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# RESEARCH ARTICLE

# SPATIOTEMPORAL DYNAMICS OF LAND USE/LAND COVER AND ITS ENVIRONMENTAL IMPLICATIONS IN THE KANTCHÉ DEPARTMENT (ZINDER REGION, NIGER) USING LANDSAT TIME SERIES (2007–2025)

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## ABSTRACT

**Background:** Land use and land cover (LULC) dynamics serve as a major indicator of environmental transformations in Sahelian regions subject to increasing anthropogenic pressure. **Objective(s):** This study analyzes the spatiotemporal dynamics of land use and its environmental implications in the Kantché department (Zinder region, Niger) between 2007 and 2025 using Landsat time series. **Methods:** Landsat 7 ETM+, Landsat 8 OLI, and Landsat 9 OLI-2 images acquired in December 2007, 2016, and 2025 were processed using ArcGIS 10.8.2. Following preprocessing, a supervised classification based on the Maximum ikelihood algorithm was performed to produce LULC maps, estimate class areas, and evaluate transitions via post-classification comparison. **Results:** The results reveal a marked transformation of the landscape over the past eighteen years. Cultivated lands increased from 86,070 ha (39.24%) in 2007 to 124,997 ha (57.80%) in 2025, representing a net gain of 38,927 ha (+45.2%). Conversely, fallow lands decreased from 101,128 ha (46.11%) to 48,706 ha (22.52%), corresponding to a net loss of 52,422 ha (−51.8%). Built-up areas expanded significantly, while rocky outcrops and bare soils overall increased. Riparian vegetation, wetlands, and water bodies exhibited more mixed dynamics. These changes reflect growing anthropisation, which is likely to exacerbate soil degradation, vegetation cover decline, and hydrological ecosystem disruptions. **Conclusions:** This study confirms the value of Landsat time series for diachronic LULC monitoring and provides essential data for sustainable natural resource management, ecosystem conservation, and land-use planning in the Kantché department.



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# INTRODUCTION

Over recent decades, the landscapes of the Sahel – and, more broadly, those of West Africa – have undergone major land-use changes due to the combined effect of several human-induced factors, notably population growth, the expansion of agricultural activities and the gradual spread of human settlements (1,2). These changes reflect an intensification of interactions between societies and natural resources, leading to an ongoing reconfiguration of ecosystems. At a regional level, land under human use more than doubled between 1975 and 2013, whilst the intensity of the changes observed is up to three times higher in areas situated close to new human settlements. This trend highlights the decisive role of population pressure in land-use conversions and in the acceleration of landscape transformations (2). In semi-arid environments, these changes are primarily reflected in the gradual conversion of natural vegetation into agricultural land, bare soil or residential areas. This dynamic leads to a reduction in vegetation cover, increased landscape fragmentation and an alteration of the ecological structure of the territories (1, 3,4, 5). In Niger, several studies have shown that the expansion of cultivated areas is often associated with a decline in herbaceous vegetation, a direct consequence of the intensification of agricultural practices and the pressure exerted on natural resources. Furthermore, in other Sahelian regions, degraded land now constitutes the main land reserves being utilised for agricultural expansion, thereby exacerbating the processes of ecosystem degradation (6,7, 8). Changes in land use also have significant repercussions on the hydrological functioning of arid and semi-arid environments. Transitions between different land-use categories influence runoff processes, the availability of surface water resources and the interactions between vegetation and soil moisture. These effects are particularly pronounced when agricultural and urban areas expand at the expense of natural habitats, altering the hydrological and ecological balances of catchment areas (8,9). In arid West Africa, several studies have already highlighted a reduction in the area of water bodies and a gradual degradation of water resources, resulting from the combined effects of human activities and climatic constraints (1). In this context, the Kantché district provides a particularly relevant natural laboratory for studying the spatiotemporal dynamics of land use within a Sahelian environment subject to significant anthropogenic pressure. Analysing changes in land-use classes over the period 2007–2025 will provide a better understanding of landscape transformations, enable an assessment of their consequences for the degradation of vegetation and natural resources, and allow us to evaluate the influence of demographic pressure on these processes. Such an approach is essential for providing scientific information that can guide strategies for the sustainable management of natural resources and land-use planning (10, 11, 12). The main objective of this study is to analyse spatiotemporal changes in land cover in the Kantché department between 2007 and 2025 using Landsat satellite imagery. Specifically, the aim is to (i) produce land-use maps for the various study dates, (ii) quantify changes in the main land-use classes, and (iii) identify the spatial dynamics associated with environmental changes in this heavily human-impacted Sahelian area. To achieve these objectives, time series of Landsat images constitute a particularly suitable data source. Thanks to their long-term continuity of acquisition, radiometric consistency and appropriate spatial resolution, Landsat images enable robust diachronic analyses of land-use changes. They also provide a reliable framework for implementing supervised classifications, enabling the differentiation of various land-use classes, the monitoring of their changes over time, and the assessment of landscape changes between 2007 and 2025.

# MATERIALS AND METHODS

**Study area :** The study was carried out in the Kantché department of the Zinder region, situated in southern Niger. The study area encompasses the communes of Kantché, Ichirnaoua, Daouché, Matamèye, Doungou, Tsaouni, Yaouri, Kourni and Dan Barto. Situated in the Sahelian zone, this region is subject to increasing anthropogenic pressure linked mainly to the expansion of agricultural activities, population growth and the exploitation of natural resources. These characteristics make it a particularly suitable area for analysing the spatio-temporal dynamics of land use.

**Satellite data**: The analysis is based on Landsat 7 ETM+, Landsat 8 OLI and Landsat 9 OLI-2 satellite images acquired in December 2007, 2016 and 2025 respectively (Table 1). These dates were chosen to ensure that images were acquired during the same time of year, thereby minimising the effects of phenological variability and improving the consistency of classifications across different observation dates (2, 7), (13). The selected scenes have low cloud cover and fall within a comparable seasonal window, in accordance with the recommendations set out for diachronic studies conducted in West Africa and in semi-arid regions (4, 8, 13, 14).

**Table 1. References for the Landsat images used in the study**

| Year | Satellite image reference |
|---|---|
| 2007 | LE07_L2SP_18805_20071119_20200913_02_T1 |
| 2016 | LC08_L2SP_18850_20161119_20200905_02_T1 |
| 2025 | LC09_L2SP_188051_20251120_20251122_02_T1 |

The Landsat series constitute a benchmark data source for studying changes in land cover due to their temporal continuity, radiometric homogeneity and spatial resolution of 30 m, which is suitable for regional analyses of arid and semi-arid landscapes (4, 13, 15, 16,17, 18). Although this resolution may limit the identification of certain small-area units in highly fragmented Sahelian landscapes, it remains widely used for analysing changes in land cover (8, 15, 19, 20).

**Pre-processing of Landsat images :** All satellite image processing was carried out using ArcGIS 10.8.2 and R version 4.5.3. Before being analysed, the Landsat images underwent a series of operations designed to ensure their consistency and comparability. In particular, the processing involved checking the quality of the selected scenes, harmonising their geometric and radiometric characteristics, and then extracting the area corresponding to the administrative boundaries of the Kantché department.

Colour composites were then generated to facilitate the visual interpretation of the different types of land cover and to improve the identification of spectral signatures prior to the classification phase. This pre-processing is an essential step in multi-temporal analyses as it helps to minimise discrepancies arising from differences between sensors, atmospheric conditions and seasonal variations, thereby improving the reliability of comparisons made between different observation dates (1, 8, 9).

**Supervised classification of land use:** Land cover mapping was carried out using supervised classification of Landsat images with the Maximum Likelihood classifier, implemented in ArcGIS 10.8.2. This method, based on the statistical properties of spectral signatures, assigns each pixel to the class with the highest probability of membership. Owing to its robustness and reliability, it remains one of the most widely used approaches in remote sensing studies focused on land cover mapping and change detection (21).

The first stage of the classification process involved defining Regions of Interest (ROIs) representing the different land cover categories. These training samples were delineated directly on the colour composites in order to characterise the spectral signatures specific to each class. Eight land-use classes were selected: cropland, fallow land, riparian formations, grasslands or wetlands, bare soil, rocky terrain, settlement areas and water bodies. This classification system, widely used in studies conducted in the Sahelian region, enables the representation of the main landscape units whilst ensuring good consistency in classifications across different observation dates (5, 4, 16, 20). The resulting maps were then subjected to post-processing aimed at reducing classification errors, in particular by removing isolated pixels and improving the spatial homogeneity of the different classes. This step helps to improve the readability of the maps and the reliability of diachronic analyses.

Detection of changes and analysis of land-use dynamics : Changes in land cover between 2007, 2016 and 2025 were analysed using a post-classification change detection approach. This method involves comparing the land-use maps produced for each date in order to identify conversions between the different classes and to quantify their extent over the periods under consideration (1, 22).

The areas of each class were calculated for each study date and then compared to highlight gains, losses and trends. Transition matrices were also drawn up to determine the changes that had occurred between the different land-use categories and to identify the main trajectories of landscape transformation.

# RESULTS

**Spatio-temporal trends in land use between 2007 and 2025 :** Figures 1, 2 and 3 show land-use maps of the Kantché department derived from the supervised classification of Landsat imagery acquired in 2007, 2016 and 2025. These maps highlight the main land-use categories and their spatial changes over the study period.

**Land use in 2007:** The 2007 map (Figure 1) shows that the landscape is predominantly characterised by cultivated land and fallow land, which represent the most widespread land-use categories. Fallow land is more concentrated in the southern areas, particularly in the municipalities of Dan Barto, Kourni and Yaouri, as well as in the north-western part of the department, around Kantché. Cultivated land is distributed relatively evenly across the entire study area.

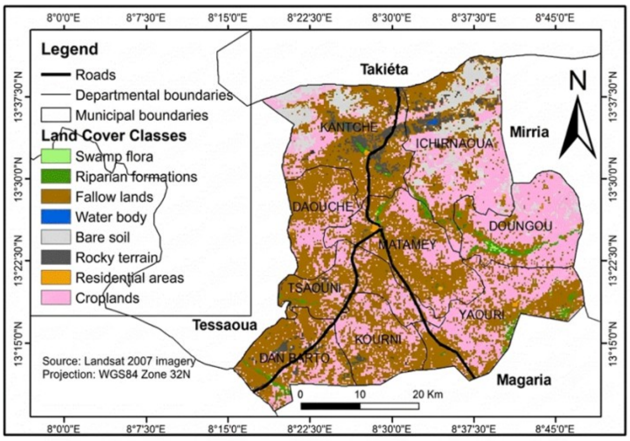


Figure 1. Land-use map of the Kantché department in 2007

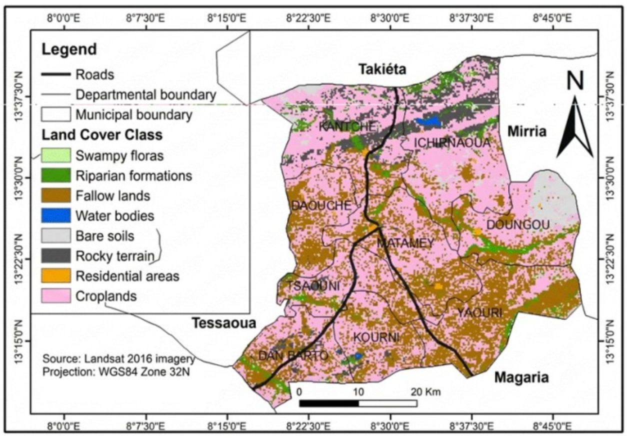


Figure 2. Land-use map of the Kantché department in 2016

Riparian vegetation, as well as grasslands and wetlands, are mainly located along valleys and low-lying areas, particularly in the municipalities of Doungou and Ichirnaoua. Settlement areas remain confined to the main urban centres and are largely situated along major roads. Bare land covers small areas and is mainly found in the northern part of the department.

**Land use in 2016:** As shown in Figure 2 below, the 2016 map highlights a change in the spatial distribution of several land-use classes compared with 2007.Cultivated land covers a larger area, whilst fallow land appears less extensive. Natural vegetation cover shows a more fragmented distribution. Bare soil is becoming more visible, particularly in the northern and central parts of the department. Settlement areas also show spatial expansion around the main urban centres and along the main transport routes linking, in particular, Kantché, Matamèye and Dan Barto.

**Land use in 2025:** The 2025 map (Figure 3) highlights the continuation of the trends observed during the previous period.

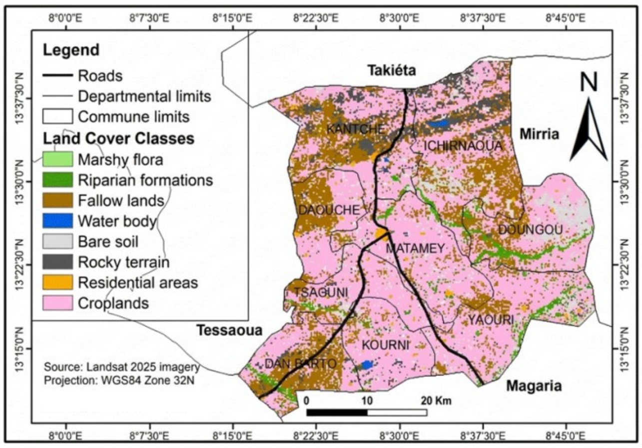


Figure 3. Land-use map of the Kantché department in 2025

Cultivated land is now the dominant land-use category and covers a large part of the study area. Fallow land is becoming more scattered and is concentrated mainly in the south-western and northern parts of the department. Bare land has expanded more markedly, particularly in the central and northern parts. Riparian formations appear more discontinuous, whilst grasslands and wetlands occupy smaller areas. Water bodies show a different spatial distribution to that observed in 2007, although some water bodies remain visible, notably in the Kourni area. Habitat areas continue to expand around the main urban centres and along road networks.

**Summary of the changes observed :** A comparison of the maps shown in Figures 1, 2 and 3 highlights a gradual change in land use in the Kantché department between 2007 and 2025.

**The main changes observed relate to:**

- an expansion of cultivated land;
- a reduction in the area occupied by fallow land;
- an increase in residential areas;
- an increase in bare land;
- a reduction in riparian vegetation, as well as in grasslands and wetlands;
- a change in the spatial distribution of water bodies.

Overall, the maps reveal a gradual reconfiguration of the spatial organisation of the various land-use classes over the period studied.

**Table 2. Changes in the areas (ha) and proportions (%) of land-use classes in 2007, 2016 and 2025**

| Land-use class | 2007 (ha) | 2007 (%) | 2016 (ha) | 2016 (%) | 2025 (ha) | 2025 (%) | Évolution 2007–2016 (ha / %) | Évolution 2016–2025 (ha / %) |
|---|---|---|---|---|---|---|---|---|
| **Marshy flower-rich areas** | 405 | 0.18 | 756 | 0.34 | 593 | 0.27 | +351 ha (+86.7 %) | -163 ha (-21.6 %) |
| **Riparian formations** | 3 784 | 1.73 | 9 501 | 4.33 | 6 383 | 2.95 | +5 717 ha (+151.1 %) | -3 118 ha (-32.8 %) |
| **Fallow land** | 101 128 | 46.11 | 64 880 | 29.58 | 48 706 | 22.52 | -36 248 ha (-35.8 %) | -16 174 ha (-24.9 %) |
| **Water bodies** | 71 | 0.03 | 531 | 0.24 | 398 | 0.18 | +460 ha (+647.9 %) | -133 ha (-25.0 %) |
| **Bare ground** | 18 554 | 8.46 | 11 324 | 5.16 | 17 184 | 7.95 | -7 230 ha (-39.0 %) | +5 860 ha (+51.7 %) |
| **Rocky terrain** | 8 713 | 3.97 | 17 799 | 8.11 | 15 577 | 7.20 | +9 086 ha (+104.3 %) | -2 222 ha (-12.5 %) |
| **Residential areas** | 617 | 0.28 | 1 160 | 0.53 | 2 437 | 1.13 | +543 ha (+88.0 %) | +1 277 ha (+110.1 %) |
| **Cultivated areas** | 86 070 | 39.24 | 113 383 | 51.69 | 124 997 | 57.80 | +27 313 ha (+31.7 %) | +11 614 ha (+10.2 %) |
| **Total** | **219 343** | **100** | **219 334** | **100** | **216 275** | **100** | — | — |

The implications of these changes will be examined in the Discussion section.

**Changes in the areas of land-use categories between 2007 and 2025:** Table 2 shows the areas (ha) and proportions (%) of the various land-use classes in the Kantché department for the years 2007, 2016 and 2025. The results show variations in the areas of the various classes over the study period.

**Changes in cultivated land and settlement areas:** Cultivated land has shown a steady increase throughout the period under review. Its area rose from 86,070 ha (39.24 per cent) in 2007 to 113,383 ha (51.69 per cent) in 2016, before reaching 124,997 ha (57.80 per cent) in 2025. This represents a total increase of 38,927 ha. Habitat areas also showed an increase over the period studied. Their area rose from 617 ha (0.28 per cent) in 2007 to 1,160 ha in 2016, and then to 2,437 ha (1.13 per cent) in 2025.

**Changes in set-aside land:** Fallow land was the largest land-use category in 2007, covering an area of 101,128 ha (46.11 per cent). This area fell to 64,880 ha (29.58 per cent) in 2016, and then to 48,706 ha (22.52 per cent) in 2025, representing a total reduction of 52,422 ha over the entire period studied.

**Changes in natural landforms and other land-use categories:** Riparian vegetation, grasslands, wetlands and bodies of water showed variations over the period studied. Riparian vegetation increased from 3,784 ha in 2007 to 9,501 ha in 2016, before falling to 6,383 ha in 2025. Rocky terrain increased from 8,713 ha in 2007 to 17,799 ha in 2016, before falling to 15,577 ha in 2025. The area of bare ground also varied between the different dates. Meanwhile, the area of water bodies increased from 71 ha in 2007 to 531 ha in 2016, and then to 398 ha in 2025. Overall, the results presented in Table 2 highlight variations in the areas of the different land-use classes between 2007 and 2025. 2.2.4

Spatio-temporal dynamics during the first period (2007–2016). Between 2007 and 2016, the landscape of the Kantché department was characterised by a significant expansion of cultivated areas, which increased by 27,313 ha (31.7 per cent), rising from 86,070 ha to 113,383 ha. This trend came at the direct expense of fallow land, which recorded the sharpest decline over the period, falling by 36,248 ha (–35.8 per cent). At the same time, residential areas saw a significant increase of 88.0 per cent (543 ha). With regard to wetland ecosystems and vegetation, the 2007–2016 period was characterised by a marked increase in riparian vegetation (+5,717 ha, or +151.1 per cent), water bodies (+460 ha, or +647.9 per cent) and marshy areas (+351 ha, or +86.7 per cent). Finally, rocky terrain increased by +9,086 ha (+104.3 per cent), whilst bare ground decreased by -7,230 ha (-39.0 per cent).

**.Spatio-temporal dynamics during the second period (2016–2025):** During the period 2016–2025, human pressure increased. The expansion of cultivated land continued, with an increase of +11,614 ha (+10.2 per cent), reaching 124,997 ha in 2025. Fallow land continued to decline at a steady rate, with a further loss of -16,174 ha (-24.9%). Urban sprawl and the expansion of built-up areas accelerated sharply, with an increase of +1,277 ha (+110.1%). In contrast to the first period, the 2016–2025 decade shows a decline in wetlands and riparian vegetation: riparian formations have lost -3,118 ha (-32.8 per cent), water bodies -133 ha (-25.0 per cent) and marshy areas -163 ha (-21.6 per cent). Furthermore, bare soil areas saw a marked increase of +5,860 ha (+51.7 per cent), whilst rocky terrain decreased slightly (-2,222 ha, or -12.5 per cent).

**Spatio-temporal trends in land-use classes:** Figure 4 illustrates changes in the main land-use categories between 2007 and 2025. Panel A shows changes in the dominant landscape categories, whilst Panel B shows changes in the categories covering smaller areas, notably residential areas, riparian vegetation and bodies of water.

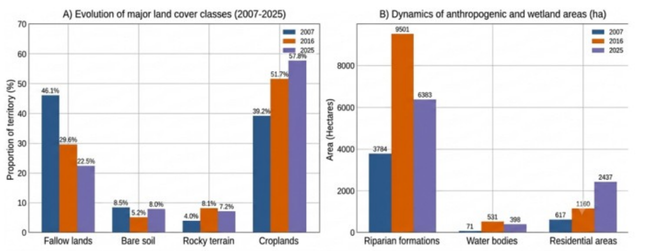


**Figure 4. Spatio-temporal changes in land-use classes between 2007 and 2025 in the Kantché department. (A) Changes in the main land-use classes. (B) Changes in settlement areas, riparian vegetation and water bodies**

**Changes in the main land-use categories:** As shown in Figure 4A, the area of cultivated land increased steadily over the period under review, rising from 39.24 per cent of the total land area in 2007 to 51.69 per cent in 2016, and then to 57.80 per cent in 2025. Conversely, fallow land has gradually decreased, with its proportion falling from 46.11 per cent in 2007 to 29.58 per cent in 2016, and then to 22.52 per cent in 2025. Rocky terrain showed an increase between 2007 (4.0 per cent) and 2016 (8.1 per cent). before falling slightly in 2025 (7.2 per cent). Bare soil also shows variations over the period studied, with a proportion of 8.5 per cent in 2007, 5.2 per cent in 2016 and 8.0 per cent in 2025.

**Changes in habitat areas and wetlands:** Figure 4B shows a gradual increase in habitat areas between 2007 and 2025. Their total area rose from 617 ha in 2007 to 1,160 ha in 2016, before reaching 2,437 ha in 2025. Riparian vegetation cover increased from 3,784 ha in 2007 to 9,501 ha in 2016, before decreasing to 6,383 ha in 2025. Water bodies also show variations over the period studied, with an area of 71 ha in 2007, 531 ha in 2016 and 398 ha in 2025. Overall, Figure 4 highlights the variations in the different land-use classes observed between 2007 and 2025.

**Analysis of the correlation matrix:** Figure 5 shows the correlation matrix between the different land-use classes in the Kantché department over the period 2007–2025. The correlation coefficients highlight positive and negative relationships of varying strength between the different land-use classes. The strongest negative correlation is observed between fallow land and cropland (r = −1.00). Fallow land also shows negative correlations with habitat areas (r = −0.90), rocky terrain (r = −0.86), water bodies (r = −0.83) and riparian formations (r = −0.64). Cultivated land shows a positive correlation with habitat areas (r = 0.90) and rocky terrain (r = 0.86). whereas a negative correlation is observed with bare soil (r = −0.40).

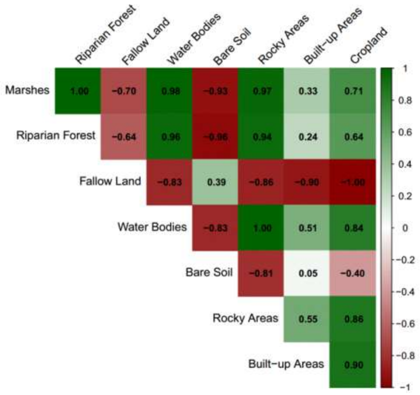


**Figure 5. Correlation matrix for land-use classes between 2007 and 2025**

Riparian formations show strong positive correlations with water bodies (r = 0.96), wetlands (r = 0.98) and rocky terrain (r = 0.94). Conversely, they are negatively correlated with bare soil (r = −0.96) and fallow land (r = −0.64). Wetlands show positive correlations with water bodies (r = 0.98), rocky terrain (r = 0.97) and cultivated land (r = 0.71). whilst they are negatively correlated with bare ground (r = −0.93) and fallow land (r = −0.70). Overall, the matrix highlights varying degrees of association between the different land-use classes over the period studied.

# DISCUSSION

The results obtained highlight a gradual and steady transformation of land use in the Kantché department between 2007 and 2025. The land-use maps, the areas covered by the various land-use classes, and the transition matrices show a continuous increase in cultivated land and settlement areas. This is accompanied by a significant reduction in fallow land and changes affecting natural formations. This trend is part of the dynamics observed in many Sahelian regions, where landscapes are increasingly dominated by human land use under the combined effect of population growth, the expansion of agricultural activities and the development of human settlements (1,2,5,23).

**However, a diachronic analysis divided into two sub-periods highlights nuanced trajectories and rates of transformation:**

- Agricultural pressure and the depletion of fallow land: The increase in cultivated land, which becomes the dominant land use category by 2025 (57.80 per cent). reflects an intensification of land use over the period studied. This expansion was particularly vigorous during the first period, 2007–2016 (+31.7 per cent, or +27,313 ha), before continuing at a more moderate pace between 2016 and 2025 (+10.2 per cent, or +11,614 ha). Conversely, fallow land recorded its sharpest decline between 2007 and 2016 (-35.8 per cent, or -36,248 ha) compared with 2016–2025 (-24.9 per cent, or -16,174 ha). This trend can be explained by the gradual reduction in the land reserve available for set-aside, forcing farmers to make full use of the available space. This trend is consistent with observations made in several Sahelian countries, where the gradual reduction in set-aside periods is one of the main consequences of increasing food requirements and pressure on land resources (11,24,25,26).
- Acceleration of urban sprawl: In contrast to cropland, the expansion of residential areas accelerated sharply during the second period. Whilst it increased by +88.0 per cent (+543 ha) between 2007 and 2016, it surged by +110.1 per cent (+1,277 ha) between 2016 and 2025. This trend highlights increased urban sprawl and population densification over the last decade, occurring mainly around major urban centres and along transport corridors (2,11,27).
- A reversal in the trend for wetland ecosystems and vegetation types: Riparian vegetation, marshes and water bodies show very contrasting trends depending on the period. A marked expansion of these habitats was observed between 2007 and 2016 (+151.1 per cent for riparian vegetation and +647.9 per cent for water bodies). This was followed by a systematic decline during the period 2016–2025 (-32.8% for riparian vegetation and -25.0% for water bodies). This reversal in trend reflects the complex interaction between hydro-climatic cycles (initial increase in rainfall) and the recent intensification of human activities. notably agricultural use of low-lying land and timber felling on riverbanks (12,28,29,30,31).
- Deterioration in the condition of land surfaces: Analysis of bare soil areas also reveals a marked reversal: following a reduction of -39.0 per cent (-7,230 ha) between 2007 and 2016 due to the large-scale cultivation of open spaces, bare soil areas have seen a sharp resurgence of +51.7 per cent (+5,860 ha) between 2016 and 2025. This recent resurgence of bare soil, coupled with the high proportion of rocky terrain (7.20 per cent in 2025), reflects the depletion and degradation of over-exploited cultivated soils lacking organic matter replenishment, which promotes soil crusting and erosion (15,26,32).

The strong negative correlation observed between fallow land and cultivated land (r = -1.00) confirms this direct substitution between the land classes. Meanwhile, the correlations with settlement areas (r = -0.90) and rocky terrain (r = -0.86) reflect the growing impact of human activities and landscape degradation. From an environmental perspective, these cumulative changes lead to the artificialisation of land surfaces, a reduction in water infiltration and an increase in runoff, thereby exacerbating the vulnerability of rural populations to climate variability (1,31).

# CONCLUSION

This study analysed the spatio-temporal dynamics of land use in the Kantché department between 2007 and 2025 using Landsat satellite time series (7 ETM+, 8 OLI and 9 OLI-2). Supervised classification was used to map landscape changes and assess their rates across two key periods (2007–2016 and 2016–2025). The results reveal ongoing and accelerating human-induced changes to the landscape. The first period (2007–2016) was characterised by the large-scale conversion of fallow land to cropland, whilst the second period (2016–2025) showed a marked acceleration in urban sprawl (+110.1 per cent), a decline in riparian vegetation and wetlands (-32.8 per cent) , as well as a marked resurgence in bare soil (+51.7%).
These developments reflect a saturation of agricultural land and growing pressure on natural resources, which are likely to undermine the functioning of ecosystems by increasing the risks of erosion, soil fertility loss and disruption to hydrological cycles. In a Sahelian context characterised by high climate vulnerability, these findings provide an essential basis for decision-making to guide spatial planning and sustainable land management in the department of Kantché.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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**Glossary of Abbreviations**

- **DPI:** Dots Per Inch
- **ETM+:** Enhanced Thematic Mapper Plus
- **GPS:** Global Positioning System
- **LULC:** Land Use and Land Cover
- **OLI:** Operational Land Imager
- **OLI-2:** Operational Land Imager 2
- **SI:** Système International d'unités (International System of Units)

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