika and Setif through Ainzel. It is surrounded by two geographical sets: the green spot plain on one side and the two Jebel Boutaleb and Jebel Ouled Chelih on the other. The Barika valley runs north-south across this region, bringing together all the rivers that water the fields downstream (Fig. 1).

With almost 600,000 apricot trees in the town and its environs, N'Gaous, the apricot's icon, has a unit dedicated to the production of jams and juices, a germ of an expanding business sector. The orchard is already failing due to diminishing arable land and water availability. Orchards will die unless immediate protection is established. A spatial mismatch between the urban environment and the orchard defines N'Gaous land. The fabric is irregular and lacks structure (Dounia & Boudjemaa, 2022). Smaller buildings on the urban outskirts fracture and disintegrate. Orchards surrounding the old core add to the city's chaotic fragmentation. The present city grew and developed around orchards.

The city's vibrant contemporary core has a Mediterranean/subtropical desert climate. It

is surrounded by major retailers and public services (town hall, daira on the main highway), giving it an irregular shape. Also, roads and pathways run through the orchards. The neighborhood's narrow, winding paths and lack of access roads testify to the lack of building lots and the history of travel on foot.

The new urban residential zone Ras El Ain lies three kilometers east of the old city. The distribution of amenities is inequitable. Most communal housing complexes are located here, displacing other urban fabric. This approach has altered spatial hierarchy and equilibrium. Individual residences are "villas" set in their own orchards with apricot trees. This substantial structure includes contemporary comforts. When this habitat encroaches on agricultural land, it is illegal.

In such situations, local governments adopt compromising positions, combining monitoring and limitation with acceptance, due to the lack of alternatives. National law forbids the development of undeveloped land into community land reserves. That is why the state repealed the Construction and Subdivision Permit Law 82-02 and established urban planning tools. This aim was achieved by creating Fenarou, 1.5 km north of the metropolitan area's economic core. Fenarou is currently part of N'Gaous due to its location and geomorphology. The area is home to the police station and hospital. Two main axes link the town to the city (the national highway and the successful North construction bypass).

N'Gaous' apricot bounty led to the creation of Emac and Enajuc (National Company for Juices and Preserves). N'gaous-Conserves were created due to the fruit's exceptional organoleptic value and natural character, as well as the preservation process learned. So N'Gaous' urban form is unique. Located in an orchard, it has a single communication line connecting it to the center.

Methods

The purpose of this work is to highlight the analytical method combined with a decision support tool through Geographic information systems (GIS) in order to understand the problem of urban sprawl on agricultural land and to measure the dynamics of the spaces in the territory of N'Gaous. The data gathering process began with the examination of documentation sources that serve as a critical foundation for understanding the state of the art. Additionally, this study is based on a firsthand survey of residents and interviews with municipal officials in N'Gaous. Concerning the case study's knowledge, it is built on field observations, and images gathered in the pursuit of local information about the issue at hand, as we have made fieldwork a methodological basis of major importance.

• **The analytical method** is structured around two distinct phases: The first phase is based on direct observation of the soil. This method entails three aspects:

– The land use mapping (aerial photos and digital pictures).
– The built urban spot (Cadastral data and cartographic products).
– Quantitative field surveys to explore local residents' true impressions of the destruction of agricultural land by urban development.

The second phase reconstitutes land use and its evolution from data initially dedicated to another activity. It is characterized by measuring flows (economic and social) and by quantification (statistical data).

• **Quantification of the expansion growth rate** – The developed methodology uses GIS as a decision support tool to spatialize the expansion of the city. The coupling of information with the decision support tool allows the territorialization of the effects of the growth of the city at the expense of agricultural land. The introduction of the database on a geo-referenced cartography through GIS leads to a quantifiable reading of the factors inherent to the phenomenon of the nibbling of agricultural land. To this end, the interrogation of this spatialization enables thematic maps to explain the impact of spatial evolution.

From the combined method used, three main indicators are defined and serve as evaluation and decision support tools to measure space consumption at a given time:

– The basic indicator for quantifying space consumption entails the characterization of the different types of land use at a given date, evolution of artificialized spaces and mutations of agricultural spaces. The second aims to qualify the consumption of space and describe its spatial dynamics:
– The second indicator tackles spatial growth and development of the built environment within and outside the urban spot, which describe the impacts on the rural space (physical surrounding and human environment) under the effect of action-related phenomena.
– The third indicator aims to put space consumption into perspective: Urban sprawl is defined by the relationship between population growth and land consumption via structural developments (social and economic) measured at a point in time T and compared to previous situations. The attractiveness of the city of N'Gaous (health, education and transportation) favors a sustained demographic growth that is manifested by a strong dynamic of its peri-urbanization.

FIG. 2 THE SHIFT FROM URBANIZATION TO THE PERIPHERY

The first method adopted allowed to characterize the dynamics of peri-urbanization and to identify their causal relationships across the N'Gaous territory through the artificialization of agricultural land. Its implementation consists of analyzing and monitoring the consumption of agricultural land.

• **Statement of the problem** – Based on the data, four main issues were identified:

– To raise awareness of the preservation of the agronomic heritage of the soil (the cultivation of apricot trees);

– To slow down the dynamics of soil artificialization (sprawl, fragmentation);

– To maintain and promote the dynamism of agricultural activity;

– Maintain and promote the territory's coherent development capacities.

For each of the four issues, measurement criteria relevant to the stakeholders' point of view and reflecting different levels of concern were identified. These criteria have been formulated in a deliberately synthetic manner to facilitate exchanges and understanding of the approach followed.

The organization of the measurement criteria constitutes a reference base that guides the selection of the three indicators mentioned above. The exercise of this analysis refers to the spatio-temporal relevance of the indicators to be retained and, therefore, to the spatial information to be mobilized. The importance of the phenomenon of agricultural land consumption led to the need to spatially focus the various indicators on the outlying lands of N'Gaous. The spatial data exploited has allowed for a building of a database with reference to the year 2018, a period of profound spatial mutations (land occupation and use) in which the action of actors in terms of territorial management fits.

Discussions on the purpose of the results of the fieldwork revealed the need for spatial data that would make it possible, on the one hand, to qualify the agronomic potential of soil and, on the other hand, to measure and monitor the consumption of this potential by artificial spaces.

RESULTS AND INTERPRETATIONS

The 1977 census indicated a population of 9,284 compared to 4,887 in 1966. Although higher than the average for small towns (4.6%), N'Gaous' growth rate declined substantially to 6%. This is due to the relative stagnation of migration resulting from the displacement of populations to other more attractive areas (Batna, Setif, and Algiers). Blind consumption of agricultural land by the urban growth will come to a halt through ordinance N° 71-73, carrying the nationalization of agricultural lands and through ordinance N° 74-26 carrying the nationalization of the urban land. During this period, it is observed that N'Gaous experienced major economic difficulties related to the context prevailing after decolonization. Houses of traditional rural character, scattered at the gates of the village on agricultural land, were built. This primary extension outside the core expresses an apparent disparity in the built environment between the initial core and these first extensions.

During the period 1977-1987, the population of N'Gaous increased by 5,848 inhabitants, from 9,284 in 1977 to 15,132 in 1987, at a rate of 5.0% per year compared to 6.0% for small towns. This demographic evolution can be

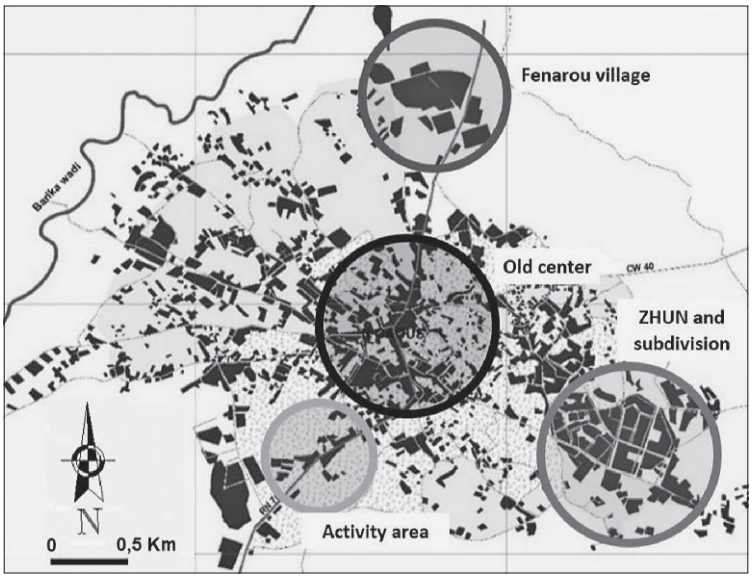


Fig. 3 N'Gaous, a radioconcentric city with a fan-shaped breakdown

explained first by more births than deaths, a logical consequence of the improvement in health conditions, where the mortality rate, including infant mortality, decreased significantly, consequently leading to an acceleration, sometimes spectacular, of natural population growth (3332 people), and, second, by a migratory balance that remains relatively constant (2516 people; Fig. 2).

Originally a rural town, N'Gaous has adapted its rurality to the needs of urban recreation as it has grown from a village into a city. A large part of its orchards has disappeared in favor of communal and private housing developments. However, local authorities are aware of the seriousness of the situation, and for this reason, strict measures have been taken to preserve agricultural land. A building permit is only issued on an agricultural parcel if the applicant is the owner and the use of the house is strictly personal.

Despite these measures, orchards are declining. That is why the city of N'Gaous presents a mosaic of vegetation and mineral; sometimes, an urban island in the middle of trees, sometimes an island of fruit trees in the middle of urban constructions. This image offers a landscape, both urban and rural (Fig. 2).

At the 1998 census, the city of N'Gaous had a population of 25,766 inhabitants, compared to 15,132 in 1987, corresponding to an annual growth rate of 4.6%, higher than the national average for small cities (3.8%). As a result, immigration is its main factor of demographic growth, coming in particular from the communes near the city.

The city of N'Gaous has urbanized rapidly following its promotion to the rank of the chief town of Daira in (1984), which has resulted in the excessive consumption of the peri-urban lands. This new administrative function led to the establishment of public services in socio-educational, administrative, and health realm, turning it into in a new urban centre. A Master Urban Plan from 1986 consequently forced developers and elected officials to consider the status of urban agricultural space.

Simultaneously, the commune has embarked on a massive program of housing estate development to suit the population's demands. Their designs are straightforward: They feature dwellings constructed on plots of 150 to 200 m^2 and consisting mostly of a first floor and an upper story. The latter is not necessarily completed as its building is contingent upon the financial resources of the owner. They are half rural, half urban dwellings designed for affluent rural immigrants determined to erect a roof by whatever means necessary and for renters desiring a pleasant "home".

Figure 2 shows that agriculture occupies gaps that are neglected almost to the point of obscurity because they are incompatible with the classical harmony of the city. It will require all local government's attention to understand that these vacant areas are an inherent part of the urban fabric and form a necessary structural element that must be addressed.

The critical fact about this period is that the bulk of these outlying communities, or pieces of land, were privately owned, allowing for the development of massive spatial extension activities to accommodate newcomers. This fast urbanization is a result of a major demographic overflow and a desire to be closer to the city's amenities (school, work, housing, electricity).

TABLE I EVOLUTION OF EMPLOYMENT BY BRANCH OF ECONOMIC ACTIVITY BETWEEN 1977 AND 2018 (IN %)

Year	Agriculture		Construction		Industry		Services		Total workers
1977	244	22.30%	232	21.21%	123	11.24%	495	45.25%	1094
1987	156	6.07%	283	11.01%	247	9.61%	1885	73.32%	2571
1998	233	5.52%	379	8.97%	763	18.06%	2849	67.45%	4224
2008	336	4.72%	495	6.96%	2127	29.93%	4148	58.37%	7106
2018	1421	10.12%	645	4.59%	5929	42.25%	6036	43.01%	14031

The city of N'Gaous has a population of 33,515 residents as of the 2018 census. The latter disperses its communities across an ever-expanding territory. Between 1998 and 2018, the built-up area more than quadrupled in size. It is highlighted that urbanization and agricultural decline coexist, giving rise to increasingly varied activity dominated by the tertiary sector. The process of residential mobility that began during the decade continues with an accentuated scope. Rather than being delayed, the urban front, voracious for space, has burst towards the whole of the gardens in a fan-shaped manner (Fig. 3), using the periurban grounds as a support point. It continues to grow at an accelerated speed, despite public pressure on lot beneficiaries, resulting in expansions in oil fields devoid of basic facilities and, as an added benefit, in the excessive consumption of land, obliterating any attempt of space optimization.

In summary, the city of N'Gaous is a pretty unique instance; it is a mosaic of plants and minerals, at times an urban island surrounded by trees, at others a fruit tree island surrounded by urban structures. This picture depicts an urban and rural setting; in reality, it depicts a metropolis in the countryside. The city's districts are spread out across an ever-expanding territory, and its fabric, which lacks a regular and organized grid, coexists with these gardens, transforming it into a green metropolis in a diluted system along the roadways supplying the peripheries. The farmer who builds his home in the center of his orchard is responsible for this swarming. Thus, N'Gaous is one of the few cities that has retained its agricultural areas despite its development at their cost.

ANALYSIS

The analysis of Table I reveals that the agricultural sector has declined in importance over the last few decades, from 22.3% of the workforce in 1977 to 6.1% in 1987 and 5.5% in 1998, despite the fact that agriculture is the region's vocation, indicating that the workforce is shifting toward more lucrative and less strenuous work. The construction and industrial sectors have remained stagnant, accounting for only 27% of the active population, despite the presence of production units (Emac and Enajuc factories for shoes and apricot processing) that employ workers from outside the municipality; whereas the tertiary sector has exploded, rising from 45.3% of occupied workforce in 1977 to 73.3% in 1987 and 67.5% in 1998, establishing itself as the driving activity in the municipality (high school, hospital, vocational training center).

Economic activity continues to be a significant driver of urban expansion in N'Gaous. Nevertheless, a 2018 survey found that the percentage of influxes continues to grow as a result of urban development on all azimuths.

In 1977, employment in N'Gaous was equally divided across all sectors, with agriculture accounting for one worker in four; the rest is employed to the tune of 45% in the tertiary, 22% in construction, and 11% in the processing industry of fruit productions. The city's promotion as a daïra in 1984 increased employment in the tertiary sector, particularly in public services, as a result of the management of newly acquired facilities. Additionally, the apparent decline in agricultural employment does not reflect a decline in agricultural activity but rather a conversion of a portion of its workforce to services and administration, as arboricultural activity is seasonal.

In 1998, the secondary sector was supplemented by the creation of a shoe factory, which offset the tertiary sector's weight and rebalanced its internal structure in favor of commercial activity.

Since the 2000s, municipal governments have reinforced their efforts by providing assistance to farmers who practice urban agriculture, actively encouraging the return of agricultural activities for the promotion of agro-industry, and ensuring the sustainability of community garden plots in the face of real estate pressure.

According to Fig. 4, the engine of the economy in N'Gaous is arboriculture, followed by related industries; paradoxically, employment is dominated by the tertiary sector due to the city's new position and the development of related activities. N'Gaous is a relay center; its physical location is the barycenter of a triangle whose apexes are the rival urban centers of Merouana, Barika, and Ain Azel in an arboriculture area.

The attractiveness of the city of N'Gaous was quanitified by examining public utilities (health and education) in conjunction with the transportation sector. This appeal has a direct effect on the city's urban sprawl. N'Gaous has a polyclinic, a health center, and a 240-bed hospital in the health sector. Apart from outpatient treatment, the hospital registered 12,361 hospitalizations in 2018, all of which originated in the communes of its daïra and its environs. This infrastructure is in high

demand because of the high level of care given and the skill of its medical and paramedical employees (Direction of Planning and Development of the Territory of Batna 2018).

Thus, 2667 patients come from N'Gaous (21.6% of the total), 779 from Boumagueur (6.3%), and 1013 from Sefiane (8.2%), for a total of 4462; 3437 patients (36.1%) under the communes that comprise its daira; 1910 patients are from Ras El Ayoun, 1613 Gosbat, 988 Guigba, a total of 4511; 3474 patients (36.5%) from the communes of the daira of Ras El Ayoun, 990 patients from Ouled Si Slimane, 482 Lemsene, 815 Taxlent, or 2448; 1885 patients (19.8%) coming from the communes of the daira of Ouled Si Slimane and finally 939 patients of Rahbat (7.6%), commune of the daïra of Ouled Sellam. As observed in Fig. 5, the strong influence of health facilities, both by the number of hospitalized and by the number of localities covered, the sector devotes 2/3 of its capacity to the service of the daïra of its region (in the circle of about 50 km).

In terms of secondary education, the city of N'Gaous is served by three high schools, two of 1000/300 and 760 posts each, and a 1000/300-seat technicum. The combined secondary cycle of the city's three-four structures accommodates 3736 students, of whom 2600 are from N'Gaous (69.6%), 265 from Boumagueur (7.1%), and 41 from Sefiane (1.1%), municipalities that are part of the city's daira; the remainder comes from the neighboring daira of Ras El Ayoun, with 11 students from Gosbat (0.3%), 30 students from Ras El Ayoun (0.8%).

Two factors account for this influence: the city's core location in this rural setting is somewhat remote from other cities of comparable size within a 50-kilometer radius, and the city has benefitted from a program to construct educational infrastructure that fits the region's youth requirements. However, its area of appeal extends farther to the northeast, including the communes of Taxlent and Ouled Si Slimane that were once part of its daira but have since been absorbed into Ouled Si Slimane; while, to the south, it is restricted to the official limits of its present daira (Fig. 5).

The attractiveness of the city through the means of transport mentioned in Fig. 5 confirms the links that unite it to its environment. The center dominates relations with the communes in its territory and those of Ras El Ayoun to the northeast in all areas, while its relations with Batna are those of a subordinate urban center, and exchanges with Barika are balanced and are of an economic nature. The current means of connection, which is the minibus for the small distances which separate the small city from the chief towns

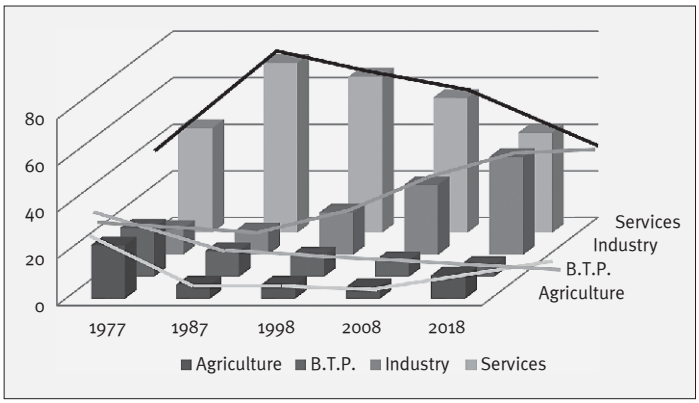


Fig. 4 Evolution of economic activity per branch from 1977 to 2018

(approximately 20 km), ensures more than 305 rotations per day. Its important economic potential, its level of appreciable equipment and its dense road network make of the city a dynamic center which serves the localities of its territory and those of its environment, pushing back even the limits of the neighboring influences (Mérouana and Aïn-Azel), whereas that of Ras El Ayoun is largely absorbed.

In sum, the city, unquestionably, exerts a multiform attraction with its rural environment directly or indirectly. Motivations for this attraction are diverse and numerous, daily or permanent. Permanent, they are related to the unprofitability of agriculture, the arduousness of agricultural work, rural un-

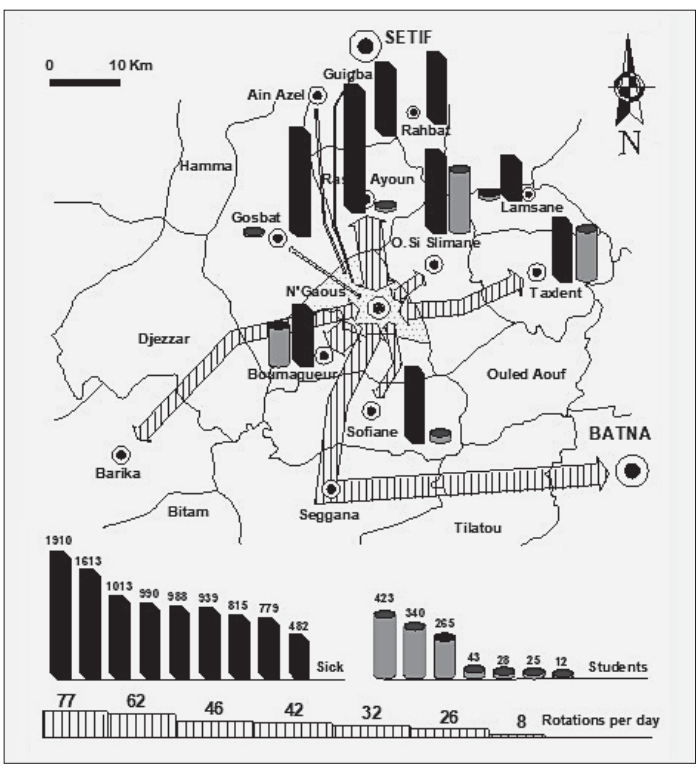


Fig. 5 The city of N'Gaous exerts a multiform attraction on its environment

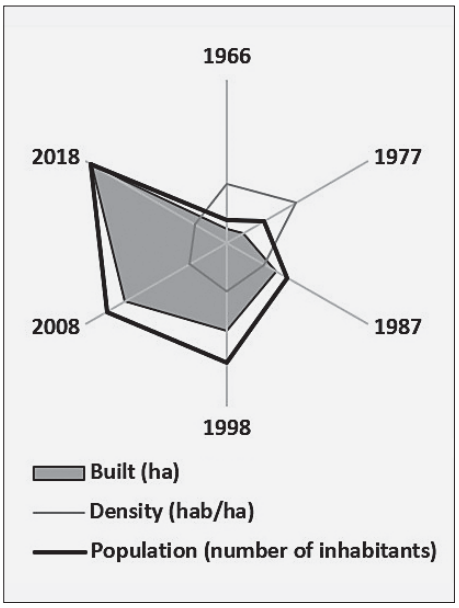


FIG. 6 CONSUMPTION OF RURAL SPACE AND EVOLUTION OF URBAN SPACE

employment, the comfort of urban services and the dynamics of the tertiary sector, etc., because city dwellers in this center, both rural and urban, are looking for the advantages of the city and the countryside combined, without their disadvantages, for the proximity of jobs, services and culture, linked to their centralities. This has led to a maximum artificialization of the gardens surrounding the city. Micro and macro socio-economic factors interact: means of transport, the land market, individual preferences for residential location, demographic changes, the attractiveness of the city.

DISCUSSION

From a technical standpoint, the cartographic and GIS approaches were deployed in estimating the changes that happened between 1966 and 2018, demonstrating a large spatial expansion equal to 69% of the entire urbanized area (Fig. 7). By conducting quantitative field surveys, local residents' true impressions of the destruction of agricultural land by urban development would be explored. The findings indicate that the town of N'Gaous's urban expansion has resulted in a spatial recomposition characterized by the steady retreat of agricultural regions in favor of built-up areas (Fig. 6). As the urban frontier spreads, the city's image deteriorates as developments on orchard land plots violate all urban planning standards. Certain types of expansion create enormous difficulties and exclude any sort of control over the management and growth of space. This circumstance is a result of a desire to possess a single-family house.

Similarly, the survey shows that the urban center is organized in a radioconcentric logic; a belt of apricot trees (600,000 apricot trees on 420 hectares) surrounds the city. The peripheral space is a food belt under the city's influence, allowing it to be supplied directly. The image of nourishing and essential agriculture remains present in the minds of city dwellers who praise "miniature" agriculture (Vidal & Fleury, 2009).

Beyond the orchards, there is an area of intensive, high-yield crops, mainly market gardening, covering 570 hectares. Despite industrialization, the city and agriculture are still closely linked. The city still needed local agriculture on the outskirts of the city, especially because the means of transportation were limited and rather slow. This agriculture allows a certain transition from the city to the countryside, despite the fact that it is often threatened by its consumption because it is considered a land reserve in answer to private actors and neglects the function of food production.

Fig. 8 illustrates the development of the urban area in relation to population increase. It represents the territory's uniqueness and history. Behind the "dynamics" of space consumption, one must detect techniques for population reception that, depending on the region, follow distinct logics but are all highly influenced by the individual's economics. These changes are indicative of a loss in agricultural land that is highly productive (Table II).

There is a remarkable emergence of a metropolis whose production and consumption are shifting back to agriculture. While the city of N'Gaous is far from avoiding the spread of peri-urbanization, it is making strides in maintaining the core green zone (Fig. 9). From now on, in the context of N'Gaous, returning to the land and caring for apricot gardens at the city's gates has developed into a privileged relationship of goodwill, and appears to have completed its transformation from agriculture considered and organized to feed humans to an "agrarianization" of places and men sharing the same space. As a result, it is suggested to properly inquire about the degree to which agriculture is evolving into a new instrument for urban development. In summary, the appeal of N'Gaous is shown by the urban area's expansion, which is surpassing population growth.

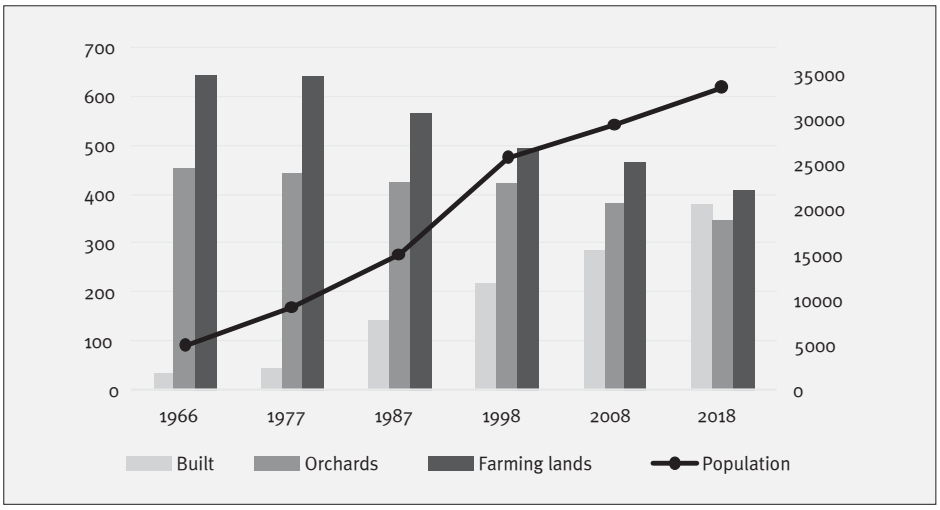
This attraction to this portion of the territory has resulted in phenomena such as:

– "De-densification" of the old and dilapidated city center increases the consumption of space in order to have an airy, and therefore not very densely populated, individual habitat and a decent housing.

– New lifestyles (shrinking of households) can explain in part this situation.

– The increased need for equipment, infrastructures, services and utilities in the attractive areas that appear to be "better provided for" than in the city center.

FIG. 7 N'GAOUS, EVOLUTION OF THE URBAN AREA FROM 1966 TO 2018



Faced with this position, local decision-makers must aim to maintain as much control over property as possible in order to influence city growth decisions and promote urban redevelopment. However, they must also strive for compactness in order to maximize the surface area and prevent land consumption, or enhance the multi-functionality of peri-urban places shared by city actors, and thereby foster a more acceptable mix (shared parking, common commercial, and service spaces). The territorial players must adopt and share the same reality of the stakes associated with space usage.

Conclusion

The current study aimed to highlight the phenomenon of the urban sprawl in the Algerian city N'Gaous. To define the implications of the phenomenon, it was necessary to adhere to urban planning standards and to implement the terms of the management plan, which are included in the city's master plan. That is why the results call upon rational land use and planning and the balance between the urban-rural realities. Apart from N'GAous, and, more widely, Algerian cities, it is indisputable that the city has lost its unfavorable reputation as a "tutelary parasite" in order to exert progressively unilateral dominance over the surrounding countryside. The city-countryside binary looks to be shifting progressively in favor of the metropolis, for which rural regions have provided suffocating contingents of peasants. The interest of this paper has been to provide practical results that contribute to improving the challenges of peri-urban agriculture in the Algerian context, which is strongly marked by rapid demographic and urban growth.

The case of N'Gaous has offered an opportunity to put the concept of an agri-urban system to the test. This has allowed for the understanding of the breadth of the city's exploring links with agriculture. Additionally, it facilitated the collection of data on the actions, uses, and arrangements of urban agricultural actors.

To this end, the findings emphasize the critical role of adaptive governance in the ongoing construction of sustainable agricultural production, in addressing environmental challenges, in reconciling rural and urban lifestyles, and in renegotiating the relationship between the city and agriculture for sustainable development: all of which are enabled by these unprecedented glimpses into rural life, using planner-like tools.

This paper proposes an analytical technique for assessing the urban sprawl in a city that decision-makers may utilize to ensure sustainable urban growth. Moreover, the research reveals that the analytical method, combined with Geographic information systems (GIS), is beneficial for urban planning and monitoring and a future regulation of new urban projects.

As for recommendations, decision-makers are accountable for enforcing and adhering to the rules, as residents construct dwellings to suit their housing requirements, which the state was unable to supply due to the silence of competent authorities. In other words, the future of Algeria's urban form is determined by the country's selected territorial planning strategy.

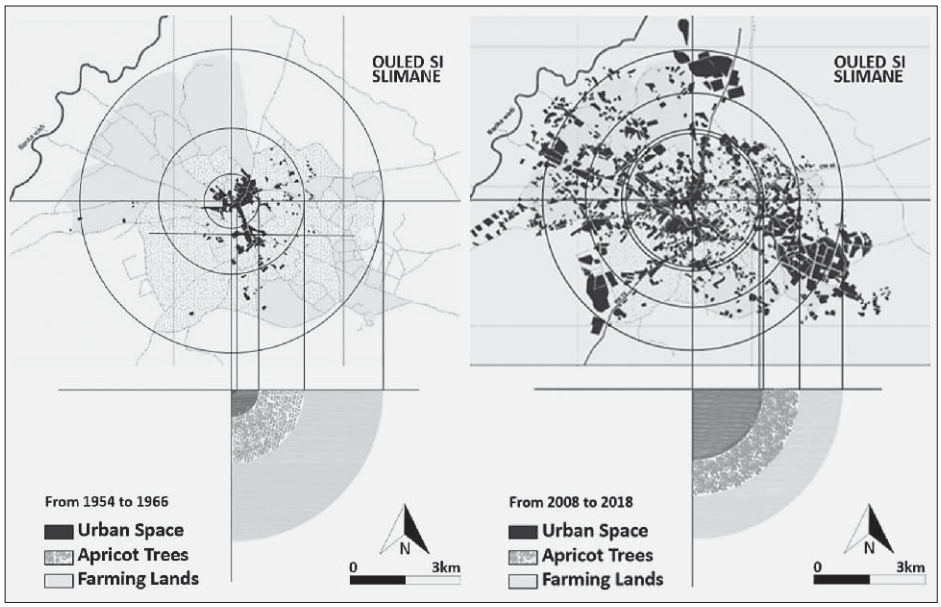
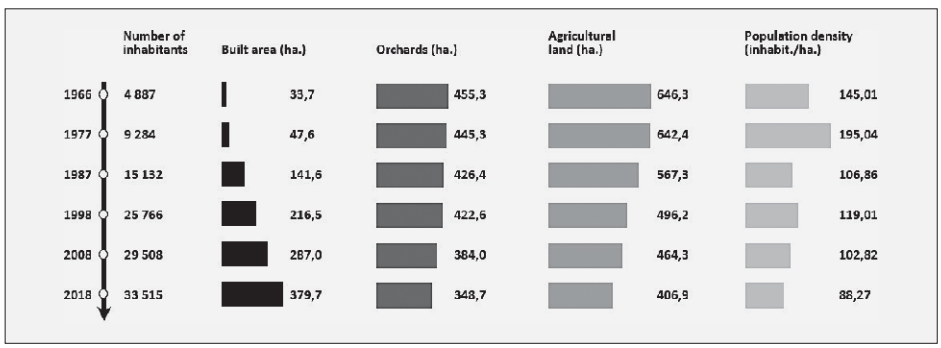


Fig. 8 The shift of N'Gaous from a rural center to a fragmented city (above)

Table II Distribution of the surface area of the territory and the population of the city of N'Gaous between 1966 and 1998

	1966	1977	1987	1998	2008	2018
Built area	33,7	47,6	141,6	216,5	287	379,7
Orchards	455,3	445,3	426,4	422,6	384	348,7
Farminglands	646,3	642,4	567,3	496,2	464,3	406,9
Trees	646 427	632 229	605 395	600 000	545 196	495 503
Population	4 887	9 284	15 132	25 766	29508	33515
Density	145	195	107	119	103	88

Fig. 9 Consumption of rural space and evolution of urban space



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Conceptualization: I.B. & S.C.; methodology: I.B. & S.C.; software: I.B.; validation: I.B.; formal analysis: I.B.; investigation: I.B.; resources: S.C.; data curation: I.B. & S.C.; writing-original draft preparation: I.B.; writing-review and editing: I.B. & S.C.; supervision: S.C.; project administration: I.B. & S.C.; funding acquisition: I.B. & S.C. Both authors have read and agreed to the published version of the manuscript.

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Illustration sources

Fig. 1	*** 2020b, treated by authors, 2020; photos: authors, 2022
Fig. 2	*** 2020d, authors' interpretation, 2018
Fig. 3	*** 2020d, authors' interpretation, 2018; photos: authors, 2022
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