

Land Degradation In The District Of Banibangou (NORTH-WEST NIGER)

Ali Nouhou^{1*}, Hainikoye Souley Ibrahim¹, Mahamadou Bahari¹

1 Department of Geography, University Abdou Moumouni Niamey, Laboratory for Study and Research on Sahelo-Saharan Territories (LERTESS), Niamey, Rep. of Niger

*Corresponding author: nouhougeo@yahoo.de

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Abstract- Sahelian ecosystems are subject to natural and anthropogenic pressures. Their proximity to the great Sahara desert makes them among the most vulnerable in West Africa. The main aim of this project is to analyze the factors driving land degradation in the district of Banibangou (North-West Niger). The study of the land use evolution was based on the processing of satellite images from 1975, 2013 and 2020. Quantitative data were collected from 384 heads of household selected from six (6) villages in the district. Land degradation in the district increased from 0.1% in 1975 to 25.05% in 2013, rising to 30.32% in 2020. Wind erosion has been given by 72% of respondents as the main source of the phenomenon. Water erosion increases especially with the exceptional rains of August and September 2024, during which the district received three times more rain than the annual average. Steppe woodland decreased from 25.89% in 1975 to only 5.44% in 2013. Between 1975 and 2020, steppic grassland shrank from 54.61% to 30.99%.

Key words - climate change, district of Banibangou, land degradation, Niger

1. INTRODUCTION

Natural resources provide the bulk of food requirements for rural populations in the Sahel. Their main activities, namely agriculture and extensive livestock, are dependent on summer rains (June-September), and are adversely affected by climate change and human pressure. The growing development of human activities, underpinned by Niger's demographic growth (3.7%), the highest in the world (INS 2018), puts pressure on the scarce resources available. In addition to this, climatic factors seem to have played a considerable role in the land degradation process in Zarmaganda, accompanied by a thinning of the vegetation cover exposing bare soils to winds and runoff (Mounkaïla, 2002). With no major surface waters, the main activities in the rural district of Banibangou are rain-fed agriculture and livestock breeding. Due to its isolation, poverty and extreme economic vulnerability, the area has suffered from almost permanent food insecurity for the past 30 years. The area chosen for our study bears all the hallmarks of a deteriorating environment, such as a general decline in production, soil compaction and denudation, extinction of animal and plant species, insufficient rainfall, etc. (ADIDB and Commune de Banibangou 2013).

However, awareness of the importance of natural resources in people's daily lives justifies the imperative of finding a way to link environmental concerns and economic development. To address this topic, the main questions concerned the factors involved in land degradation in this terroir and how this manifests itself, with the main hypothesis that land degradation comes from the combination of human actions and climatic variations that reduce agricultural yields and promote the deterioration of socio-economic activities.

2. METHODOLOGY

2.1 PRESENTATION OF THE STUDY AREA

The rural district of Banibangou belongs to the Zarmaganda agropastoral zone located in the north of Tillabéry region. With a surface of 4,928 km² (INS, 2018), it is located between latitudes 14° 30' and 15° 24' North and longitudes 2° 00' and 3° 07' East. Its capital, Banibangou, lies 250 km northeast of Niamey (Niger's capital) on the National street (RN 24). It is bordered to the north by the Republic of Mali, to the south by the Department of Filingué and the Department of Ouallam (District rurale de Dingazi); to the east by the Department of Abala; and to the west by the Department of Ouallam (District rurale de Tondikiwindi) (Fig. 1).

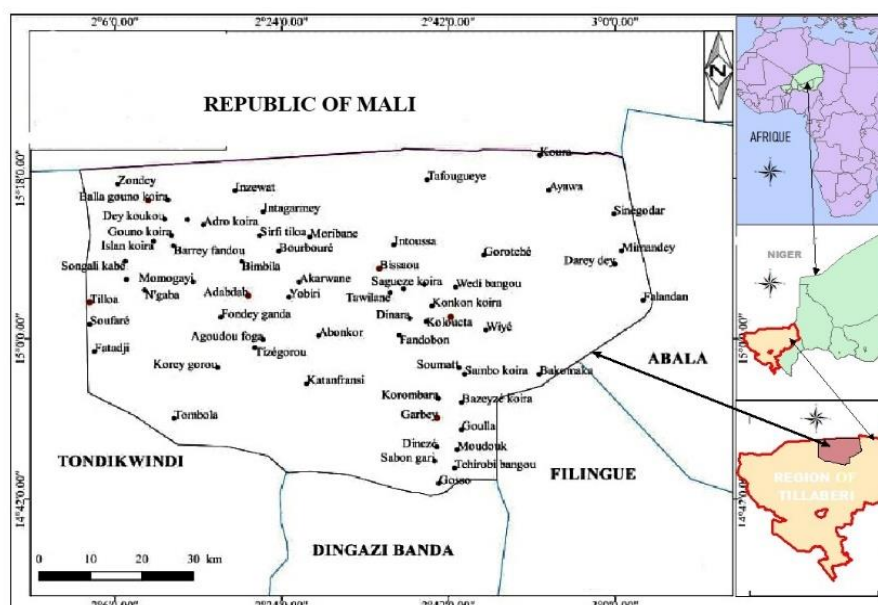


Fig. 1. Location of study area

The topography of the District of Banibangou is marked by plains, glacies and a few plateaus, sand dunes and low-lying areas or depressions. The Sahelian climate is mainly characterized by two distinct seasons: a long dry season (October-May) and a short rainy season (June-September). Rainfall, which is irregular in time and space, starts in the district in June-July and ends in September-October, with average annual rainfall totals of between 200 and 300 mm, decreasing from south to north. Maximum rainfall is generally recorded in August alone, and average temperatures range from 18°C in January to over 45°C in April (ADIDB and Commune de Banibangou 2013). These climatic conditions influence land degradation, hence the role of climate in environmental deterioration. The soils of the District of Banibangou are sandy in texture, poor in organic matter and with low cation retention and exchange capacity. They are tropical ferruginous, shallow and highly susceptible to erosion.

The plant cover is essentially composed of xerophytic trees. These are thorny shrubs dominated by acacias (*Radiana*, *Seyal*, *Albida*, *Nilotica*, *Tortilus*), *Balanites* *egyptiaca* and *combretaceous* species such as *Guiera Senegalensis*, *Bostia Senegalensis*, *Combretums* *Glutunosum*, *Combretums* *Nicrantum*, *Combretums* *Nigricans*, etc. The herbaceous stratum includes seasonal plants such as *Cenchnus* *Biflorus*, *Casia* *Tora*, *Echinola* *Stagnina*, *Zornia* *Glochidiata* and *Eragrotis* *Tremula*. The District of Banibangou is drained by only a few semi-permanent streams. However, its hydrographic network is essentially made up of surface water (ponds and koris) and groundwater (water tables and aquifers). The surface waters are made up of large temporary, semi-permanent and permanent koris and ponds, fed by rainwater runoff.

As a result of the 4th census (RGP/H-2012), the rural district of Banibangou had 69,949 inhabitants. With an annual natural growth rate of 3.1% and a high fertility rate of 6.9 children per woman, Banibangou's population is estimated at 87,149 in 2019 (INS 2019). This population is spread across 57 administrative villages covering an area of 4,928 km². Extensive farming (millet, sorghum and cowpeas) is the main economic and subsistence activity. It includes rain-fed crops, which are the mainstay of the communal economy and provide employment for around 100% of the population, and market gardening around permanent and semi-permanent ponds for around 5% of the population (mainly women). The livestock production system is marked by the existence of several types of livestock farming: transhumant livestock farming, semi-extensive livestock farming and hut farming. All these livestock farming systems involve large and small ruminants, the total number of which rose from 277,668 head in 2013 to 327,699 head in 2017 (INS 2019).

2.2 Methodological approach

The rural district of Banibangou comprises 54 administrative villages. The sample villages were selected using the simple probabilistic sampling. This involved calculating the sampling step and randomly selecting a number between 0 and the integrated part of the step, which was 5.4, based on 10% of the villages in the district. To this end, six (6) villages were pre-selected, based on accessibility and zoning criteria, in order to achieve a balanced spatial distribution.

3. CLIMATIC FACTORS IN LAND DEGRADATION

3.1 Droughts

For more than three (3) decades, droughts have been almost permanent in the District of Banibangou. These inadequate and irregular rainfall can be explained by the southward migration of isohyets and the short duration of the ITCZ (Intertropical Convergence Zone) to the north of the area. According to an analysis by Quillérou et al (2019), isohyets have moved 200 km southwards (Touré, 2011). This brings the District of Banibangou below isohyet 250, marking a sharp drop in rainfall. The almost permanent rainfall deficit in the Sahelian zone (Touré et al. 2024) limits vegetables regeneration. As a result, trees that can no longer adapt to hydric stress, compounded by high temperatures, gradually disappear one after the other without human intervention.

3.2 Erosion

Whether aeolian or hydric, erosion is the main type of land degradation. They lead to the lost of the upper, most fertile part of the land. The lost of surface soil reduces organic matter, basic exchange capacity and water retention. The erosive mechanism is intense in the District of Banibangou, especially wind erosion, which is much deplored by 72% of those surveyed. Wind erosion transforms sandy areas into glacia, uprooting trees or worse, uprooting them at the beginning of each rainy season. Water erosion is on the rise again, especially with the exceptional rains of August and September 2024, during which the district received three times more rain than the annual average. As a result, impermeable soils intensify runoff during the rainy season, leading to land-grabbing gullying.

3.3 Reduced vegetation cover

Today, the Banibangou area is characterized by a low presence of trees and shrubs. Tree steppe has fallen from 25.89% in 1975 to 5.44% in 2013 (ADIDB and commune de Banibangou 2013). Between 1975 and 2020, to grassland steppe shrank from 54.61% to 30.99%. As for gallery forests, they represent only 3.88%. Thus, perennial plants are being replaced by annual grasses or woody vegetation.

4. ANTHROPOGENIC FACTORS IN LAND DEGRADATION

4.1 Demographics

Rapid population growth is a factor in land degradation. With an annual natural growth rate of 2.8% (INS 2018), the population of the District of Banibangou rose from 66,949 in 2012 to 89,851 inhabitants in 2020, an increased of 22,902 people in eight (8) years. This implies new needs for agricultural land, hence the perpetual increase in cultivated areas. These are estimated at 60,865 hectares in 2013 and 72,865 hectares in 2020 (INS 2018), i.e. 1,500 hectares of fallow land each year. However, the increase in these cultivated areas can be explained not only by rapid population growth, but also by the transformation of nomadic herders into sedentary farmers. Indeed, out of the 27 people interviewed from the nomadic community, 23 (85.15%) said that their main activity is now farming. The results of our survey show that 85.19% of respondents inherited their fields, compared with 20% by loan, 3.64% by gift, 2.86% by purchase and 2.08% by pledge.

4.2 Farming

Agriculture is the main economic activity in the rural district of Banibangou. Easy access to land leads to the extension and multiplication of fields. Indeed, on average, there are two (2) fields per person, with an average of 20 hectares per field. However, the farming systems practiced in the area are inadequate: extensive agriculture with abusive land clearing. Field preparation prior to sowing involves reducing vegetation to almost nothing. Thus, 38.7% of the people surveyed spare only medicinal trees and shrubs in their fields, compared to 4.42% who make their fields treeless even for the shade under which they can rest. During an interview, some people explained that they prefer to make their fields treeless to prevent their children from becoming future slackers. The more shade there is in the field, the greater the desire to rest while working. This clearing system reduces any chance of natural regeneration of the plant cover. As a result, cultivated areas are vast and virtually devoid of vegetation. Inappropriate agricultural production systems, with repeated cycles of cereal crops, including millet monoculture with no fallow, collection of crop residues after harvest, lack of soil conditioning, no combination of livestock farming and agriculture for manure, little or no leguminous fodder crops in crop rotations, all contribute to the fragility of the land.

4.3 Overgrazing

The rural district of Banibangou is one of Niger's agro-pastoral zones. Livestock farming is highly developed here, with free, unregulated access to grazing land for livestock. Transhumance is most common in this area. Indeed, during each season of the year, the district welcomes animals from the south of the country on their way to the Malian border. What is more, 98.9% of those surveyed raise livestock domestically, compared to 1.1% who do not do so out of poverty. In recent years, these types of farming have been joined by the intensive system used by local people to maintain (fatten) animals for commercial purposes. This involves cutting down trees to feed their livestock during the long dry season, when fodder is in short supply. However, it is above all transhumance that is degrading the land in the district, due to the uncontrolled number and/or type of animals and the length of time they use the pastures. This practice leads to overgrazing, which is an overload (number of livestock/ha). It refers to a high concentration of herds in a given

area, far exceeding the animal carrying capacity that the environment can support. This compromises the ecological conditions necessary for the natural regeneration of forests and herbaceous species. As one respondent puts it: “By God, animals destroy vegetation. But our own animals alone are not enough to destroy it. It is mainly the transhumant animals coming from Boboye and Nigeria in large number that are responsible”. It is in this sense that “livestock production is one of the main causes of the most pressing environmental problems, namely global warming, land degradation, atmospheric and water pollution and biological lost” (FAO 2003). In fact, the majority of those interviewed maintain that transhumance is a pastoral practice that reduces forage, since the nomadic animals (notably the Peuls), in greater numbers, eat the herbaceous cover before it reaches maturity.

4.4 Wood harvesting

People of the rural district of Banibangou make several uses of vegetation to satisfy their needs. These include gathering, building, domestic energy, etc. Gathering is the direct exploitation of plant resources through leaves and fruit. This activity is most intense in the Zarmaganda region, where it is highly regarded. In the rural district of Banibangou, for example, people are much more active in consuming “kopto” following agricultural failures. To this, must be added the pharmacopoeia (all the remedies obtained in the traditional way). Indeed, the bush abounds in species with curative virtues, and people are interested in the leaves, bark and roots - in other words, the whole species. As a result, there is strong pressure on trees with medicinal value. It is in this context that most of the useful species disappeared from the area, as evidenced by this high-sounding sentence: “All the useful trees have disappeared, making way for the thorny ones”. Domestic energy production is a much more significant factor in the degradation of the district's land. Indeed, 100% of those surveyed use wood exclusively as their main fuel for cooking at least three meals a day (breakfast, lunch and dinner). Some sell wood as an income-generating activity. As a result of the scarcity of dry firewood, 80% of women surveyed cut trees to dry, compared to 5% of men, to produce commercial charcoal.

4.5 Bush fires

Bushfire is a phenomenon that affects not only vegetation, but also the soil and everything that inhabits it. According to OSS (2024), bushfires are one of the main factors in deforestation and the degradation of natural resources in Mali. In the District of Banibangou, people complain a great deal about the frequent outbreaks of bush fires. Thus, 17% of those surveyed said that this phenomenon occurs from time to time, compared to 2% who said that bushfires occur very often. This is explained by the scarcity of certain plant and animal species in the locality.

5. DYNAMICS OF LAND USE IN THE DISTRICT BETWEEN 1970 AND 2020

Land degradation is a recent problem in the area. In fact, in the early 1970s, the land in the District of Banibangou was in no way degraded. They were characterized by high vegetation cover (extensive tree steppe, good grassland steppe cover, gallery forests found along watercourses) and small areas under cultivation (ADIDB and commune de Banibangou 2013) as shown on Fig. 2.

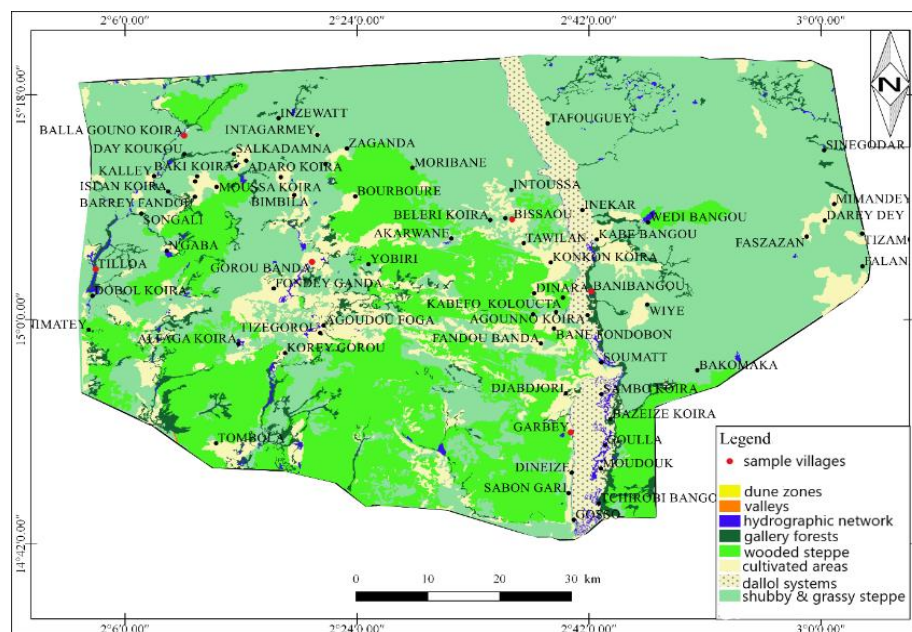


Fig. 2. Land use in 1975

Since 2013, however, the land has undergone severe degradation, with a consequent decline in tree, shrub and grass cover, the extension of cultivated areas, the outcropping of glacies and cuirasses, and the appearance of new watercourses and waterholes around which gallery forests have formed (Fig. 3).

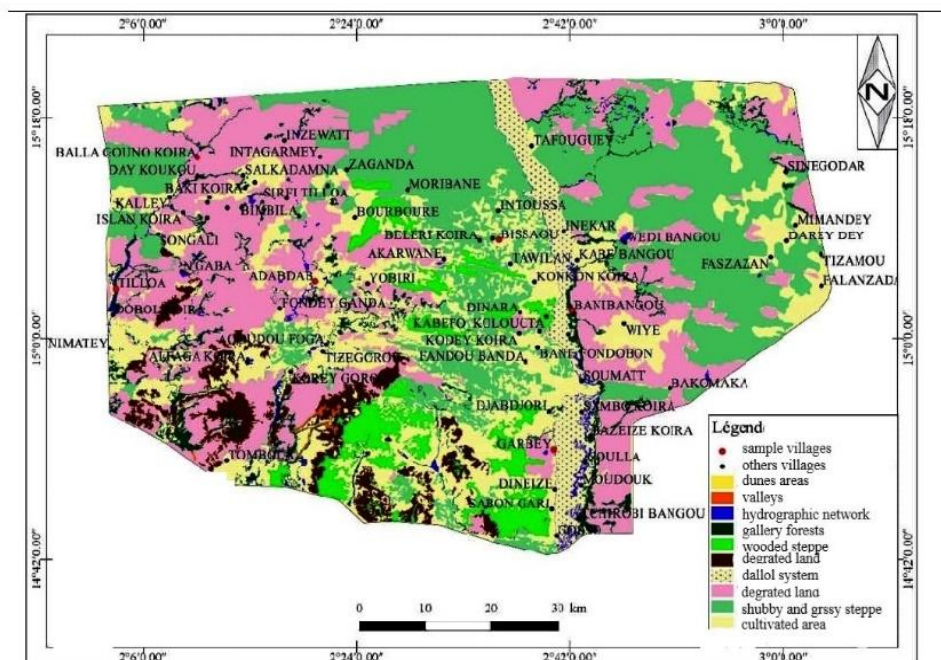


Fig. 3. Land use in 2013

According to this Fig., the District of Banibangou has experienced significant land degradation compared to the 1970s. This degradation was 12.81% in 1984, 25.05% in 2013, an average increased of 0.65% per year. Based on this trend, land degradation is estimated at 30.32% of the communal territory in 2020 (Fig. 4).

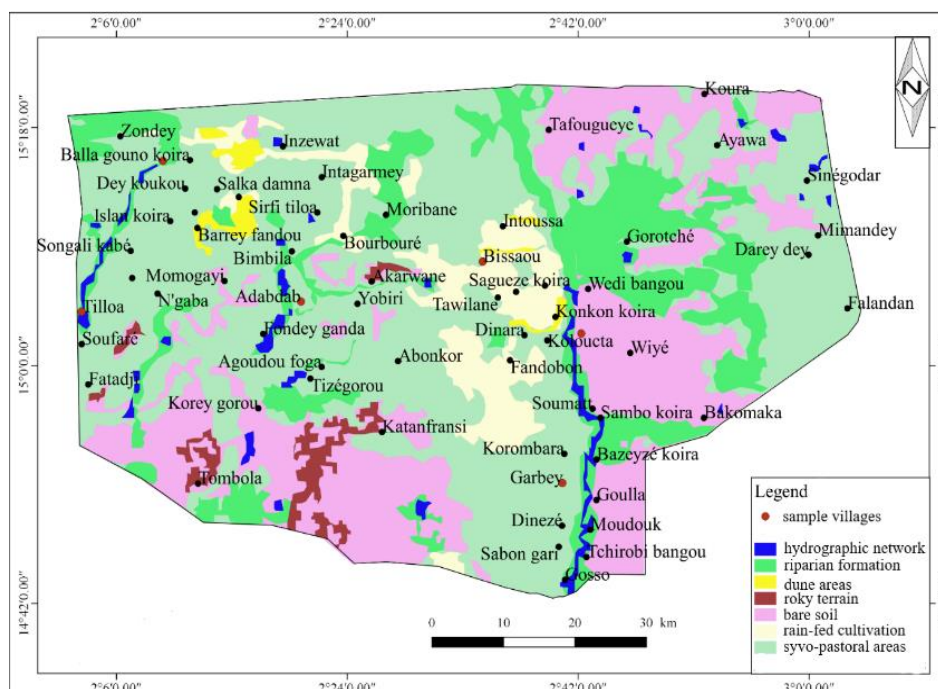


Fig. 4. Land use in 2020

The erosive mechanism is intense in the District of Banibangou. Wind erosion in particular is much deplored by 72% of those surveyed, compared to 5% for water erosion. Wind erosion (especially from November to March) and storms (between June and August) transform sandy areas into glacia and uproot trees. As a result, impermeable soils intensify runoff during the winter months, leading to land-grabbing gullying.

6. DISCUSSION

Land degradation characteristics are observed in the District of Banibangou. This confirms the results of studies carried out by ALG and BOAD (2017) in the regional program for sustainable land management and strengthening the resilience of rural communities and ecosystems to climate change in the Liptako-Gourma States. These studies noted a widespread process of land degradation in Niger, the factors of which are essentially climatic and anthropogenic. Similarly, analysis of the data in the present study identifies climate and man as the main factors responsible for this phenomenon. The poor management of natural resources in the District of Banibangou is the main reason why population growth is considered a factor in land degradation. Elsewhere, high population density is blamed for land degradation in studies such as those by Yehia (2016) in the Maradi region. Inappropriate farming practices in the study district are similar to those reported in the study by Kohio (2019) in Burkina Faso. Land accessibility is therefore as much an urban (Coulbaly 2024) as a rural problem.

Based on farmers' opinions, climate change is one of the main factors contributing to land degradation. These same hazards are identified in the district by ADIDB and commune de Banibangou (2013) as part of the studies for the elaboration of the Communal Development Plan. Wind erosion was decried, which corroborates the findings of Yang et al. (2023). Furthermore, a study carried out in the rural district of Tondikwindi (Touré 2011) explains the disappearance of certain plant species by the migration of isohyets from north to south. Several scientific studies, such as those by IAS (2016) and Agrhymet (2010), have highlighted this same factor as one of the causes of land degradation.

The District of Banibangou is an area that has hitherto enjoyed free access to natural resources. The use of wood to build huts and sheds in hamlets and villages, to make roofs for houses and especially garden enclosures, plays a major role in deforestation. In addition, woodcutters use certain plant species, such as *Acacia Albida* and *Balanites aegyptiaca*, to make mortars, pestles and so on. The use of butane gas is virtually non-existent in the district due to the difficulties associated with its supply. As a result, it is reserved exclusively for a few civil servants. The exclusive use of wood for cooking therefore plays a significant role in the degradation of plant cover and land.

Land degradation is not only caused by human activities in the District of Banibangou. With the southward migration of isohyets (Quillérou et al. 2019), the rainfall regime is disrupted in the district. However, as Yang et al. (2022) and Boukary et al. (2023) have pointed out in their studies of the Sahel, droughts are the most severe of these climatic hazards in the study area.

If we look at the opinions freely expressed by the respondents to explain land degradation, we can see that there are divergences in the blamed factors. For some, the new climatic conditions, including rainfall deficit, irregular rainfall and above all long dry spells, are the primary causes of land degradation. However, for others in the minority, the extensive use of vegetation and inappropriate farming practices, deforestation and transhumant herding are put forward to justify the phenomenon of land degradation.

7. CONCLUSION

In view of the results, the endogenous assessment of the state of the land is mainly based on the regression of the vegetation cover. In the District of Banibangou, land degradation is mainly due to human activities: population growth, agriculture, overgrazing and deforestation. These activities are responsible for modifying the area's landscape. The phenomenon is particularly noticeable in the bare, crested and compacted aspect of the soils, which limits water infiltration in favor of runoff and erosion. These run-off waters, the overflowing of ponds and rivers, and the reactivation of fossil valleys all contribute to the frequent flooding of silty-clay soils (fertile for agriculture and irrigation), the collapse of dwellings and road infrastructures, and the loss of human lives observed in August and September 2024 across all regions of the country.

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