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EVALUATION AND VALORIZATION OF PERI-URBAN WASTELAND IN ALGERIA USING DATABASE INDICES

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Abstract: This study examined the transformation of fertile peri-urban land surrounding large Algerian cities. Khemis El Khechna municipality in Boumerdes province was a case study for this phenomenon. Researchers utilized remote sensing techniques through Geographic Information Systems (GIS) to quantify land-use change. Specifically, the Normalized Difference Vegetation Index (NDVI) contributed to finding regions with high biodiversity and healthy vegetation, while the Normalized Difference Built-up Index (NDBI) highlighted areas of concentrated buildings. This data was crucial in identifying wastelands or potential wastelands. The ultimate goal was to promote the development of such areas as an alternative to encroaching on productive farmland. The indexes and their database hold great promise for agriculture in the form of a national cadaster. The method could also be easily applied to other African countries, by promoting the utilization of wasteland and the adoption of precise farming methods.

Keywords: NDVI; NDBI; Landsat8**;** agriculture**;** promoting; Algeria; Peri-urban; wasteland; Valorization; Database.

1. INTRODUCTION

Agricultural production around the world faces a complex challenge: balancing the need for urban expansion with the need to maintain fertile land for food security. Land degradation, a term encompassing a variety of land quality changes that negatively affect its current or future use, is a significant threat to global sustainability, particularly in developing countries (CSFD, 2010). This process reduces or eliminates the biological or economic productivity of the land. It is driven by several factors, including climate change, unsustainable land management practices, and population growth (Fertas et al., 2023). Similar to Algeria, many countries experience rapid urbanization, which is often concentrated in areas with favorable climates and fertile soils. This phenomenon threatens vital agricultural land, putting a strain on a nation's ability to feed its population. Moreover, "the Useful Agricultural Area (UAA) occupies only 8.3 million hectares, or 3% of the national territory", out of Algeria's total surface area of 238 million hectares in 2018 (DSA, 2018). Besides its narrowness, this UAA (8 million ha) is regularly exposed to several threats, including uncontrolled urbanization, which results in the annual loss of large agricultural areas" (Kehal, 2006). "Consequently, over 300000 ha of agricultural land have given way to concrete since independence, drastically reducing regional and national self-sufficiency potential" (Chahat, 2018).

Standardized assessment and spatial mapping of agricultural land health are critical prerequisites for effective land restoration and protection policy design and evaluation (Perpiña et al., 2020). This systematic approach allows for robust impact assessments, and quantifies the effectiveness of implemented policies on the ground. A significant historical impediment has been the absence of a universally adopted technical framework for land degradation assessment. This lack of standardization hinders the comparability of data across diverse geographical regions and periods (CFSD, 2010).

Leveraging empirical data, there is a wide range of indices that encompass both vegetation and soil characteristics. Vegetation indices have long been a crucial tool for monitoring plant growth and health (Vélez et al., 2023) in particular, and serve a dual purpose. They do not only facilitate the identification and monitoring of vegetation health and change, but also allow for the estimation of crucial biophysical parameters like biomass, leaf area index, and the fraction of Photosynthetically Active Radiation (PAR) absorbed by plants.

Our research explores the potential of digital agriculture to unlock previously untapped agricultural potential. To do so, we're using a variety of indices to create a comprehensive inventory of land with high agricultural potential. This inventory will be crucial in guiding future land use decisions.

Digital agriculture is the convergence of agriculture and information technology. This powerful combination includes sensors to collect data, intelligent networks to transmit that data, data science tools to analyze it, and user-friendly applications to visualize the insights.

The core objective is to increase productivity and meet environmental and social expectations throughout the agricultural value chain. One of the key research questions we're exploring is: how can digital tools be optimized to identify and unlock this potential while respecting environmental and social sustainability practices? Digital agriculture serves as a critical tool to replace outdated practices that can no longer meet the demands of precision agriculture.

As an illustrative model of this deplorable situation, we will focus on agriculture Khemis El Khechna Municipality. Located in the heart of the Mitidja region, our study area, which has always had an agricultural vocation, is now faced with urbanization, industrialization and other factors encroaching on its agricultural land, causing spatial and functional mutations. Agriculture in our study area is going through a delicate phase, especially in terms of spatial and functional transformations. This is due to the ever-increasing population density and urbanization, which increases the risk of losing its role as a productive sector. Given this situation, our questions are: What is the risk of excessive urbanization on the long-term agricultural productivity of our study area? How can such a rapid urban sprawl be managed? What approaches can be used to achieve land-use integration that fosters the co-existence of urban and agricultural functions??

This article presents the context and the precision agriculture methodology used to study and analyze the situation of agriculture, in particular that of wasteland, and finally discusses the main findings.

1.1. Study area

The municipality is located in the plain of Mitidja, where the land is very fertile, especially in the north-western part. Its geographical coordinates are between 36° 38′ 48″ to the north and 3° 20′ 01″ to the east. Resulting from the administrative division of 7 February 1984, it is situated at the extreme west of Boumerdes province, at 30 km distance from the capital Algiers (Figure 1). It covers an area of 8,192 hectares. It has a population of 98,051 inhabitants (DPSB, 2018). It has a population density of 1196 inhabitants/km² and an urbanization rate of 75.41% in 2015 (ANIREF, 2018). This is lower than the province rate, estimated at 87.4% (PATW, 2015).

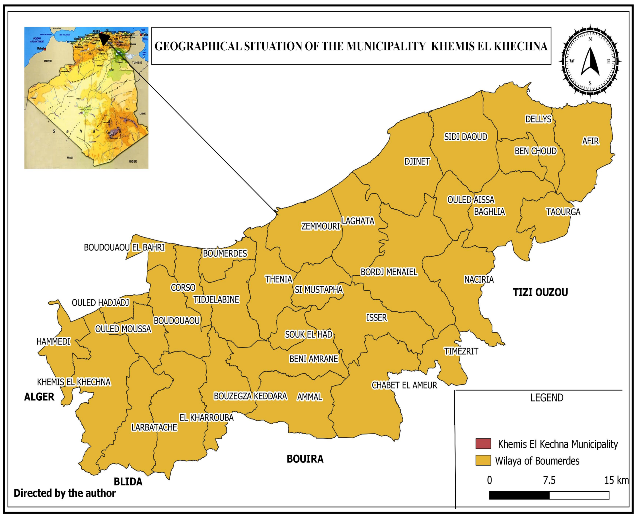

Figure 1. Geographical map of Khemis El Khechna municipality

1.2. The geographical characteristics of the study area

A description of the physical geographical characteristics of the study area and its components, such as soil type, prevailing climate, existing hydrographic network, etc., is necessary for a more appropriate and rational use of the land, on one hand and its potential on the other.

The municipality of Khemis El Khechna has a Mediterranean climate with rainfall between 800 and 900 ml/year and is entirely under the influence of the Mediterranean basin. Temperatures fluctuate throughout the year, ranging from lows of 8°C to highs of 38°C. The annual average temperature sits comfortably at 25°C, (ANIREF, 2018). The Mediterranean climate is characterized by a rainy season and a dry, sunny summer, maintained by the proximity of the sea. The relative humidity is high and constant throughout the year. The rainy season favors agricultural activity. The dry season requires irrigation, either with surface water (wadis) or underground water, which is the originality of Mitidja's hydrography.

Table 1. Evolution of the population (1977-2018).

Municipality	Census of				
	1977	1987	1998	2008	2018
Khemis El khechna	27062	45453	58574	76 474	98051

1.3. Population growth (1977/2018)

Compared to the period spanning 1977-1998, the population of the municipality increased by 53702 inhabitants between 1998 and 2018, at an average annual rate of 3.61% (DPSB, 2018). In 2008, the population Khemis El Khechna was more than 70000 inhabitants (Table 1).

Due to its landlocked location, exacerbated by a very high mountainous terrain (75% of the municipal territory) and poor land and water resources, the population density of the study area was 1196 inhabitants/km^2 in 2018.

1.4. The paradox of Agriculture urban sprawl

The municipality benefits from natural conditions conducive to agricultural development. However, the study area faces several constraints; mainly urban sprawl at the expense of agriculture. It is essential to analyze the land situation, the changing land use patterns, and the impact of urban change on agricultural activity and try to understand why (Boudjenouia et al., 2008). Khemis El Khechna is classified as having high agricultural potential for mixed agriculture (zone A). It is characterized by assets associated with:

- Useful agricultural area of 3686 ha (DSA. 2018)
- Favorable climate.
- Significant water resources.
- Forest Park of 33 ha (DSA.2018)

1.5. Potentialities of the agricultural sector

A breakdown of the municipality's agricultural landscape in 2022 reveals a mix of farm types:

-Collective Farms: There were 100 collective farms, occupying 58.76% of the total agricultural area. These farms contribute 27.10% of the total agricultural output.

-Private Holdings: 565 private holdings operated on 1049.5 hectares of land.

-Other Holdings: This category includes a 300-hectare experimental holding and 3 holdings totaling 33 hectares.

1.6. Land Management Rights

Algerian regulations established under law No. 87-19 of 8th December 1987 empower farmers with significant management autonomy:
-Beneficiaries have unrestricted management control over their farms.
-The State grants agricultural producers perpetual use rights over their land (Articles 6 & 7, Law No. 87-19).
- Article 43 of this law prohibits interference in farm administration and management (Ahmed 2011).
This level of autonomy allows farmers to make independent decisions regarding:
-Crop Selection: Farmers have the freedom to choose the crops they cultivate.
-Production Quality and Quantity: Management decisions directly impact the quality and quantity of agricultural output.

While farmer autonomy offers advantages, it is important to consider potential implications, such as sustainability practices; without guidance, some farmers may neglect sustainable agricultural practices. Independent decision-making may not always align with market demands.

1.7. Labor: The Backbone of Agriculture

Agricultural activities rely heavily on manual labor (Si tayeb, 2015). Private farms, which occupy the majority (59.07%) of the total agricultural land (3686 hectares), absorb most of this labor force. However, there seems to be a disparity between the vast land area and the available workforce. This suggests a potential shortage of agricultural workers, which could hinder productivity.

2. METHODS

This study utilizes Landsat imagery obtained from the U.S. Geological Survey (USGS) for the period 2016-2023. The imagery was specifically chosen to represent the dry season, known for its optimal differentiation of land cover elements. Processing and analysis were conducted within the QGIS 3.4 software environment, with Google Earth employed for ancillary data verification. The Landsat data offers several advantages:

-Freely available: The imagery can be readily downloaded at no cost from the USGS server.

-High spatial resolution: The resampled thermal infrared bands boast a 30-meter resolution, ensuring compatibility with other datasets and minimizing potential artifacts during calculations.

Consequently, the spatial resolution of this study is established at 25 meters (Khallef & Brahamia, 2019). Additionally, a Universal Transverse Mercator (UTM) zone 32 north projection system is consistently applied to all data for optimal spatial analysis.

After processing the satellite images, two indexes and one indicator were used:

-Normalized Difference Vegetation Index (NDVI): This index helps assess vegetation health and density (Haraldur & Iman, 2021).

-Normalized Difference Built-up Index (NDBI): This index helps identify areas of urban development and infrastructure.

- Irrigated Utilized Agricultural Area indicator (UAA): To overlap the results of the indicator and those of the NDVI index.

To complement the satellite-derived data and capture the human perspective on land health, a social survey was conducted utilizing a standardized personal questionnaire. This survey targeted various stakeholder groups, including representatives from government departments (Alaeddine et al., 2022), agricultural holdings, and relevant associations. This multi-stakeholder approach facilitated the establishment of community engagement and the collection of valuable ground-level feedback. The survey involved 707 farmers and 50 managers and employees of State institutions.

2.1. Diachronic analysis of agricultural land use in the area studied (2009-2023)

This study utilizes the Normalized Difference Vegetation Index (NDVI) to analyze the historical and current state of agricultural land. We focus on the distribution of the agricultural land base (the average amount of land dedicated to agriculture) in 2009 and compare it to the updated situation in 2023 (Figure 2). This comparison aims to highlight the encroachment on agricultural land. According to the Standardized Difference Vegetation Index (NDVI),

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

RED: Infrared NIR: Near Infrared

The continuous nature of this encroachment is a key concern. By monitoring its evolution through NDVI analysis over time, we believe we can gain valuable insights into the changing agricultural landscape.

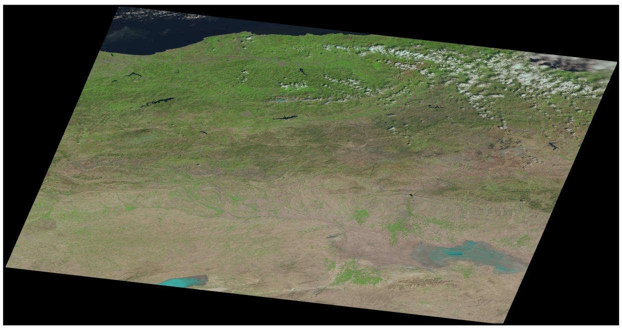

Figure 2. Landsat8 satellite image 24/07/2023

2.2. NDBI: Complementing NDVI to Mitigate Measurement Errors

This study investigates the potential loss of agricultural land to urbanization in Khemis el Khechna. Particularly, it aims to quantify the extent of this encroachment and assess whether urban development adheres to established guidelines (Megherbi, 2015). By analyzing this phenomenon, we delve into the root of the problem: the consequences of unchecked urban sprawl on a region known for its agricultural value.

To understand the urban sprawl in Khemis el Khechna, we'll examine the historical development of its built environment and infrastructure. To summarize this, we used the Normalized Difference Building Index (NDBI). It is based on ratios designed to mitigate the effects of differing terrain lighting and atmospheric effects, (Figure 3).

NDBI = (SWIR - NIR) / (SWIR + NIR)

SWIR: Short Infrared NIR: Near Infrared

The purpose of classifying the NDBI index is to quantify the land use of the study area, and consequently to map built-up and vacant land, (Table 2).

It is ratio-based to mitigate the effects of terrain illumination differences as well as atmospheric effects.

2.3. The Irrigated Utilized Agricultural Area (UAA)

The indicator is a crucial tool for understanding the challenges facing Boumerdes province’s vital agricultural sector. Disparities between urban and rural areas, driven by factors like industrialization and urbanization, threaten this region's rich agricultural potential where irrigation is essential for crop production.

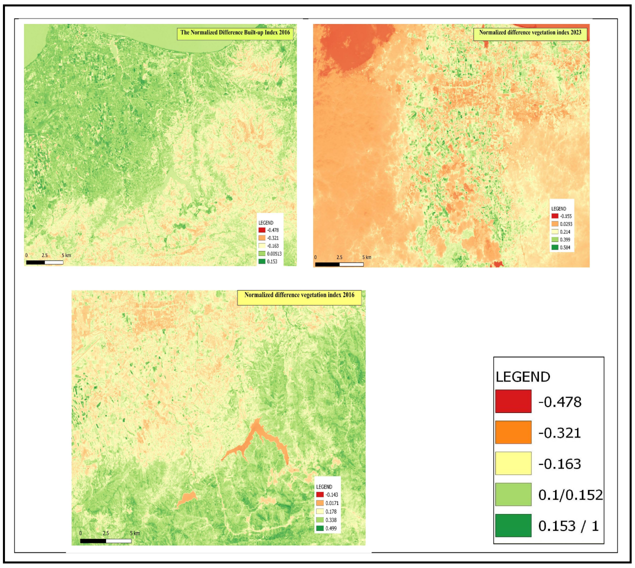

Figure 3. Evaluation of the NDVI index 2016-2022-2023; Author editing using QGIS 3.4 software

Table 2. Calculates the Normalized Difference Built-up Index for a Landsat 8 image

Setting	Explanation	Data type
Raster	The input raster.	Raster
Swir_band_id	The band ID of the shortwave infrared band. The ID index uses one-based indexing. (The default value is 6)	Integer
Nir_band_id	The band ID of the near-infrared band. The ID index uses one-based indexing. (The default value is 5)	Integer
Returned value		
	The output raster object with the NDBI values.	Raster

This indicator is a variable value to:

-Assess whether the farm used water to irrigate its crops.

-Calculate the total area irrigated. These variables measure the farm area in which water was used to irrigate crops.

-Identify the decline in water availability observed.

-Determine the organizations responsible for allocating water in the farm's region.

-Area of farmland on the holding. These variables measure the area of farmland on the holding, in hectares. It is calculated by adding together the areas of the farm covered.

This indicator helps pinpoint municipalities struggling with water deficits. By analyzing the collected data, we can identify key factors influencing agricultural land health in Boumerdes province. This knowledge can then be leveraged to develop targeted resource allocation strategies and implement data-driven sustainable practices. These combined efforts can promote the long-term viability and resilience of the agricultural sector in the region.

3. RESULTS

The survey/questionnaire results provided valuable data that enriched and complemented our understanding of the irrigation status of agricultural land in the study area. The results obtained during this research carried out in our municipality can be summarized as follows:

3.1. The NDVI results

According to Figure 3, the results are similar to the NDVI calculation in QGIS 3.4, but with more pronounced contrasts for water braids, gravel and sediment banks, pioneer vegetation, lowland vegetation, and forested areas of mountainous relief (shown in dark green). According to scientific standards, NDVI values range from -1 to 1 (Vélez et al., 2023). Five classes have been identified, reflecting three land cover types:

≥--0.478.
- -0.478*-0.321 } **Urbanised land**

- -0.321*-0.163 } **Waste Land**

- 0.0.152 * 0.1.
- 0.153*1 } **Agricultural land**

According to the above classes, the spatial distribution of the land is as follows (Table 3).

Table 3. Distribution of real assets (ha) 2009-2023

DESIGNATION	In Dry	In Irrigation	TOTAL
Bare land 2009 (1)	1999.64	1197.36	3197
Bare land 2023 (1’)	1222	1745.75	2967.75
Cultivated land 2009	290	339	629
Cultivated land	267	451.25	718.25
Total (1+2) 2009 (3)	2289.64	1536.36	3826
Total (1’+2’) 2023 (3’)	1489	2197	3686
Wasteland 2009 (4)	4366	-	4366
Wasteland 2023 (4’)	4506	-	4506
Total (3+4) 2009	6655.64	1536.36	8192
Total (3’+4’) 2023	5995	2197	8192

A recent update on land resources in the municipality of Khemis Khechna reveals a total agricultural area of 3686 hectares (ha). This contrasts with 4506 ha of wasteland.

Notably, irrigated land comprises a significant portion (2197 ha) at 59.60% of the total utilized agricultural surface area (SBU) (DSA, 2018). Dryland constitutes the remaining 40.39% (1489 ha) of the SBU.

3.2. The NDBI results

The results show that there are three classes of index (Figure 4):

0.153*1 } **Urbanised land**

0.153 * -0.0053.
-0.0053* -0.163. } **Waste Land**

-0.-0.163 * --0.478.
-0.-0.478 -1 } **Agricultural land**

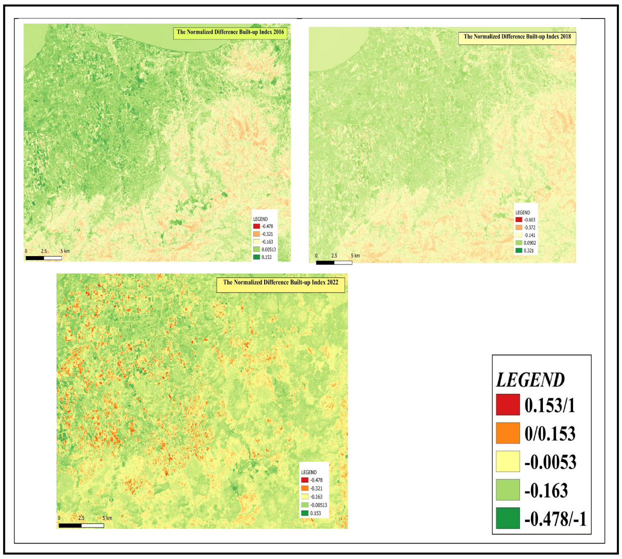

Figure 4. Assessment of the NDBI index 2016-2022-2023. Source: Author of the article using QGIS 3.4

It is ratio-based to mitigate the effects of terrain illumination differences as well as atmospheric effects (Table 4).

Table 4. Inventory of the land parcels in the study area according to the NDBI index.

Total area Municipality	Agricultural land	Waste Land	Urbanized land
8192Ha	2289.64Ha	4506Ha	1396.36Ha
100%	28%	55%	17%

Source: Author of the article based on NDBI results.

The value of NDBI ranges between -1 and 1. Research suggests that positive NDBI values represent urban areas and negative values non rural areas, (Yuanmao et al., 2021). This explains the results obtained.

3.3. The Irrigated Utilized Agricultural Area indicator results supplemented by the survey

We have chosen the western municipalities of Boumerdes province as our study area, (Figure 5).

Nestled within the Mitidja plain, this region is known for its highly irrigated Utilized Agricultural Area (UAA). These municipalities boast UAA values that are a remarkable 31% to 68% higher than the average for the entire province.

An interesting trend emerges when comparing (Figures 3 and 5). There is a decrease in the area of dry land, seemingly in favor of an increase in irrigated land. However, a closer look reveals a more concerning development: a net decrease of 140 ha in cultivated land (both irrigated and dry). This decline coincides with a concerning 140 ha increase in wasteland.

4. DISCUSSION

Based on recent investigations at the local level in Serbia which made use of CORINE Land Cover (CLC) and NDVI (Miomir et al., 2018), this research reveals a significant constraint of CLC information.

While CLC's data is valuable for environmental analysis, it is primarily tailored to regional scales, which limits its applicability for highly localized studies due to infrequent updates occurring every 5-10 years. On the other hand, NDVI provides yearly data, making it a more appropriate option for temporal analyses. The choice of NDVI is further justified by its adherence to the same methodology and spatial resolution as NDBI (Normalized Difference Built-Up Index). This methodological alignment contributes to the precision of our obtained results. To enhance the reliability and accuracy of our findings, both NDVI and NDBI are cross-checked against a universally recognized metric: the United Nations irrigation indicator.

A comparative analysis of official statistics and data from NDVI and NDBI during the same timeframe (Miomir et al., 2018) exposed statistical discrepancies. By integrating this data, we refined our analysis, providing a comprehensive explanation for the observed outcomes.

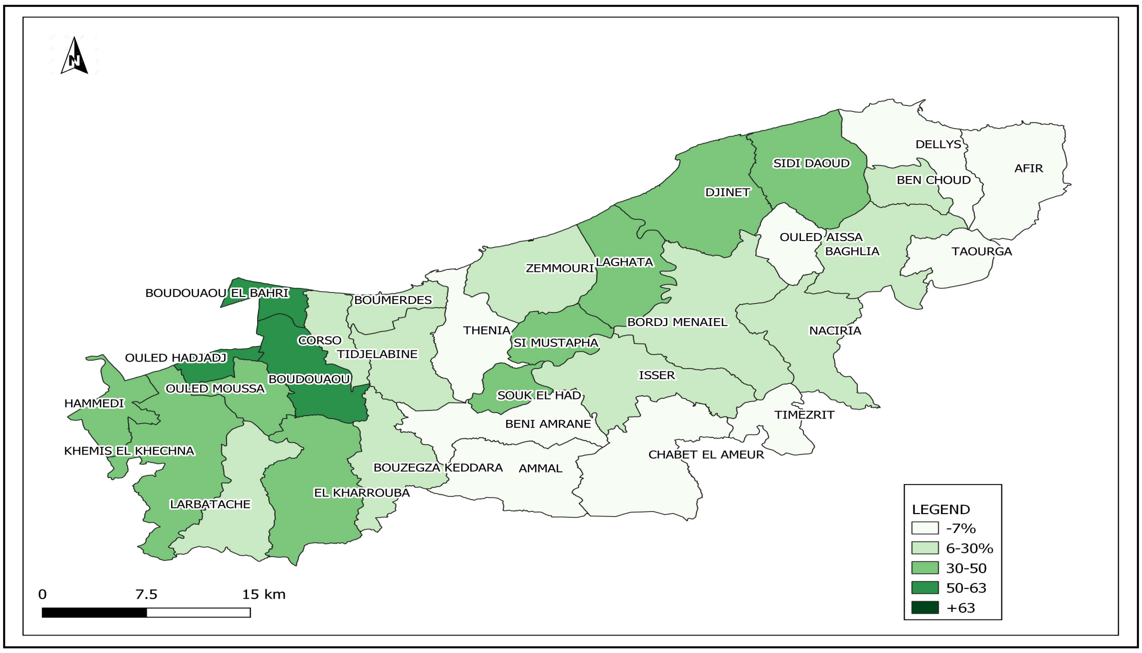

Figure 5. Map of Useful irrigated agricultural areas in the wilaya of Boumerdes.

4.1. The Shifting Landscape of Khemis el Khechna

In terms of economic development, the agricultural sector plays a very important role. Unfortunately, this fact is not taken into account by the authorities (Badreddine, 2015). The secondary sector, which is composed of industry, buildings, and public works (Benyoucef, 2015), accounted for 40.83% of employment in 2009, which increased to 43.22% in 2017, with an increase of 21918 people employed in the secondary sector. The analysis of this factor shows that the industrial sector in the municipality of Khemis el Khechna continues to grow (Figure 6), especially with the establishment of the industrial park, which covers a considerable area of 136 hectares (DPSB, 2018).

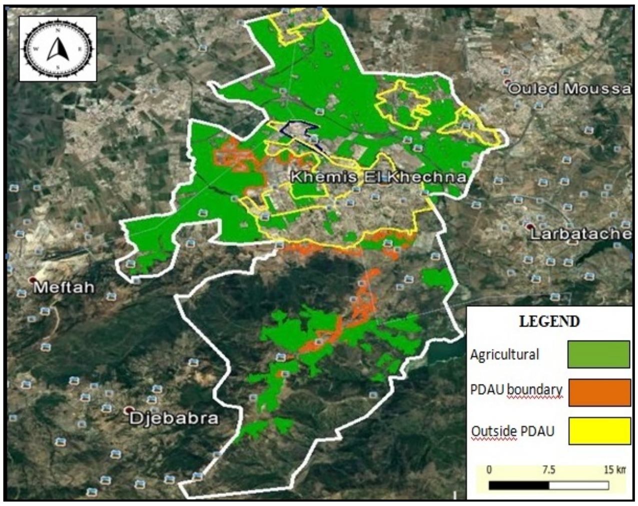

Figure 6. Map of agricultural land according to the Master Urban Plan 2022(PDAU).

The tertiary sector occupies an important place. The occupancy rate in 2009 was 37.53%, which has risen to an estimated 43.36%, which represents an increase of 2439 people.

Several factors might be driving this conversion of agricultural land to non-agricultural uses:

-Infrastructure Development: The completion of government projects, including two major roads (highway and ring road), may have contributed to land use change.

-Industrial Growth: The creation of industrial estates and a dry port could have further reduced available agricultural land.

-Illegal Land Practices: The text suggests that illegal parceling out of agricultural land by the private sector may also be a contributing factor.

Understanding the reasons behind this land use shift is crucial for policymakers and stakeholders. By addressing these factors, strategies can be developed to promote sustainable land use practices and protect the valuable agricultural resources of Khemis El-Khechna.

4.2. High levels of wasteland identified in the cadastral survey of our study area

According to the graph (Figure 7), 55% of the study area is a wasteland, which can only help to revitalize agriculture in our region.

Given this situation of built-up areas and farmland and the problems encountered (Boudjenouia, 2008), the following section outlines the measures to be taken in the development and town planning plans (Belghit, 2016), as well as the preliminary recommendations designed for the Daïra and their implications.

According to the pie chart (Figure 7), 55% of the area is a wasteland, which can only help to revitalize agriculture in our region.

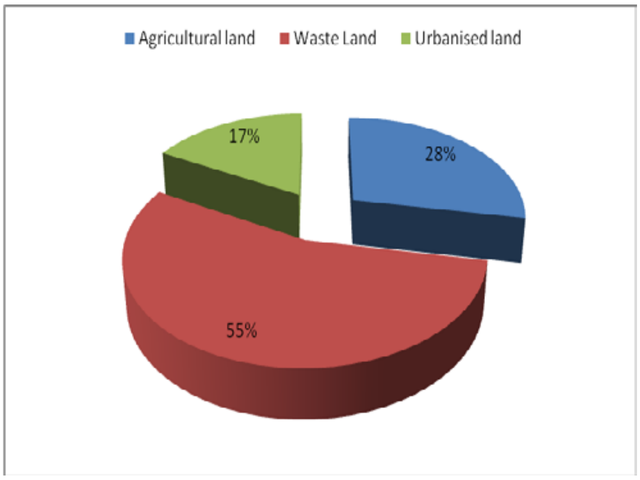

Figure 7. Distribution of Land Cover Types.

Owing to this situation of built-up areas and farmland, and given the problems encountered, the following section outlines the measures to be taken in the development and town planning plans (Belghit, 2016), as well as the preliminary recommendations designed for the Daïra and their implications.

The expansion of urban areas in the towns located on the plain poses a threat to the productive agricultural land and water reserves in the northern part of the municipality. Additionally, it gives rise to a disorganized urban structure devoid of any logical design. It is crucial for the future progress of the local government to rejuvenate this region. A locality rich in agricultural significance is experiencing swift urban expansion alongside limited industrial development (Loyat, 2007). To address the existing disparities, suggestions have been put forth that encompass both agricultural and urban domains. This endeavor ought to have been in accordance with the tenets of Sustainable Development Goals (SDGs) by giving precedence to a threefold aim (Tsani et al., 2020).

Safeguarding Agricultural Productivity: Ensuring the land preserves its agricultural function by employing methods that bolster food security (SDG 2) and sustainable land management (SDG 15). Illustrations may encompass strategies influenced by the ecological intensification framework of the Food and Agriculture Organization (FAO).

Elevating Living Standards: Enhancing the standard of living within the current residential setting by concentrating on aspects such as air and water purity, green areas and infrastructure enhancement. All this will contribute to welfare (SDG 3) in accordance with the recommendations of the World Health Organization (WHO) for healthful urban settings.

Inclusively Spatial Development: Ensuring that spatial development strategies address the requirements of the entire populace through fair and transparent planning procedures, mirroring the principles of inclusive and sustainable urban development (SDG 11). This might have entailed referring to particular approaches advocated by UN-Habitat, like participatory planning methodologies.

4.3. Correlation Analysis

The correlation analysis (Gjoka et al., 2023) reveals important relationships between the Remotely sensed data indexes and the survey questionnaire.

The result of 3686 ha obtained from the survey of farmers and various bodies is superimposed on that obtained from the NDVI and NDBI indices (Table 5), with a margin of error of 1 ha (3685 ha).

Table5. Analysis of questionnaire survey results

Number of farms surveyed	Number of technicians and managers surveyed	Surface area of peri-urban agricultural land (Ha)
70	50	3686

This confirms, firstly, the 55% rate of fallow land to be developed. Second, it confirms the reliability of these indexes, which will be adopted by countries in the field of precision agriculture.

A minor problem raised by the survey is that agricultural land in urban areas can be misinterpreted by low-precision remote sensing equipment such as CLC.

4.4. Promoting sustainable practices

It is imperative to execute the approach delineated in Table 6 within the framework of establishing safeguarded agricultural zones or perimeters to safeguard peripheral agricultural and natural areas.

It is therefore necessary to support the implementation of Law No. 90-25 on Land Tenure (Zeghbib, 1991) and Decree no. 09-339 of 22 October 2009 to support the efforts of the State and local authorities.

Table 6. Operational diagram for the development of agricultural wasteland

<table>
<tr><th>Operation path</th><th colspan="3">Step Consistency</th></tr>
<tr><td>Step I</td><td colspan="3">Inventory of fallow and/or forest Land with agricultural potential. Accurately map land available to develop</td></tr>
<tr><td>Step II</td><td colspan="2">Characterization Fallow land, agricultural wasteland, Assessing land pressure</td><td>Identifying forests with potential Agricultural Identification of land's agricultural history</td></tr>
<tr><td>Step III</td><td>Identifying the prospective trajectory of agriculture for the specific land area entails the delineation of its agronomic capacity.</td><td>Integrating the multifunctionality of spaces involves the identification of various other territorial issues.</td><td>Identification of sources and characterization of partnerships between local authorities and professionals.</td></tr>
<tr><td>Step VI</td><td>Define the project Targeting areas where agricultural development is threatened.</td><td>Determination of the management method deposits Definition of the conditions for the agricultural reclamation of the main sectors.</td><td>Definition and Action Plan. The action plan needs to be defined concertedly to make sure it is and to ensure the involvement of all stakeholders.</td></tr>
</table>

5. CONCLUSION

The agricultural operations in Khemis El Khechna are under significant pressure due to the rapid expansion of residential areas, flourishing commercial enterprises, the possibility of industrial growth, and continuous urban development which are encroaching upon agricultural lands. Consequently, this situation has led to a reduction in available land for farming activities and a diminishing role of agriculture in the region. The traditional agricultural character of the area is being gradually replaced by a new urban environment. Our investigation affirms that the growth of urban areas has had a profound impact on agricultural regions, resulting in the disappearance of essential farmlands.

Various measures have been enforced by the authorities to manage urban expansion through the implementation of urban planning strategies at different levels. These initiatives are designed to facilitate the harmonious coexistence of urban expansion and agricultural practices. Successful tactics involve restricting urban sprawl, acquiring land for controlled development purposes, and establishing clear boundaries between urban and rural zones. Our analysis focused on the transformation of unused land within urban settings.

While one strategy emphasizes the promotion of large-scale commercial farming, we are currently engaged in formulating a conceptual framework for the utilization of such land, which will be the primary focus of our ongoing research endeavors in the coming years.

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