

Assessing The Evolution of Slum's Urban Form In Chouf Lekdad, Setif From 2003 To 2023

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Abstract: Housing represents a significant problem in Algeria, characterized by enormous challenges. The phenomenon of informal housing has merged and rapidly worsened for many reasons. As a result, slums have become a prevalent form of informal housing, offering a living space for families with limited resources on the city's outskirts. However, these informal settlements have grown over time, indicating an evolving informal urbanism and the emergence of a different urban form through the self-build and organisation of numerous houses. This study aims to assess the spatiotemporal distribution of informal housing in Setif, Algeria. Additionally, it seeks to analyse the evolution of the slum area to comprehend the urban form characteristics of this informal housing. It also assesses the factors and causes that influenced the development of this particular form. A combination of methodologies was used to attain the purpose of this study. It included in-situ observations and remote sensing to analyse the spatial distribution and temporal evolution of these informal settlements from 2003 to 2023 using Google Earth and GIS to map and visualise the changes, helping to identify their emerging form. This study investigated the Chouf Lekdad slum area in Setif, Algeria. This investigation determined that this slum's area is entirely residential because it is based on individual needs. The spatial distribution was initially characterised by sparsely built-up areas, which gradually became denser in a particular part. Buildings and vacant space have similarities in shape and scale, harmoniously integrating into the overall form of the site. This organisation can allow other occupants to construct or enlarge their buildings. Therefore, it is challenging to accurately predict the amount and arrangement of potential empty space.

Keywords : slum, informal housing, urban form, self-build, remote sensing, Setif.

Introduction:

Slums and informal settlements are residential areas and communities undergoing physical and social disintegration. Urban slums refer to a wide range of informal settlements distinguished by densely populated living conditions and inadequate housing supply. According to (Adejare et al., 2024), these areas are characterised by localised levels of poverty, where inhabitants frequently face socioeconomic difficulties. Forms of informal settlements and slums are distinct from one another. In contrast to slums, which are dilapidated urban areas marked by inadequate housing and squalor, informal settlements refer to illegal or less acknowledged communities that house illegal migrants and impoverished families unable to afford regular housing. Moreover, self-constructed neighbourhoods refer to informal regions where their residents actively contribute to the establishment and growth of urban development processes. This process gives rise to a unique urban configuration apart from officially planned urban structures; it has a distinct physical appearance and validates the physical distinction between slums and official settlements. Furthermore, informal settlements are typically portrayed in literature as the opposite of recognized settlements (Kamalipour & Dovey, 2019). According to (Dovey & King, 2011), informal settlement is not a single process; rather, it involves many relationships with the official city as well as variations in geography, climate, culture, materials, economy, and politics.

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While informal settlements create accessible land by utilizing public and private properties and offer various forms of land tenure (Payne, 2004), affordable housing, and urban infrastructure, there remains limited understanding of the origins and development processes behind this infrastructure. Although informal settlements are sometimes perceived as disorderly, they represent a type of urban design and planning encompassing a few incompletely understood logics. Progressively, these slums have grown, illustrating the continually evolving character of informal urbanism and the progressive development of a unique urban structure influenced by self-constructed dwellings and integrated organization. According to (Selatnia & Farhi, 2017), there are three typologies of informal settlements: urban, rural and nomadic. However, the forms of informal settlements are usually studied at a micro-scale, focusing more on spatial form than temporal evolution (Kamalipour, 2016).

Since Algeria's independence in 1962, the population has grown substantially, indicative of demographic changes and socio-economic developments. By 2022, the population growth rate had risen by 2.23%. Furthermore, urbanisation and economic development have affected migration patterns and settlement growth, contributing to population increases in urban areas.

The appearance of slums in Algeria dates back to the colonial period. We place the emergence of the first slums around the 1930s. The second phase of the exodus following the revolution in 1954 resulted in a significant migration of rural residents to urban areas. Following independence in 1962, slums persisted for various reasons, as poverty, unemployment, and inadequate housing conditions compelled rural inhabitants to migrate to urban areas. In the early 1970s, we observed the presence of 98 slums inhabited by 6,800 families, comprising a total population of 39,472 individuals in Algiers and its vicinity. In 1983, 17,302 slums existed, with a population of 119,831 individuals. The authorities took an ineffectual strategy in response to the housing crisis of the 1970s and 1980s and the issue of slums, neglecting to address the underlying causes of the situation and consider its economic and social dimensions. In the 1990s, the security problem affecting rural regions prompted increased migration to urban areas. The official census (RGPH 2008) estimates the count of precarious housing at 211,000.

In 2012, the Ministry of Housing, Town Planning, and the City identified 350,000 families living in slums. Between 2005 and 2015, the authorities relocated around 200,000 families, including 45,000 in Algiers, in an attempt to end this practice. The goal of eliminating slums in the capital and other wilayas by the end of 2015 and the first six months of 2016 was unsuccessful.

The increasing need for housing, driven by rapid population growth and rural-to-urban migration, has contributed to the rise of slums, which have introduced a new urban form characterized by unplanned and self-built structures usually located on the city's outskirts. However, these slums have different forms and shapes, depending on social, economic, and environmental factors, which can differ from one location to another. Alternatively, there is a need for more studies in Algeria that specifically focus on this type of informal housing and its evolution over time. Therefore, studies on the form evolution of these settlements need to be given special attention and consideration to understand the development of self-built communities.

This study aims to analyse the spatial organisation and examine how the form of these slums has evolved over a two-decade period, along with the contributing factors. It is based on the hypothesis that claims the form of slums has undergone significant evolution between 2003 and 2023, shaped by a combination of different factors. The research seeks to answer the following question: **How has the form of slums in Chouf Lekdad evolved from 2003 to 2023, and what are the key factors influencing this development?**

The objective of this study is to analyse the spatiotemporal development and distribution of slums of two decades, from 2003 to 2023. Through a detailed examination of the specific slum in Setif, Algeria, this study aims to reveal the distinctive characteristics of the urban form that has developed within these slums. Furthermore, it aims to evaluate the factors and causes that influenced the development of this particular form.

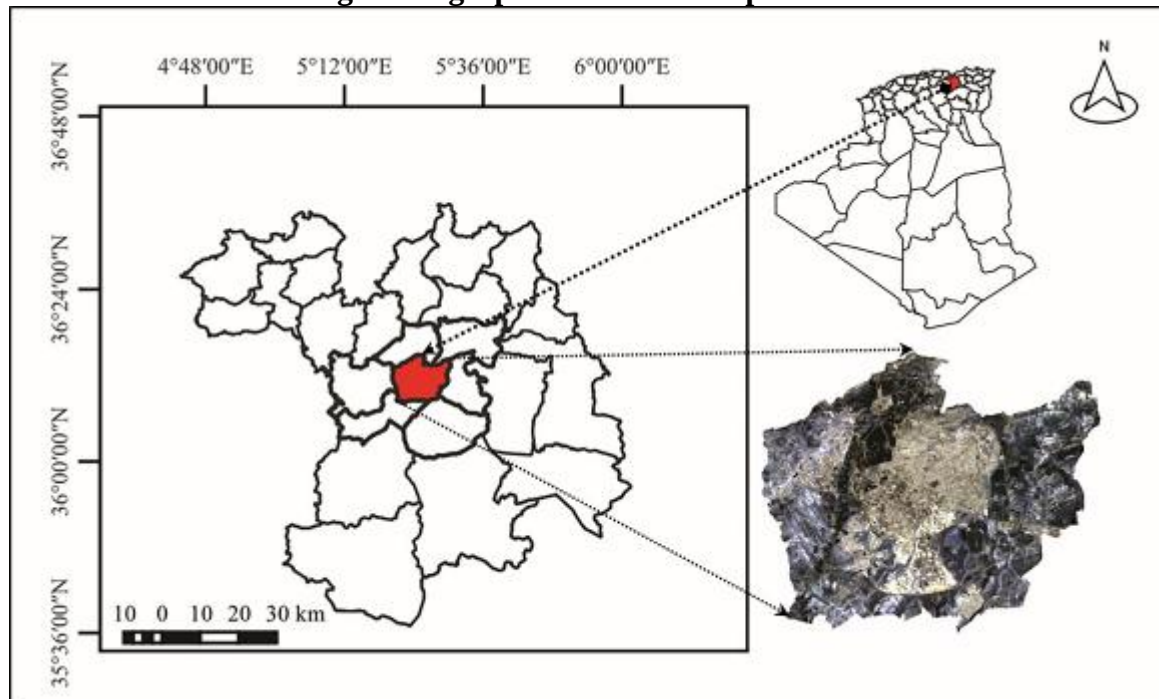
This study's primary research methodologies are direct observation and urban cartography (Peimani & Kamalipour, 2016). Remote sensing and other geospatial technologies offer significant opportunities to improve our understanding of the spatiotemporal contexts of informal settlements, which are rapidly becoming urbanised (Cinnamon & Noth, 2023). These tools are particularly valuable in analysing the rapid urbanisation processes shaping, offering a comprehensive view of their evolution and influencing factors.

1. Research methodology

1.1 Research area

This research was conducted in Setif, Algeria, located at a latitude of $36^{\circ} 09' \text{ North}$ and a longitude of $5^{\circ} 26' \text{ East}$, and an altitude of 1100 meters. The capital of the Tell Atlas of Algeria, Setif, is located 300 km southeast of the capital, Algiers, and 50 km from the Mediterranean Sea, bordered by six wilayas. Setif region spans 6,504 km², representing 0.27% of the total land area of Algeria. It ranks among the wilayas with the highest population density. It is not only significant due to its population but also for its strategic location, with access to extensive transportation routes linking the north to the south and the east to the west. Furthermore, it has strengthened its position as a prominent economic centre, including industrial, commercial, and agricultural sectors, becoming a crucial contributor to Algeria's overarching economic activity.

Fig.1. Geographical location map of Setif



Source: authors, 2024

The studied zone is located in the northwest of Setif centre and occupies an area of 64 ha (figure 2). The selection of the Chouf Lekdad slum was based on its substantial size and advantageous location in proximity to Setif City. Currently, it is the sole slum in the town following the national effort to eradicate the vulnerable and disorderly structures. It was created in the late 1980s (Ali

Khodja, 2022). Conversely, this area has had significant population growth. The population rose from 1,398 in 1987 to 7,688 in 2008, then increased to 28,450 in 2020, established by the National Statistics Office (ONS) (Table 1).

Table 1. The demographic evolution of the Chouf Lekdad.

	RGPH 1987	RGPH 1998	Growth rate	RGPH 2008	Growth rate	RGPH 2020	Growth rate
Setif	186000	239195	13.52%	287574	3.15%	457709	3.87%
Chouf Lekdad	1398	5640	2.31%	7688	1.86%	28450	10.9%

Source: URBAS

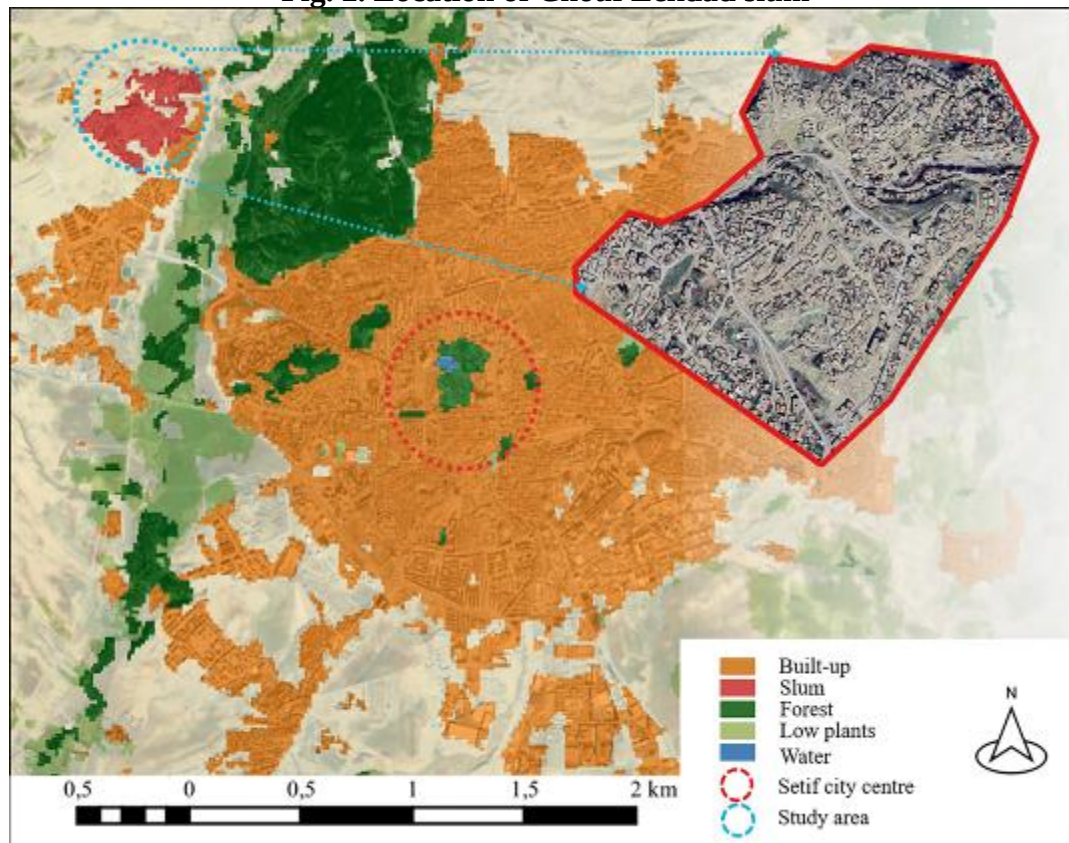
1.2 Method

In this study, a combination of two methods were used. In-situ observation is combined with remote sensing to understand the area comprehensively.

In-situ observation

This study employed non-participant observation and photography to gain a comprehensive understanding of both the physical environment and the community's social dynamics. Photography is used to represent the physical condition of the slum, including the site's terrain, buildings, and infrastructure. Furthermore, it can highlight the socio-economic difficulties related to poor construction quality and inadequate infrastructure, therefore highlighting the living conditions and challenges faced by residents. However, non-participant observation guarantees that the observed behaviours and conditions remain authentic. This approach prevents interference with the community's activities. It also includes the socio-economic dynamics of the slum, including socialisation patterns and community organisation.

Fig. 2. Location of Chouf Lekdad slum



Source: authors, 2024

1.3 Data

In this study, Landsat satellite images were obtained from the United States Geological Survey (USGS) official website (<https://earthexplorer.usgs.gov>) due to its extensive temporal coverage, free accessibility, and suitable spatial resolution. Landsat 5 images were selected for 2003, while Landsat 8 images were chosen for 2013 and 2023, based on cloud cover and availability. This study focused on the years 2003, 2013, and 2023 to conduct a thorough analysis of the chronological development of informal settlements form over a period of twenty years.

Table 2. Landsat images used in this study.

Year	Landsat entity ID	Date of Landsat images
2003	LT51940352003202MTI01	2003-07-21
2013	LC81940352013197LGN01	2013-07-16
2023	LC81940352023289LGN00	2023-10-16

Source: authors, 2024

1.4 Identification of the built-up area

The evolution of these informal settlements over a 20 years was analysed and visualised using Google Earth and QGIS. It facilitated a thorough analysis of the dynamic evolution of these communities through time. The resolution of Landsat 5 and 8 images was 30m and clipped to fit the case study area.

First, NDBI was calculated to identify the built-up areas. Then, NDVI is used to detect the vegetated areas. This sequential method helps distinguish urban constructions from natural vegetation in the research area.

NDBI (Normalized Difference Built-Up Index)

$$NDBI = \frac{SWIR - NIR}{SWIR + NIR} \quad (1)$$

NDVI (Normalized Difference Vegetation Index)

$$NDVI = \frac{NIR - RED}{NIR + RED} \quad (2)$$

SWIR corresponds to Band 6 in Landsat 8 and Band 5 in Landsat 5. NIR is represented by Band 5 in Landsat 8 and Band 4 in Landsat 5. RED is Band 4 for Landsat 8 and Band 3 for Landsat 5. The Built-Up Index (BU) is calculated by combining the Normalized Difference Built-Up Index (NDBI) and the Normalized Difference Vegetation Index (NDVI).

$$BU = NDBI - NDVI \quad (3)$$

This combination helps differentiate built-up areas, especially in urban and peri-urban zones, by separating them from vegetated regions. The index highlights built-up areas while reducing the potential confusion with vegetation.

Table 3. The land cover classes used in this study.

LULC type	Description
Built-up area	All human made structure such as residential buildings and roads...
Non-built-up area	Vegetation, water bodies, bare soil and open land such as rocky terrain and unused plots...

Source: authors, 2024

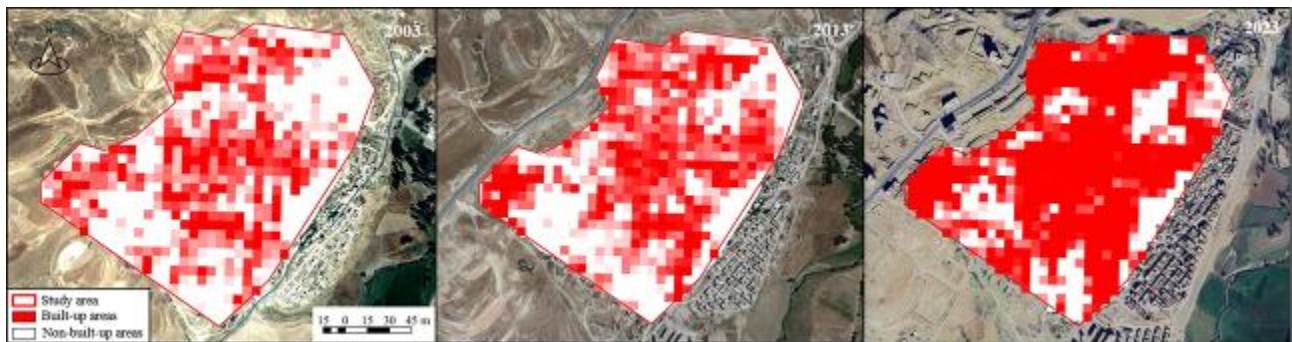
1.5 Materials

This study was supported by the land use plan (POS) delivered by the Direction of Urban Planning, Architecture, and Construction of Setif. This plan has provided valuable context and depth to our research findings. It serves as a significant document, offering crucial insights into the spatial organization of the study zone. The incorporation of this urban planning tool in the research has not only provided a dependable framework for investigating land use patterns and urban form but also ensured that the study's findings align with the urban development policies and future projections of the area under investigation. The diligent data collection by the Direction of Urban Planning, Architecture, and Construction has significantly enhanced the research process, enabling a deeper understanding of these settlements.

3. Results

The built-up index (BU) showed the progression of the built areas in 2003, 2013, and 2023 (figure 3). The positive values ranging from 0 to 1 of BU indicated the presence of built-up areas like buildings and roads. Conversely, the negative values ranging from -1 to 0 of BU indicated the non-built-up areas such as vegetation or natural landscape. Although, values around 0 represented a mixture of built up and non-built-up areas. The expansion of built-up areas is evident throughout the study period.

Fig.3. Land cover map showing built-up area and non-built-up area of study zone



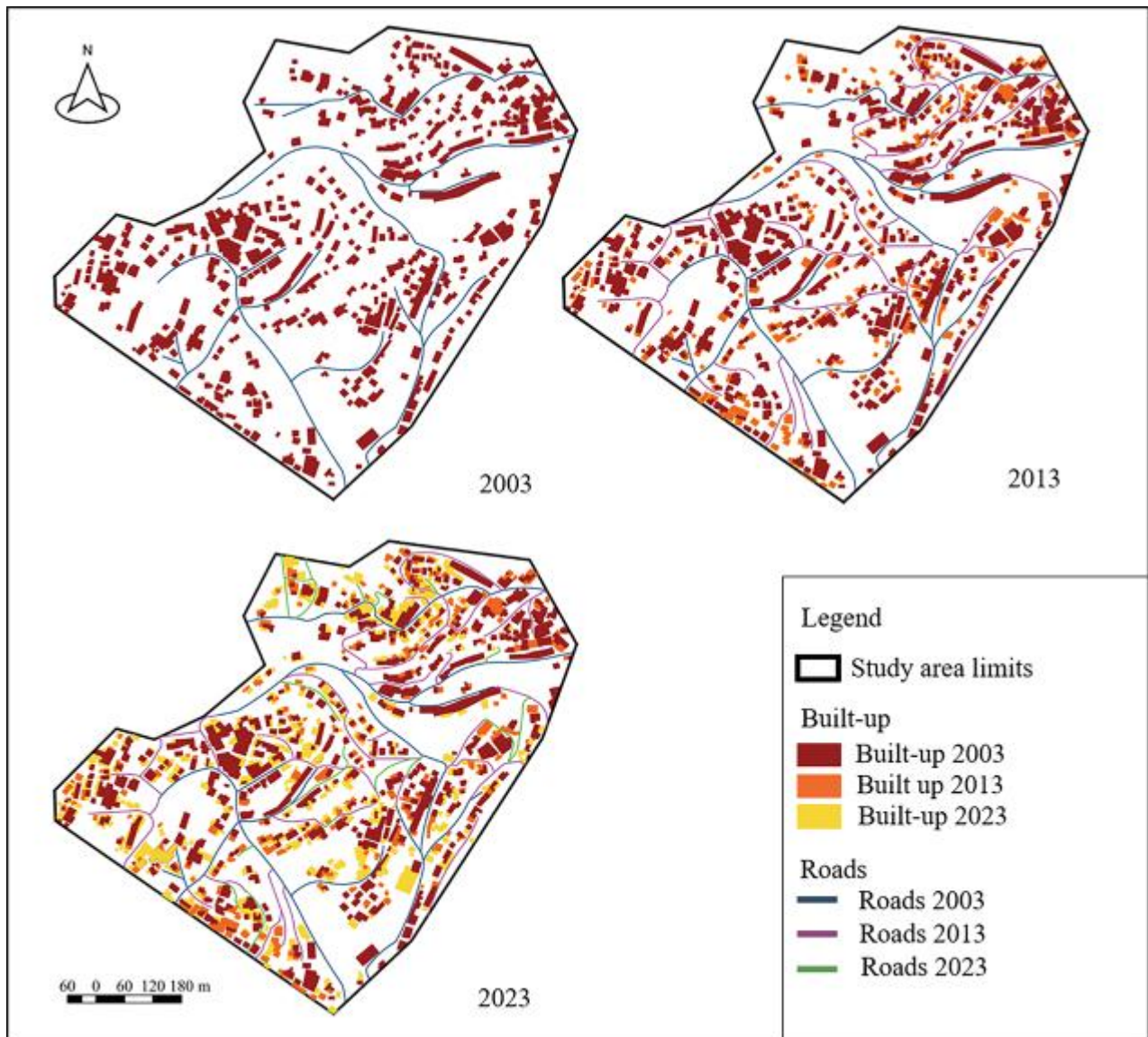
Source: authors, 2024

Furthermore, the data presented in Table 3 reveals a substantial increase in the urban footprint of these settlements. In 2003, the built-up area covered 10.39 hectares, representing 16.15% of the total study zone. By 2013, this figure had grown to 13.44 hectares, accounting for 20.89% of the area. This upward trend continued, with the urban environment expanding to 17.97 hectares by 2023, covering 29.93% of the total zone. This steady growth over two decades highlights the significant transformation in land use, reflecting the pressures of population growth and urban sprawl on these informal settlements. Furthermore, the development of roads within these settlements, especially in 2013, marked a period of significant infrastructure progress.

Table 4. Built-up area and non-built up area in 2003, 2013 and 2023.

Year	2003	2013	2023
Built-up area	10.39 ha	13.44 ha	17.97 ha
Non Built-up area	53.93 ha	50.88 ha	46.35 ha
Total area		64.32 ha	
Percentage of built-up area	16.15 %	20.89 %	27.93 %
Percentage of non-built-up area	83.85 %	79.11 %	72.07 %

Source: authors, 2024

Fig.4. The evolution of slum's urban form in 2003, 2013 and 2023

Source: authors, 2024

4. Discussion

Our investigation revealed that the slum area is entirely residential, with only a municipal branch, a small medical facility, and a mosque. There is no integration of transportation networks, services, or public spaces. The configuration and arrangement of the buildings within the slum determine the form of the infrastructure. Furthermore, inhabitants prioritize the proximity of their construction to roadways, and, in certain instances, they either reduce or eliminate the roads to accommodate the expansion of their structures, resulting in the formation of impasses. The presence of this type of infrastructure is a clear consequence of the growth in the region being motivated by individual interests rather than the collective requirements of the community. Moreover, the pedestrian pathways were created not just to accommodate the needs of the residents but also to align the particular topography of the terrain (Figure 5).

Fig.5. Informal settlements of Chouf Lekdad



Source: authors, 2024

4.1 Development of slum's form

The unique structure within the slum was distinguished by low-density residential zones in 2003. Over time, each section of the slum has undergone a notable rise in population density through various means, such as the filling of once vacant areas with new buildings or enlarging existing structures. The differing growth rates of these settlements indicate a 4.74% increase in the initial decade, contrasted with a 7.04% gain in the following decade. The slower growth during the first decade can be attributed to the division of the population living in slums, spread across several areas in Sétif, including Chouf Lekdad, Farmatou, and Ain Tick. However, the dynamics changed significantly after 2014, when Farmatou and Ain Tick were eradicated. The removal of two major slums resulted in the concentration of low-income and unemployed individuals in Chouf Lekdad, which became the sole remaining slum in Sétif.

This informal structure enables adaptability throughout the process of construction. Moreover, informal settlements are expanding faster than any other type of urban development because they cannot be completely rebuilt or removed (Dovey & King, 2011). According to the POS provided by Setif's Direction of Urban Planning, Architecture, and Construction, not all of these informal settlements can be eliminated; rather, they can be incorporated into formal urbanism in the future.

The form of slums frequently results from an unplanned development process. The form of slums frequently results from an unplanned development process. Rather than adhering to a predetermined layout, residents build and expand constructions over time. It leads to a non-linear street pattern and a patchwork of buildings with irregular shapes and sizes. Chouf Lekdad slum has same characteristics of road network as Boudghène in Tlemcen, which is composed of narrow alleys and dead ends that are difficult to drive through (Badreddine, 2021). The urban form is typically dense and compact in some parts of the area. Buildings are constructed near one another, utilizing every available section of land. This disorganised, spontaneous construction method results in a spatial arrangement that is often chaotic and unique, lacking the organised grid or hierarchy that are the characteristics of planned urban areas.

The slum of Chouf Lekdad exhibits a unique combination of urban and rural typologies, unlike other slums in Biskra (Selatnia & Farhi, 2017), which are typically characterised by a single typology. Urban typology resembling self-constructed housing combined with a rural typology characterized by activities such as livestock farming. The presence of these two typologies demonstrates the complex socio-economic dynamics of Chouf Lekdad, where urbanisation and rural lives intersect.

Fig.6. The statue of Chouf Lekdad streets.



Source: authors, 2024

4.2 Buildings

The first impetus for the growth of buildings is the presence of empty land, which enables inhabitants to construct or extend their buildings as adequate resources become available. This approach exploits the interconnected system of unoccupied or underutilized areas between adjacent structures. Consequently, the area experiences a progressive increase in population density and compactness, particularly since a large portion of the population consists of extended family members, which is the same case in Boudghène and Sidi Chaker in Tlemcen (Badreddine, 2021).

The buildings exhibit similarities in their shape, scale, and materials, creating a somewhat harmonious integration into the overall form of the site. However, the structural arrangement of these informal settlements is notably distinct from that of the formal city. Unlike the formal city, which is characterised by hierarchical, integrated, and organised structures, the slum's form lacks these elements.

Fig.7. The deteriorated condition of buildings.



Source: authors, 2024

4.3 Slums and social cohesion

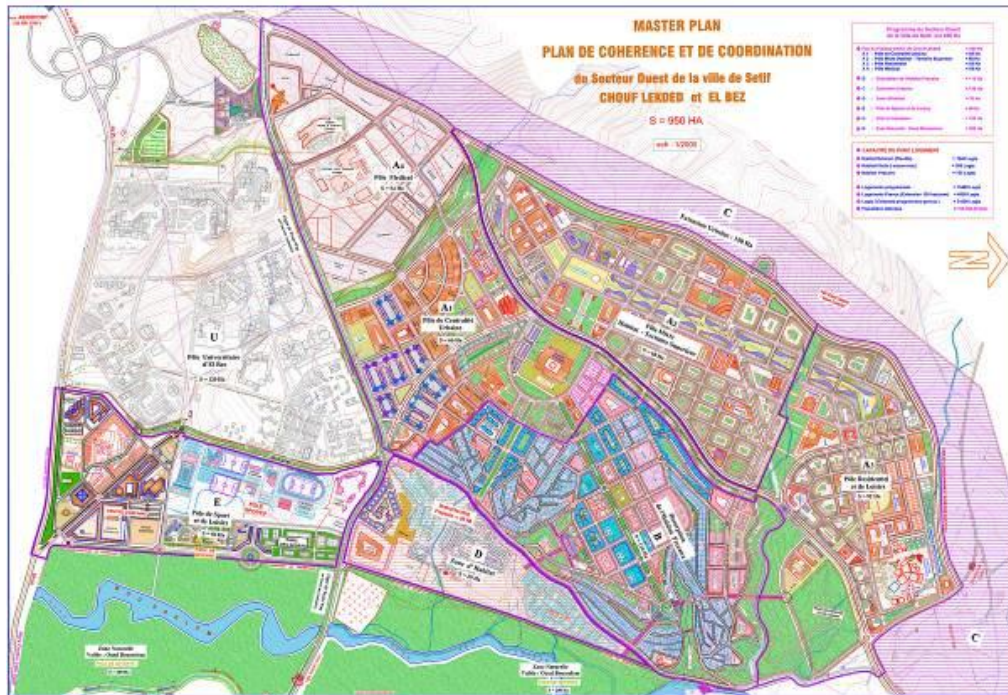
While these areas typically experience challenges to social cohesion, they also exhibit forms of solidarity and resilience. Residents of the slum are familiar with one another, closely recognising every family to the extent that they can identify any new individual who enters the community. The slum is marked by poverty, inadequate infrastructure and buildings and a lack of essential facilities. Despite their challenging economic situation, they regularly share meals, providing mutual support during times of need. Social cohesion provided the most significant influence on community resilience, as evidenced by the slum's ability to endure for over 30 years.

4.4 Predictability and future planning

While informal settlements are the most widespread manifestation of urbanization inside cities, there is limited understanding of how informal urban design functions as a creation of urban space (Dovey et al., 2020). However, predictions are further complicated by the socioeconomic conditions of residents and the irregularity in the availability of resources. Vacant areas may persist for extended periods, while others may rapidly develop into densely populated areas. This adaptive approach to development means that predicting the amount and arrangement of potential empty space is challenging. Consequently, the resolution of this matter necessitates planning strategies that are both adaptable and flexible, allowing them to adapt to the evolving spatial dynamics of informal settlements.

However, public authorities have strategically decided to eliminate the only slum in Sétif as part of an urban recuperation initiative. This decision seeks to tackle the issues related to the slum and regain essential property for urban development and infrastructure programs (Figure 8). This initiative launched in October 2024, resulting in the eradication of a significant part of the slum, including the resettlement of 1,300 families.

Fig.8. Proposed urban planning for Chouf Lekdad in 2015.



Source: the Direction of Urban Planning, Architecture, and Construction of Sétif.

Conclusion

This study provided a thorough examination of the spatiotemporal evolution of informal settlements in Chouf Lekdad, Sétif, Algeria. The research has identified the distinctive urban form and adaptive characteristics of slums using direct observation, remote sensing, and urban mapping.

The findings revealed that the built-up area covered 16.15%, grown to 20.89% and then to 29.93% of the total area in 2003, 2013, and 2023, respectively. This growth indicates the significant evolution of this settlement over two decades. Moreover, structures and vacant areas exhibit similarities in shape and scale, seamlessly merging into the site's overall form. The form is influenced by personal needs and the surrounding topography rather than formal urban planning.

The development of this slum illustrated how societies systematically organize and expand, exploiting available land. It is also shaped by socio-economic factors and resource availability, limiting efforts to predict future expansion.

Through this investigation, some of the recommendations aim to combine the adaptive characteristics of the slum with the necessity for formal infrastructure and sustainable development to improve the living conditions of residents. They include engaging local occupants in urban planning, preserving the social and cultural dynamics of slums, and integrating essential infrastructure and public services. Environmental sustainability must be essential to any urban design strategy for informal settlements, supported by encouraging residents to adopt more resilient construction methods by employing sustainable building materials. Moreover, land use flexibility can promote the development of the adaptability of informal settlements.

The results of this study make a substantial contribution to the expanding knowledge of the urban manifestation of informal housing, which plays a role in influencing contemporary urban environments in unique ways. This leads to the emergence of a new urban organisation distinguished by informal urbanism, which is defined by the efforts and requirements of the residents themselves.

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