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Spatio-temporal dynamics of land use and land cover in the commune of Po, Burkina Faso

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Abstract

The commune of Po in Burkina Faso is an area with high agroecological potential and favorable climatic context. These assets make the commune one of the preferred destinations for agropastoral population, in search of better living conditions. This situation has an impact on the dynamics of land use and land cover. The aim of this study is to assess the nature of land cover as well as the intensity of their use over the last two decades (2003-2023). Changes were detected using remote sensing and geographic information systems (GIS). The methodology is based on supervised classification by maximum likelihood, which has made it possible to highlight land use and land cover classes. The transition matrix, and the conversion and expansion rates derived from it, indicate that the various land-use units in Po have changed between 2003 and 2023. Vegetation formations (wooded savannah and gallery forest) have declined overall, to the benefit of farms, which have increased by 28.64%. This knowledge of the dynamics of land cover and land use in Po is helping to provide local authorities and technical services with a better understanding of the mechanisms and strategies to be implemented for effective management of the commune's natural resources.
Keywords: *Burkina Faso, Po, land use, land cover, change detection, natural resource degradation*

Introduction

In Burkina Faso, the agricultural sector contributes 33% to the gross domestic product and employs more than 70% of the working population (Herrera & Ilboudo 2012; INSD 2019). Nearly 90% of the agricultural population lives in rural areas and engages in extensive farming that is detrimental to natural resources (Kaboré & Dipama, 2014). As a result of the country's agro-ecological and climatic disparities, people are moving further south, south-west and west, where conditions are more favorable for agro-pastoral activities in terms of availability of land and pastures (Drabo I et al., 2003; Bassolé et al. 2015). These pioneer fronts are not without consequences for the natural resources of the host areas (Bassolé et al., 2015). Indeed, Rajan and Shibasaki (1997) consider that man is the main factor in the changes and conversions that affect land use as a result of his various activities. Man has always played a crucial role in the transformation of ecosystems (Scouvart & Lambin, 2006). As a result, natural resources are under increasing pressure from human activity, leading to disruption of terrestrial ecosystems and loss of biodiversity. Demographic pressure, through the methods and systems used to exploit available resources, is the determining factor in changes to land use and landscape configuration (Bamba et al., 2008).

According to statistical data from the general population and housing census (Recensement Général de la Population et de l'Habitat -RGPH,2019), the population of the commune of Po (Nahouri province) more than doubled between 1986 and 2019, rising from 31,502 to 64,609 inhabitants. This situation is exposing resources to increased exploitation and changing the landscape. This is why it is important to examine the processes and extent of land cover in the commune, hence the interest of this study, which is to analyse the spatio-temporal dynamics between 2003 and 2023 using Landsat satellite images.

Study area

The study area is located in the province of Nahouri, in south-central of Burkina Faso (Figure 1). It covers an area of 3,801 km², and is delimited by the following coordinates: 11° and 11°30' north latitude, and 1°30' and 0°40' west longitude .

The rural commune of Po was chosen because, due to its geographical position in the south of the country, it enjoys favorable climatic and agro-ecological conditions for agricultural activity. As a result, it is subject to population migration in search of arable land. This has an impact of the dynamics of the commune's natural resources.

The commune of Po is in the Sudanian climate zone, with a dry season from November to April and a wet season from May to October. Annual rainfall totals vary from 900 to 1000 mm, while average temperatures fluctuate between 27.9 and 28.9°C during the last normal

period. There are around 80 rainy days per year (ANAM, 2024).

The vegetation is of the Sudanian type, with shrub savannah (Figure 2) and tree savannah (Figure 3) as the dominant formations, to which are added gallery forests along the watercourses. The flora is rich in woody species, the most abundant oh which are formed by *Vitellaria paradoxa, Burkea africana, Acacia sieberiana, Anogeissus leiocarpus, Khaya senegalensis, Daniela oliveri, Andansonia, digitata, Lannea micropcarpa, Butyrospermum parkii* and *Parkia biglobosa*. As for herbaceous plants, these are mainly grasses such as *Andropogoneae* and *Cassia Tora*.

The soil units in the commune are varied both in terms of typology and agronomic value (suitability), ranging from lithosols to vertisols, eutrophic brown soils and hydromorphic soils. Most of these soils are suitable for all tropical crops, including cereals, tubers, market gardening, cotton and other cash crops. Rainfed crops cover around 58% of the province's total area, or 227,020 ha. The commune of Po has over 90% of good land throughout its territory (PCD, 2020).

For the province as a whole, the resident population is 195,608 persons, giving an average density of 41 inhabitants/km² (INSD, 2019). This population is mainly agricultural and pastoral. In the study area, the agro-sylvo-pastoral sector plays an essential role in the economy and agriculture is the main source of income for the population. It is characterized by family farms with small plots of land, essentially using traditional or even rudimentary cultivation techniques and methods (slash-and-burn cultivation, animal traction, etc.) (Bagré et al., 2023, p. 54). As in the rest of the province, pastoral activity is secondary in the commune of Po. The most widespread system combines subsistence farming with livestock rearing, dominated by small ruminants. Transhumant livestock system is also practiced by Fulani herders from the Central and Northern regions, with a large number of cattle. This extensive livestock farming system uses natural pastures made up of woody and herbaceous species.

Although agriculture is the main activity in rural areas and provides employment, it is subject to economic constraints that are driving the population to turn to artisanal gold mining. Also, the installation of spontaneous artisanal mines is favored by the proximity of industrial deposits which have been established in the province. In a context of limited resources and opportunities, gold mining appears to be an excellent option for the local population (Bohbot, 2017). It is also an activity that requires low initial investment and, above all, makes it possible to absorb part of the workforce resulting from the country's demographic growth. However, it is a source of numerous environmental degradations.

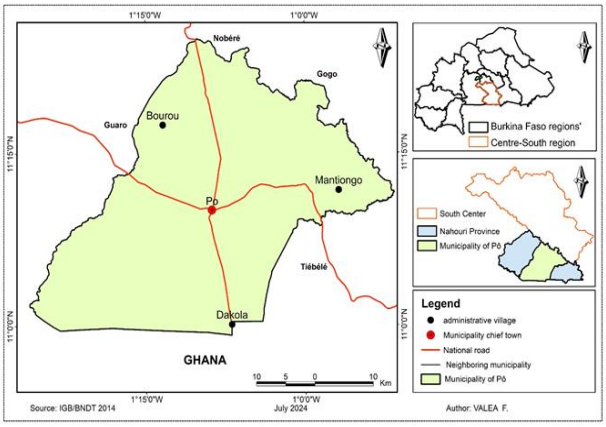

Figure 1: Situation of the study area

Figure 2: Shrub savannah in the commune of Po (Photo Valea F. - June 2022)

Figure 3: Wooded savannah in the commune of Po (Photo Valea F. - June 2022)

Data collection and methods

The data used are essentially Landsat images with 30 m resolution dating from October, more specifically 10/10/2003 for the 195_052 scene, 07/10/2003 for the 194_052 scene, 25/10/2023 for the 195_052 scene and 15/10/2023 for the 194_052 scene. They were downloaded from the United States Geological Studies (USGS) website: https://earthexplorer.usgs.gov/. Field data, the National Topographic Data Base (BNDT 2012) of Burkina Faso and socio-economic data from the National Institute of Statistics and Development (INSD, 2019) were also used. A GPS was used to locate the field control points. Processing the satellite images with Envi.5.3 software involved several steps:

- importing and combining bands: importing bands involves loading the various individual bands, and combining bands involves grouping the various individual

bands together to produce a new multiband file. The aim is to create a multispectral image;

- display as a colour composition to facilitate interpretation and visual analysis. This operation involves combining three bands. For the present study, false colour composition was used because it enables the different occupancy units to be distinguished perfectly. For Landsat 8, false color composition combined bands (6-5-4) and for Landsat 7, bands (5-4-3);

- image mosaic is an operation that consists of creating a mosaic from a number of image scenes to form a single image. As the commune of Po straddles the 195/052 and 194/052 scenes, it is necessary to create a mosaic in order to have a single image for processing;

- integration of the vector layer and delineation of the boundaries of the study area;

- identification of the nomenclature of the objects to be mapped;

- identification of training sites or Regions Of Interest (ROI). In total, seven (7) land use classes were identified. These were: agglomeration class, gallery forest, water body, wooded savannah, shrub savannah, bare soil and agricultural area;

- the use of the 'Maximum likelihood' algorithm for supervised classification based on field knowledge;

- conversion of classified images from raster mode to vector mode using ArcGIS 10.8 software.

The classification was validated using statistical indicators such as the confusion matrix and the kappa index. The Kappa index reflects a level of agreement that is all the higher as its value is close to 1 (Hountondji 2008, p. 79). According to Pontius (2000, p1011), classification is perfect if kappa index = 1.

The surface areas of the various land-use categories were calculated and diagrams drawn up to assess changes. The transition matrix made it possible to specify the land-use allocations over the time interval under consideration and to specify the changes. It was used to assess the gains, losses and persistence in terms of surface area of the land use categories at two different dates.

The gross gain for each category is calculated by subtracting the persistence from the row total, while the gross loss is calculated by subtracting the persistence from the column total (Agbanou T et al., 2018, p. 252). Equation (1) and (2) give the method for calculating the Gain (G) and Loss (L) observed at the level of each land use category between two dates.

$$Gj = \frac{\{(\sum_{i=1}^{j} sjj) - sjj\} \times 100}{\sum_{i=1}^{j} sjj} \quad \text{where} \quad Gj = (\sum_{i=1}^{j} Sjj \quad (1)$$

$$Li = \frac{\{(\sum_{j=1}^{j} sij) - sii\} \times 100}{\sum_{j=1}^{j} sij} \quad \text{where} \quad Lj = (\sum_{j=1}^{j} Sii) - Sii \quad (2)$$

where,

Gj = Gain in area (or proportion) of land use category j

Li = Loss of area (or proportion) of land use category i

Sii = Stable area of land cover category i between two dates

Sjj = Stable area of land cover category i between two dates

Sij = Area of an occupancy category i transformed into j between two dates

Sji = Area of an occupancy category j transformed into i between two dates

The rates of change (overall rate of change and annual rate of change) of the areas of the land use classes between 2003 and 2023 are obtained from the equation taken from Agbanou T et al. (2018 p. 253) according to the formula TG (i, k) is equal to:

$$TG = \frac{Sk - Si}{Si} \times 100$$

where TG = Global rate of change

For the annual rate of change, the formula below taken from Tankouano et al. (2015, p. 1986) was used. According to this formula:

$$TC = \frac{\lfloor (S2023 - S2003/S2003 \rfloor \, x \, 100}{t_2 - t_1}$$

where TC = Average annual rate of change

S2003 = area of class i in 2003 as a percentage

S2023 = area of class i in 2023 as a percentage

t_2-t_1 = number of years

Results

Classification accuracy

Processing of the 2003 image indicates an overall accuracy of 98.88% (Table 1) with a Kappa index of 0.98%. For the 2023 image, the overall accuracy is 98.68% (Table 2) and the Kappa index is 0.98%. These results indicate that the Kappa indices are all in almost perfect agreement, as they are between 0.81 and 1.

Table 1: Confusion matrix 2003

Classes	Ag	GF	W	WS	SS	BS	AA
Ag	345	0	0	0	0	0	0
GF	0	298	2	0	0	0	0
W	0	0	205	0	0	0	2
WS	0	0	0	2345	4	0	0

SS	0	0	1	0	3456	0	0
BS	5	0	0	5	0	180	0
AA	0	0	0	0	0	0	2230
Total	350	298	208	2350	3460	180	2232
MAP	0.98	1	0.98	0.99	0.99	1	0.99
Overall accuracy	**98.88%**						
Kappa index	**0.98**						

Legend: Ag: Agglomeration, GF: gallery forest, W: water, WS: wooded savannah, SS: shrub savannah, BS: Bare Soil, AA: Agricultural Area, MAP: Map Validity Index

Table 2: Confusion Matrix 2023

Classes	Ag	GF	W	WS	SS	BS	AA
Ag	350	0	0	0	0	0	0
GF	0	255	2	0	0	0	0
W	0	0	312	0	0	0	0
WS	0	0	0	2500	4	0	0
SS	0	0	1	0	3800	0	0
BS	5	0	0	0	0	120	0
AA	0	0	0	0	0	0	3000
Total	355	255	315	2500	3804	178	3000
MAP	0.98	1	0.98	0.99	0.99	1	0.99
Overall accuracy	**98.68%**						
Kappa Index	**0.98**						

Legend: Ag: Agglomeration, GF: gallery forest, W: water, WS: wooded savannah, SS: shrub savannah, BS: Bare Soil, AA: Agricultural Area, MAP: Map Validity Index

Land cover dynamics in the commune of Po from 2003 to 2023

Regarding the land use units of the commune of Po, there were mapped seven classes (Fig. 4): agglomeration, gallery forests, water, wooded savannah, shrubby savannah, bare soil, agricultural area. Table 3 shows the respective percentages of each occupancy class.

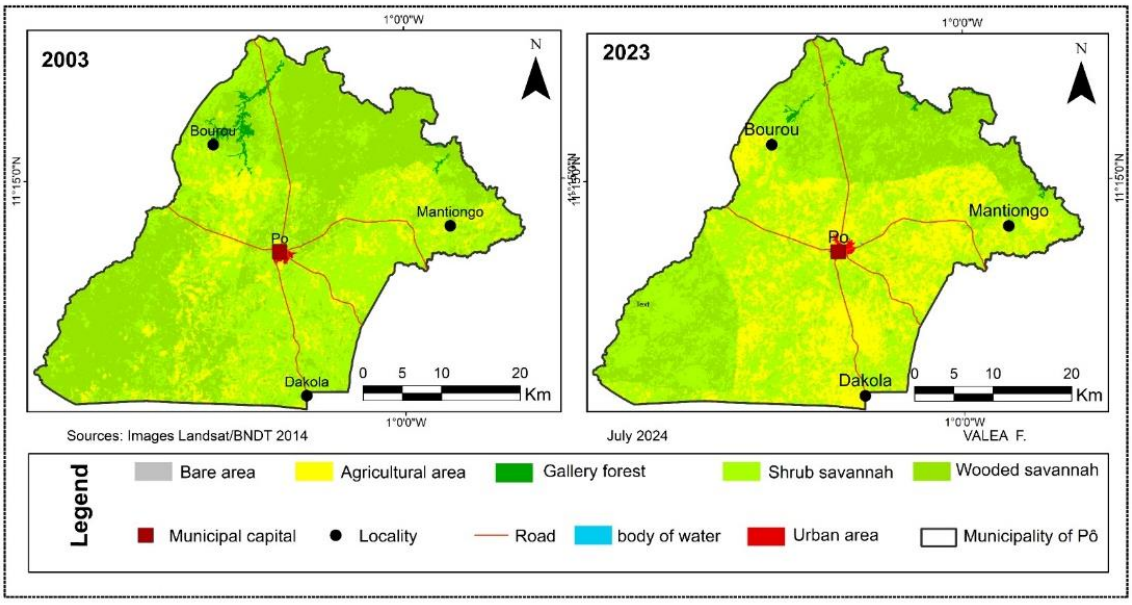

Figure 4: Dynamics of land use between 2003 and 2023

Table 3: Area of occupancy units in 2003 and 2023

Land use	Area (2003)		Area (2023)	
	Ha	%	Ha	%
Agglomeration	389.75	0.24	506.18	0.32
Gallery Forest	1429.51	0.90	514.18	0.32
Water area	7.74	0.004	6.93	0,004
Wooded savannah	68090.14	43.07	35317.03	22.34
Shrub savannah	68111.98	43.08	76422.18	48.34
Bare soil	3.87	0.002	28.43	0.017
Agricultural Area	20042.27	12.67	45279.63	28.64
Total	158075.26		158075.26	

The analysis of Figure 5 and Table 3 shows that in 2003, shrub savannah covered 43.08% of the study area, with a surface area of 68111.98 ha. It is located throughout the eastern and central-western parts. It is followed by wooded savannah with 68090 ha (43.07%), located mainly in the north and south-west of the commune. These two savannah formations alone occupied 86.15% of the total surface area of the study area. Agricultural areas covered 20042.27 ha, with a few patches visible mainly in the east and center-west of the commune. Agricultural activity was not very important at that time (20042.27 ha or 12.67%). The gallery forests along the watercourses covered 1429.51 hectares, or 0.90%. The Po agglomeration was less represented with only 389.75 ha (0.24%). Bare ground (3.87 ha) and water area (7.74 ha) were almost non-existent in the 158075.26 ha of the commune. In 2023, shrub savannah are still the dominant formation, occupying 76422.18 ha, or 48.34% of the total surface area, and are located throughout the commune. Agricultural areas have increased in size by 45279.63 ha (28.64%). They have increased within the central, western and eastern part of the commune. Wooded savannah has decreased in size to 35317.03 ha (22.34%). They are particularly prevalent in the north and south-west of the commune, where the Po and Nazinga protected areas are located. The agglomeration has also increased in size, with 506.18 ha, or 0.32%. Gallery forests have largely regressed (514 ha or 0.32%). Bare soil increased in area to 28.43 ha. Water area have not really changed (6.93 ha). Figure 4 summarizes the dynamics of the different land use units from 2003 to 2023. It shows an increase in the area of the agglomeration which goes from 0.24% to 0.32%. The same applies to shrub savannah, which increased from 43.08% to 48.34%, bare soil from 0.002% to 0.017%, and agricultural areas from 1.67% to 28.64%. On the other hand, gallery forest decreased from 0.90% to 0.32%. The area of wooded savannah has also shrunken, from 43.07% to 22.34%.

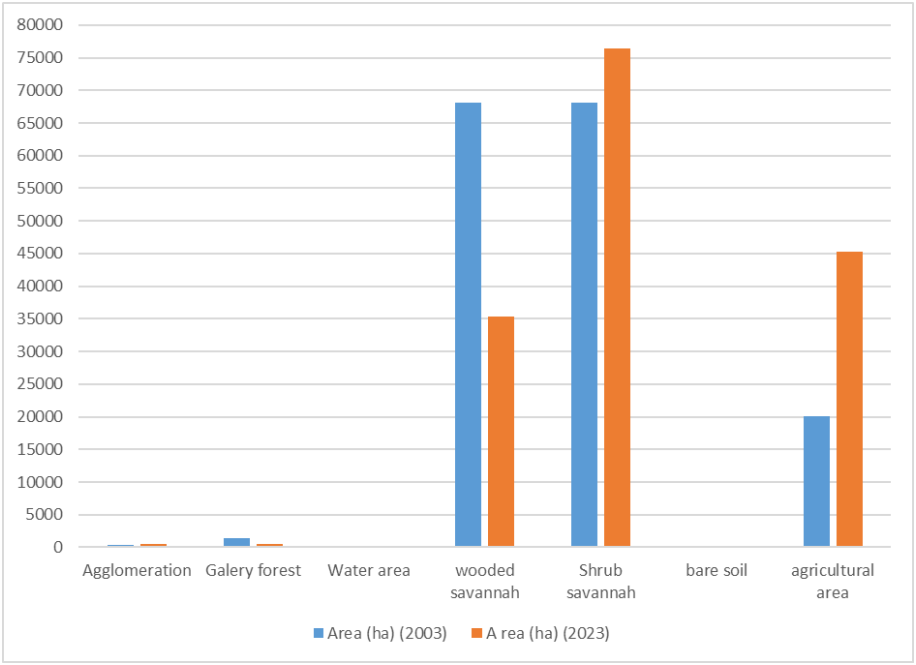

Figure 5: Evolution of land use units from 2003 to 2023

Evolution of land use between 2003 and 2023

The rates of variation of area of land use classes are presented in Table 4. It shows the evolution of land use in the commune of Po between 2003 and 2023, as well as the overall rate of change (TG) and the average annual rate of change (TC).

The land-use units varied over the two selected years (Table 4). Between 2003 and 2023, the gallery forest, water bodies and wooded savannah regressed by 3.20%, 0.62% and 2.40% per year respectively. On the other hand, agglomeration areas, shrub savannah and bare ground maintained their progressive dynamics with an annual rate of 1.5% for agglomeration areas, 0.61% for shrub savannah, 6.29% for agricultural areas and 30% for bare ground. The bare land class showed the strongest increase, followed by agricultural areas.

Figure 6 shows the overall rate of change by land use class from 2003 to 2023.

Table 4: Areas and rates of change in land use classes

Land use	Area (Ha) 2003	Area (Ha) 2023	TC (%)	Nature of evolution	TG (%)
Agglomeration	389.75	506.88	1.5	Progress	30
Gallery forest	1429.51	514.18	-3.20	Regression	- 64.03
Water area	7.74	6.93	-0.52	Regression	-10.46
Wooded savannah	68090.14	35317.03	-2.40	Regression	-48.13
Shrub savannah	68111.98	76422.18	0.61	Progress	12.20
Bare soil	3.87	28.43	31.73	Progress	634.62
Agricultural area	20042.27	45279.63	6.29	Progress	125.92

TC: average annual rate of change between 2003 and 2023
TG: overall rate of change (2003 to 2023)

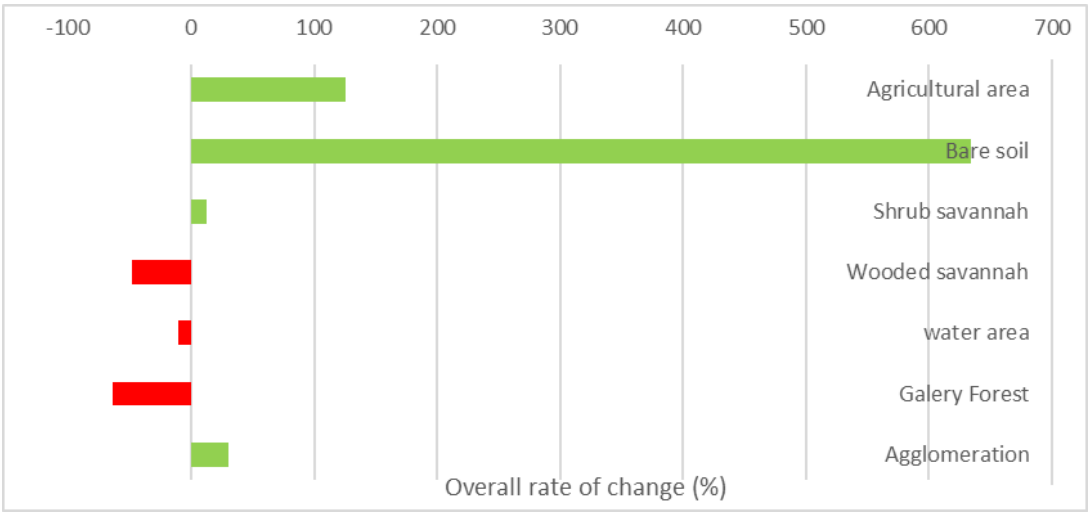

Figure 6: Overall rate of change of land use classes (2003-2023)

Bare soil has increased significantly, with an overall rate of change of 634.62%, followed by agricultural land (125.92%), agglomeration areas (30%) and shrub savannah (12.20%) (Fig. 6). However, 3 land-use classes declined, namely gallery forest (64.03%), wooded savannah (48.13%) and water area (10.46%).

The transition matrix of land use units between 2003 and 2023

The superposition of the land use maps of 2003 and 2023 made it possible to highlight the transition matrix (Table 5). It shows the changes in land cover classes between these two dates. In each land use class, the intensity of change is observed through losses and gains. The situation of stability corresponds to the diagonal value of the matrix.

Observation of the transition matrix shows that vegetation cover in the study area has regressed. The gallery forest, which occupied 1429.51 ha in 2003, has decreased to 514.18 ha. 859.23 ha of the gallery forest has been converted to wooded savannah and 486.49 ha to shrub savannah. In addition, 33912.99 ha of wooded savannah was converted to shrub savannah and 6509.34 ha to agricultural land. The area of wooded savannah has increased from 68090.14 ha in 2003 to 35317.03 ha in 2023. A large part of the shrub savannah has been

converted to agricultural land (25654.81 ha) and 19.66 ha to bare soil. Shrub savannah is the most stable of the formations. In fact, 35520 ha of shrub savannah remained stable. We also note the conversion of 6657.49 ha into wooded savannah and 118.27 ha into gallery forest. 95.22 ha of agricultural area, 141.66 ha of shrub savannah and 59.22 ha of wooded savannah were converted into agglomeration areas.

Table 5: Transition matrix for 2003 to 2023

	Agglomera-tion	Gallery forest	Water area	Wooded savannah	Shrub savan-nah	Bare soil	Agricultur-al area	Total 2003	LOSS
Agglomeration	209.16	-	-	-	49.62	-	130.97	389.75	**180.59**
Gallery forest	-	79.29		859.23	486.49	-	4.50	1429.51	**1350.22**
Water area	1.62	-	5.49	0.18	0.45	-	-	7.74	**2.25**
Wooded sa-vannah	59.22	313.20	1.35	27294.05	33912.99	-	6509.34	68090.14	**40796.09**
Shrub savan-nah	141.66	118.27	0.09	6657.49	35520.00	19.66	25654.81	68111.98	**32591.98**
Bare soil	-	-	-	-	3.69	-	0.18	3.87	**3.87**
Agricultural area	95.22	3.42	-	506.09	6448.94	8.78	12979.83	20042.27	**7062.44**
Total 2023	506.88	514.18	6.93	35317.03	76422.18	28.43	45279.63	158075.26	
GAIN	**299.72**	**434.89**	**1.44**	**8022.98**	**40902.18**	**28.43**	**32299.8**		

Also, the analysis of the transition matrix shows that wooded savannah and shrub savannah have suffered the greatest losses, at 40796.09 ha and 32591.98 ha respectively. These were followed by agricultural areas (7062.44 ha). As for the gains, the shrub savannah and the agricultural area recorded the greatest gains, at 40902.18 ha and 32299.8 ha respectively. As for the stability, 209.16 ha of agglomeration areas, 79.29 ha of gallery forest, 5.49 ha of water bodies, 27294.05 ha of wooded savannah, 35520 ha of shrub savannah and 12979.83 ha of agricultural areas remained stable.

Figure 7 shows the dynamics of the land use units between 2003 and 2023.

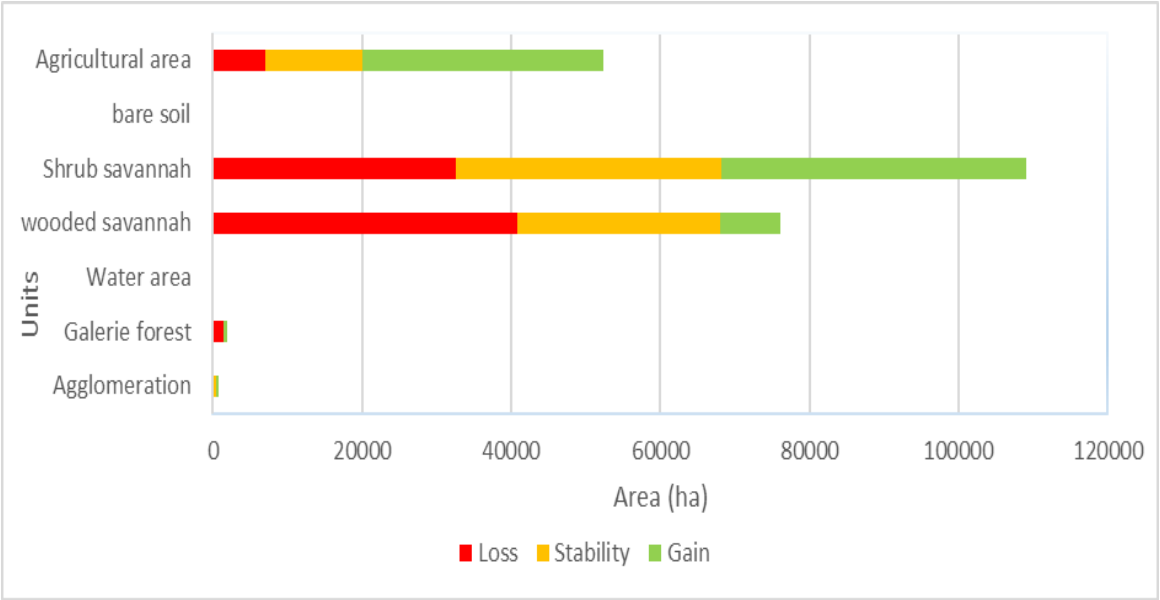

Figure 7: Intensity of change by land use category

Discussion

Landsat image processing is used in this study to assess the dynamics of land use classes between 2003 and 2023. The supervised classification gives almost perfect results, with Kappa indices ranging from 0.81 to 1, as indicated in the work of Chalifoux et al. (2006, p. 12). The analysis of the dynamics of land use indicates that in 2003, the commune of Po comprised 43.08% shrub savannah, 43.07% wooded savannah, 12.67% agricultural area, 0.90% gallery forest, 0.24% for agglomeration area and practically no bare soil. In 2023, wooded savannah has been reduced by more than half to 22.34%. Gallery forest has also declined to 0.32%. Bare soil (0.017%), agglomeration areas (0.32%) and agricultural land (28.64%) have increased. This implies that land-use systems, in this case gallery forests and wooded savannah, have evolved towards anthropogenic systems (agricultural zone, bare soil, agglomerations). Several authors such as Avakoudjo et al. (2014) in Park W in the Sudanian region in northern Benin, Kaboré and Dipama (2014) in the Kompienga, have made the same observations.

The overall rate of change reveals a progressive and significant evolution for the bare soil classes (634.62%), a progressive evolution for the agricultural zone (125.92%), the agglomeration (30%), and the shrub savannah (12.20%), while the gallery forest (- 64.03%) and the tree savannah (- 48.13%) have decreased. These results corroborate those of Koffi et al. (2016) who examined the evolution of land use in the Yoto prefecture in south-eastern Togo. They found that natural formations (forests, savannahs) are increasingly being replaced by anthropogenic land use classes (fields and fallows, plantations and agroforests, agglomerations and bare soil). Furthermore, Gbohoui (2021, p. 63) discovered that in Burkina Faso agricultural land, housing and bare areas increased. This has had an impact on savannah areas, which have lost surface area.

The proportion of changes in the study area shows gains and losses for all the land-use units considered. The largest areas of gain are in the agricultural zone (32299.8 ha) and the shrub savannah (40902.18 ha). In terms of losses, the shrub savannah had the largest area at 40796.09 ha. The factors explaining the dynamics of land use in the commune of Po are multiple and interdependent.

The climatic conditions in the study area are favorable, with rainfall reaching and even exceeding 1000 mm per year (ANAM, 2024). This is an attractive factor for farming, in contrast to the average rainfall for the country as a whole, which is 750 mm. What is more, because of its low population density (15 to 50 inhabitants per km²), the commune remains a favored location for agricultural migrants in search of fertile land. Indeed, the density of Po is lower than that of the other communes in the province, with a density of 224.01 inh./km² for Zecco, 160.1 inh./km² for Tiébélé and 84.12 inh./km² for Ziou (INSD, 2019). This has reinforced the commune's reputation as a land of welcome due to the availability of agricultural land. These results are in line with those obtained by Sanou et al. (2018) in their study on land use dynamics in the Kompienga watershed.

Popescu et al. (2024)explain that changes in landscapes are caused by the effects of human activities such as economic development and urban sprawl, intensive agricultural practices and deforestation, as well as population growth and the consequent increase in consumption patterns. Po commune is no exception to these factors. In our study area, an analysis of changes in land use reveals an increase in the area of fields to the detriment of vegetation. According to Kaboré (2013), production methods are the main cause of the deterioration in vegetation cover. Land use is based on clearing land (Photo 8) in order to increase agricultural areas (Photo 9). This is a form of agriculture that consumes a lot of space, and is seen by the population as a strategy for increasing production (Agbanou B. T et al, 2018) in the event of rainfall deficits and reducing the exodus due to famine (Sanou et.al., 2018). Moreover, Chaïbou and Banoin (2008) and Anthelme et al. (2006) also show that this deterioration is attributed to human action. Population growth leads to an increase in demand for land and fodder, causing an extension of agricultural land and an expansion of grazing areas.

Figure 8: Clearing land for agricultural use (Photo Valéa F. - June 2022)

Figure 9: Cultivated areas (Photo Valéa F. - June 2022)

Socio-economic factors also contribute to the degradation of the study area. In the commune of Po, these include artisanal gold mining, timber and charcoal mining and the removal of vegetation for firewood. According to Drabo et al. (2003) population growth and certain types of exploitation are responsible for the deterioration of the land, which in turn disrupts the ecological balance.

Gold panning, or artisanal gold mining, is a common practice in rural areas. In the commune of Po, the sharp increase in the bare zone class could be explained by the growth of this activity. During site preparation, vegetation is destroyed to build makeshift shelters, for firewood or to leave a space free of vegetation so that the activity can be carried out. For Watha-Ndoudy et al. (2022), the installation of gold miners at mining sites requires clearing, uprooting trees and even cutting down wood. Wood therefore plays an essential role in the artisanal gold mining process (Hue et al., 2020). The consequences of the installation of gold miners are the destruction of vegetation cover and soil. In addition, Rouamba et al. (2024) have shown that gold mining activity leads to an increase in the population on mining sites, which has an effect on the dynamics of land use in the area concerned. These results are in agreement with Lecerf (2008, p. 150) who argue that gold mining activity itself promotes the dynamics of land over and land use.

Wood is an essential resource, particularly in rural areas where firewood is the main source of energy. According to a study by Millogo et al. (2024) in the Dinderesso and Peni forests in Burkina Faso, it was found that the heads of households interviewed harvested wood for a variety of reasons: energy needs, house building, charcoal production, etc. They also used it as a source of fuel. In Po, timber harvesting is a growing activity because it generates income. It is carried out fraudulently in conservation areas or in the bush. Some plant species are threatened, such as Khaya senegalensis, which is highly prized for the quality of its wood. The need for wood (fuelwood) is exacerbating the effects of the destruction of the savannah. This activity is also a source of income for local people through the manufacture of charcoal. Wood is also used for roofing, fences, livestock pens and handles for farm implements.

These practices are complemented by pastoral activities. In the commune of Po, the presence of the national park encourages the installation of livestock breeders. This is transhumant livestock farming, with animals moving around the park and its surroundings. These movements introduce new practices in the use of forest resources, in this case the pruning of certain plant species (*Acacia albida*, *Acacia seyal*) that are appreciated by the animals. The number of livestock exacerbates the effects on the vegetation cover.

Conclusions

The spatial dynamics of the commune of Po shows the changes in land use between 2003 and 2023. Indeed, the considerable influx of the pioneer front has led to an increase in the number and size of farms as well as buildings. This has been to the detriment of natural resources, in particular vegetation including wooded savannah and gallery forests. Changes in land cover and land use caused by human activities have modified the plant cover. Extensive agriculture, gold panning, and excessive cutting of wood energy are all factors that determine this dynamic. Therefore, it appears essential that knowledge of the determinants in the transition of land use and occupation is fundamental in terms of preserving natural resources or ecosystems. Indeed, the formulation of environmental policies, as well as the implementation of resource conservation strategies, proceed from the analysis of the factors and processes underlying their degradation. In this respect, this study is a contribution to informing decision-making on the protection and conservation of plant biodiversity in the commune of Po in the spirit of a participatory approach and concerted management.

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Conflicts of interest

The author declare no conflict of interest.

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