



(RESEARCH ARTICLE)



ANALYSIS OF INDIGENOUS PERCEPTIONS OF THE FACTORS CONTRIBUTING TO SOIL DEGRADATION IN THE 2 KP COMMUNES (KOUANDÉ, KÉROU AND PÉHUNCO), NORTHWESTERN BENIN

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ABSTRACT

In the communes of Kouandé, Kérou and Péhunco (2 KP), soil degradation is a major concern for farming communities. This study analyses indigenous perceptions of the factors responsible for soil degradation in these three communes. The methodological approach combined a literature review, field observations and surveys of local stakeholders. A sample of 364 farming households was determined using the Schwartz (1995) method, with a 95% confidence level and a 5% margin of error. The data collected were analysed using the Importance Value (IV) and the Consensus Value (UCs) proposed by Byg and Balslev (2001), together with Correspondence Factor Analysis (CFA).

The results show that 45.71% of respondents considered the land to be poorly fertile, compared with 37.60% who considered it fertile and 16.97% very fertile. Among the direct factors, farming practices had the highest importance value (IV = 0.43), followed by forest exploitation (IV = 0.20) and erosion (IV = 0.15), while hunting (IV = 0.05) was perceived as having low importance; the highest consensus value was recorded for farming practices (UCs = 0.87). Among the indirect factors, population growth (IV = 0.45) and urbanisation (IV = 0.25) ranked highest, with consensus values of 0.90 and 0.50 respectively. CFA revealed variations in perceptions across the communes: erosion and hunting were more strongly associated with Kouandé, farming practices and livestock farming with Kérou, and forest exploitation and climate with Péhunco. For the indirect factors, urbanisation and land tenure were associated with Kérou, population growth with Kouandé, and agricultural colonisation together with natural-resource-management policy with Péhunco. The study shows that farming practices and population growth are perceived as the principal factors of soil degradation in the 2 KP communes.

Keywords: Soil Degradation; Indigenous Perceptions; Farming Practices; Population Growth; Kouandé; Kérou; Péhunco

1 INTRODUCTION

The continuing degradation of soils, particularly in sub-Saharan Africa, has become a major concern for millions of farmers who depend closely on the land for their subsistence [1]. This phenomenon affects 20 to 60% of land in Africa, causing an annual loss of 6 million hectares of productive land — equivalent to US\$42 billion in reduced revenue attributable to land degradation [2]. The result is a negative impact on food security and on poverty-reduction efforts.

In Benin, agriculture is a major driver of economic development, contributing approximately 23% of Gross Domestic Product [3]. It provides about 75% of export earnings and 15% of State revenue [4]. However, this land is subject to substantial degradation caused by poor farming practices, even though agriculture the backbone of the country's economy employs 70% of the working population [5]. In Benin, numerous studies [6] show that, faced with this degradation, producers develop strategies for soil and water conservation and for restoring soil fertility. Most of these practices are aimed primarily at improving crop yields, and these local strategies allow producers, to some extent, to meet their livelihood and subsistence needs.

The Atacora Department, in northwestern Benin, is subject to these same constraints. This department is frequently cited as characterised by widespread poverty, where land-tenure problems are particularly acute [7,8]. The population practises mainly extensive farming on impoverished soils. It appears necessary and urgent to reconsider land restoration in the Atacora with a view to increasing agricultural production [9]. Such soil exploitation cannot guarantee sustainable land use; accordingly, maintaining soil fertility remains a major concern for farmers [10].

The 2 KP communes are essentially agricultural, with more than 80% of the working population engaged in farming, over a combined area of 10,259 km² [4]. Agriculture in the study area is carried out using rudimentary methods and techniques (the use of fire, tree felling) that accelerate soil degradation. Furthermore, rapid population growth from 197,975 inhabitants in 2002 to 289,954 in 2013, a gross increase of 46.46% over eleven years, corresponding to an average annual growth rate of 3.04% between 2002 and 2013 constitutes a source of pressure on natural resources, whose unregulated exploitation continues to intensify soil-degradation problems [11,12]. In the study area, the population perceives several factors of soil degradation. This research therefore aims to analyse the indigenous perceptions of these factors in the communes of Kouandé, Kérou and Péhunco (2 KP).

2 MATERIALS AND METHODS

2.1 Study area

Located in northwestern Benin, the 2 KP communes lie between parallels 10°02'30" and 11°24'10" North latitude and between meridians 1°22'05" and 2°23'20" East longitude. They cover a combined area of 10,259 km², of which 20% is forest and 64% is cultivable land, and are home to 289,954 inhabitants [12] (Figure 1).

The dominant climate is of the Sudanian (tropical) type, with two main seasons — a rainy season and a dry season that structure human life and activities in the area. The rainy season, from May to October, is dominated by west to southwest monsoon flows, though squall lines occasionally generate heavy downpours across the region. The humid period runs from mid-June to mid-October, with a peak-humidity period from mid-July to end of September, while the dry period begins in October and ends in June. In an average rainfall year, eleven ten-day periods (dekads) are favourable for crop development, of which ten are markedly humid. The area's climatic regime is unimodal, typically starting in May–June and ending in October–November.

The hydrographic network is organised around two main rivers, the Pendjari (135 km) and the Mékrou (410 km), together with their tributaries, which drain most of the communes of the department. The Pendjari rises at Perpoyakou (commune of Natitingou), flows north, crosses the Atacora range, and then turns back southwest into Pendjari National Park [13]. The Mékrou River drains the communes of Kouandé, Péhunco and Kérou.

In the study area, soil is a loose structure of variable thickness resulting from the transformation of the parent rock under the influence of various physical, chemical and biological factors. Several soil types are identified, namely weakly developed soils, raw mineral soils, hydromorphic soils, ferruginous soils and ferrallitic soils, distributed across a varied topography.

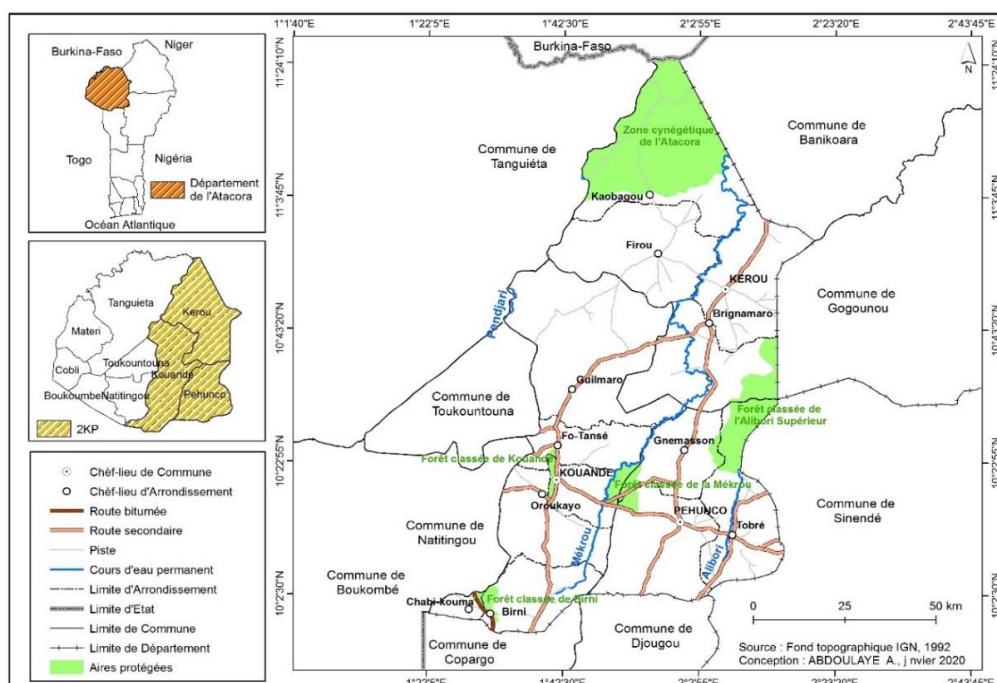


Figure 1: Geographic and administrative location of the 2 KP communes

Source: IGN topographic base map, 1992; cartography by Abdoulaye A., 2020

2.2 Data and data sources

The study drew on both qualitative and quantitative data. Qualitative data were collected from village elders, communal authorities, resource persons and farming households. They covered, in particular, indigenous and modern soil-fertility restoration practices, farmers' local knowledge, and the historical, social and cultural factors associated with soil degradation. Quantitative data mainly concerned population figures for the communes of Kouandé, Kérou and Péhunco, drawn from the General Population and Housing Censuses (RGPH) of 1979, 1992, 2002 and 2013, as well as the distribution of sociocultural groups. Together, these data made it possible to characterise soil-fertility restoration practices and to analyse how they vary according to the sociodemographic and sociocultural context of the study area.

2.3 Sampling and selection of respondents

The farmers surveyed were not selected in advance. Selection was carried out in the field through direct observation, a "snowball" approach, and with the assistance of the crop-production extension officers who work with farmers. A sample was defined for each commune following the method of Schwartz [14]:

$$N = Z\alpha^2 \times P \times (1 - P) / i^2$$

where N = sample size per commune; $Z\alpha = 1.96$, corresponding to a 95% confidence level; P = the number of farming households in the surveyed villages divided by the total number of farming households in the commune; $Q = 1 - P$; and i = the margin of error, set at 5%.

Applying this formula, $N = (1.96)^2 \times (13,915/24,913) \times (1 - 0.56) / (0.05)^2 = 364.34$, i.e. 364 farming households, distributed as shown in Table 1.

The total number of respondents per village was then obtained by applying a coefficient $k = p/P$, where p is the sample size obtained by the Schwartz method and P is the total number of households in the surveyed villages according to the fourth General Population and Housing Census (RGPH-4). Thus $k = 364/13,915 \approx 0.026$, i.e. approximately 3% of each surveyed locality's household count. The resulting sample distribution is presented in Table 1.

Table 1: Distribution of the sample across the selected localities

Commune	District	Village	Total agricultural households	Households surveyed	Share of sample (%)*
Kérou	Kérou	Boukou Bourou	702	22	6.04
Kérou	Kérou	Pikiré	661	21	5.77
Kérou	Brignamarou	Brignamarou	1 400	12	3.30
Kérou	Brignamarou	Kossou	608	15	4.12
Kérou	Firou	Kabongourou	429	15	4.12
Kérou	Firou	Djolini	294	13	3.57
Kérou	Kaobagou	Kaobagou	229	10	2.75
Kérou	Kaobagou	Yinsiga	264	10	2.75
Kouandé	Fô-tancé	Fô-tancé	328	13	3.57
Kouandé	Fô-tancé	Tikou	280	10	2.75
Kouandé	Guilmaro	Sinakpagourou	1 438	15	4.12
Kouandé	Guilmaro	Damouti	241	12	3.30
Kouandé	Kouandé	Mary	230	12	3.30
Kouandé	Kouandé	Sékégourou	460	17	4.67
Kouandé	Birni	Gorgoba	280	10	2.75
Kouandé	Birni	Tassigourou	422	15	4.12
Kouandé	Chabi Couma	Chabi Couma	423	14	3.85
Kouandé	Chabi Couma	Papatia	273	10	2.75
Kouandé	Orou-Kayo	Orou-Kayo	367	15	4.12
Kouandé	Orou-Kayo	Niékéne Banssou	1 579	18	4.95
Péhunco	Gnemasson	Doh	349	13	3.57
Péhunco	Gnemasson	Gnemasson	521	17	4.67
Péhunco	Tobré	Ouassa Kika	315	12	3.30
Péhunco	Tobré	Guimbérérrou	678	10	2.75
Péhunco	Péhunco	Bouerou	688	20	5.49
Péhunco	Péhunco	Soadoudou	356	13	3.57
TOTAL — 3 communes, 13 districts, 26 villages			13 915†	364	100

Source: Field survey, 2022

* Recomputed as $(\text{households surveyed} \div 364) \times 100$. In the original manuscript, the percentage recorded for roughly a third of the villages did not correspond to this formula (several unrelated villages shared an identical, evidently miscopied value of 2.47%) and the column did not sum to 100%; the values shown here have been recalculated directly from the household-count formula stated in the text and now sum to 100%. † The sum of the 26 individual village figures in this column is 13,815, which differs by 100 from the total of 13,915 given in the original manuscript; this discrepancy could not be resolved from the source document and should be checked by the author against the underlying RGPH-4 data.

The villages surveyed were selected primarily on the basis of agricultural potential, the size of the farming population, and the geographic location of each village.

2.4 Methods for analysing soil-degradation factors and soil-fertility restoration practices

2.4.1 Data processing and analysis of results

Qualitative data formed the basis for analysing the main results obtained. Data on the factors responsible for soil degradation were processed by synthesising the information gathered from the target population together with the physical characteristics of the surveyed environment; this was then analysed to give a scientific basis to the various assessments of the information collected. The determination of the factors responsible for soil degradation was based on the importance parameters of Byg and Balslev [15].

2.4.1.1 Byg and Balslev importance parameters

These parameters were originally used in ethnobotany to assess the importance of the use of certain plants in Madagascar. They comprise the importance value and the consensus value of the choice of determining factors.

2.4.1.2 Importance value of the determinants

The importance value (IV) of a determinant is the proportion of respondents who consider an activity or factor to be a determinant [15]. It ranges from 0 to 1 and is calculated as:

$$IV = n_{is} / n$$

where n_{is} is the number of respondents who identify a given practice or factor, and n is the total number of respondents. Accordingly: $IV = 1$ indicates that the activity has a perfect influence on soil degradation; $IV = 0$ indicates no effect; and IV approaching 1 indicates a strong influence on soil degradation.

2.4.1.3 Consensus value of the choice of determinants

The consensus value of the choice of determinants (UCs) measures the degree of agreement among respondents in their choice of determinants, and is calculated as:

$$UCs = n_s / n$$

where n_s is the number of respondents who chose determinant s , and n is the total number of respondents.

2.4.1.4 Correspondence Factor Analysis (CFA) and linear regression analysis

Correspondence Factor Analysis (CFA) was used to better characterise the factors responsible for soil degradation, using SPSS version 21. CFA first made it possible to reduce a large number of statements to a smaller number of factors, each representing one dimension of the variable studied. The chi-square correlation coefficient was also calculated to examine the relationships between the three communes and their assessments of the main direct and indirect factors of soil degradation in the 2 KP communes. In a second step, CFA was used to relate the different sociocultural groups to soil-fertility restoration practices, using Minitab version 14.

3 RESULTS

The results of this research concern the analysis of indigenous perceptions of the factors of soil degradation in the 2 KP communes.

3.1 Perceived state of land fertility in the 2 KP communes

Farmers' perceptions regarding the fertility of the land were analysed using the importance values of respondents' choices and the frequency of opinions expressed (Figure 2).

Figure 2 shows that assessments of land fertility vary across the 2 KP communes, ranging from fertile, poorly fertile and very fertile land, with response rates of 37.6%, 45.71% and 16.97% respectively. Across the three communes, 45.71% of respondents considered the land to be poorly fertile, which points to the scale of land degradation in these environments and to the resulting reliance on chemical fertilisers. It is therefore important to identify the factors of soil degradation in these communes, which were analysed on the basis of the indigenous perceptions of the 2 KP communities.

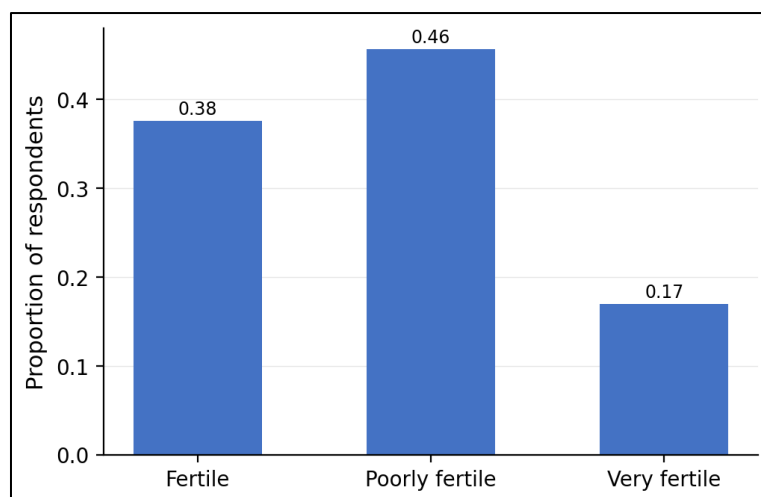


Figure 2: Importance value of farmers' assessment of land fertility in the 2 KP communes

Source: Field survey, July 2025

3.2 Indigenous perceptions of the factors of soil degradation

Local knowledge of the factors of soil degradation was analysed using the importance value and the consensus value of respondents' choices of determinants. A cross-analysis of perceptions of these determinants was then carried out by socio-professional category. Both direct and indirect determinants were considered.

3.2.1 Perception of direct factors of soil degradation

Direct determinants of soil degradation are activities that directly affect soil structure and composition. The direct determinants identified are: farming practices, forest exploitation, livestock farming, hunting, erosion and climate.

3.2.1.1 Importance and consensus values of the direct factors (Byg and Balslev parameters)

Respondents' perceptions were analysed using the importance value of the direct factors of soil degradation (Figure 3).

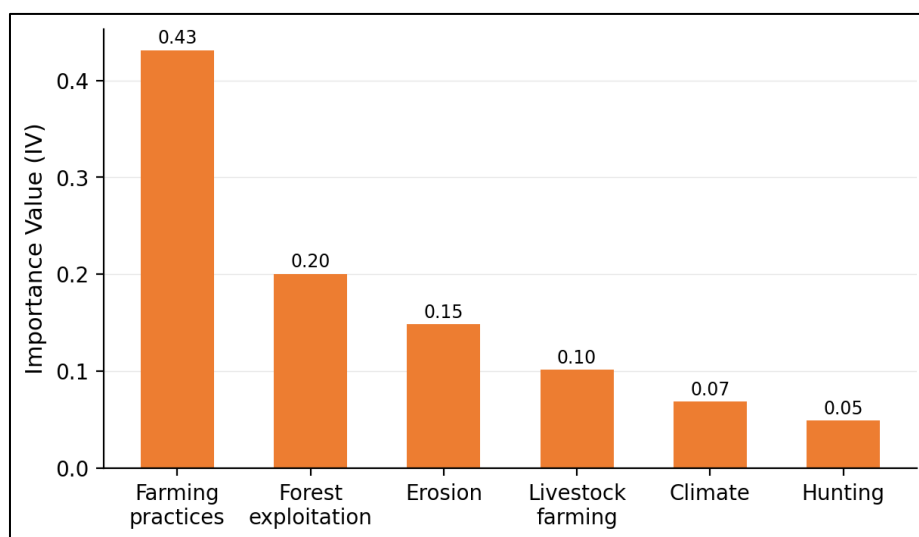


Figure 3: Importance value of the direct factors of soil degradation in the 2 KP communes

Source: Field survey and statistical processing, November 2025

Figure 3 shows that farming practices constitute the factor with the highest importance value (0.43) among the direct factors of soil degradation, followed by forest exploitation (0.20). These factors are therefore perceived by farmers as the principal causes of soil degradation. Erosion (0.15) and climate are perceived as intermediate but still non-negligible factors, whereas hunting has a low importance value (0.05) among the factors of soil degradation; the scale of hunting

is indeed shrinking as wildlife disappears, itself possibly linked to the intensification of forest exploitation and the expansion of grazing land.

The quantitative measures characterising the degree of agreement among farmers in their choice of direct factors of soil degradation are shown in Figure 4.

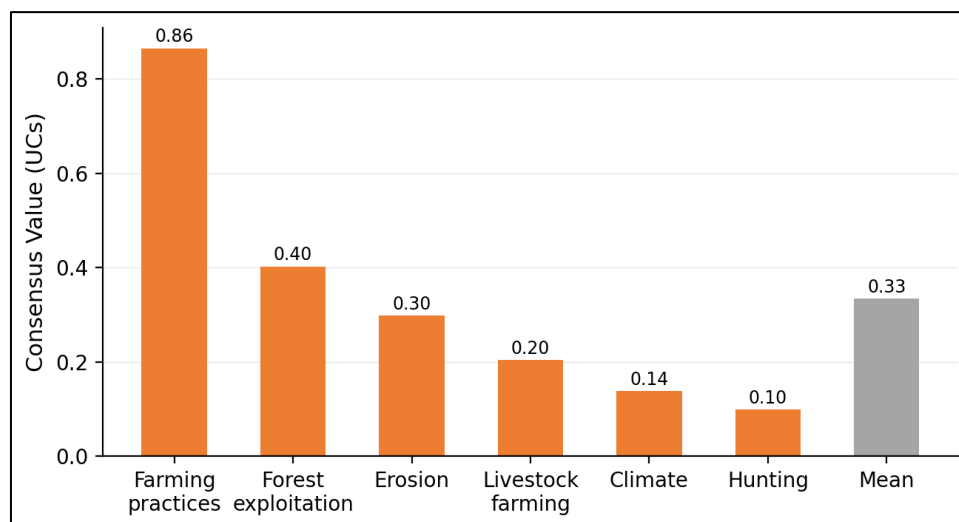


Figure 4: Consensus value of the choice of direct factors of soil degradation in the 2 KP communes

Source: Field survey and statistical processing, November 2025

Figure 4 shows that the consensus value for farming practices (0.87) is very high relative to the mean of the direct factors (0.33): nearly all farmers surveyed agree that farming practices contribute markedly to soil degradation in the study area. The consensus value for forest exploitation is slightly above the mean (0.40), whereas the consensus values for climate and hunting (0.14 and 0.10) are well below the general mean indicating that, in farmers' view, these are not major factors of soil degradation in the 2 KP communes.

3.2.1.2 Cross-tabulation of direct factors by commune

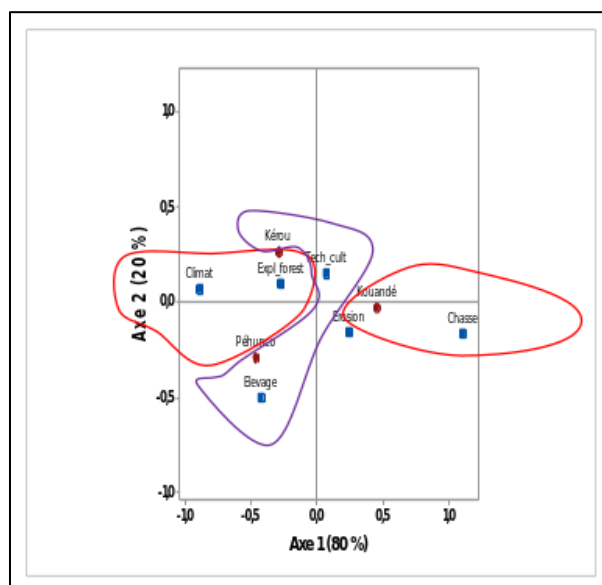


Figure 5: Correspondence-analysis projection of perceptions of the direct factors of soil degradation in the 2 KP communes

Source: Field survey, August 2025. Legend: Tech_cult = farming practices; Expl_forest = forest exploitation

To better characterise perceptions of the factors responsible for soil degradation across the three communes, Correspondence Factor Analysis (CFA) was carried out (Figure 5). Axis 1 accounts for approximately 80% of the

information projected on the factorial plane, while axis 2 accounts for the remaining 20%, together capturing the totality of the projected information — largely sufficient to support a robust interpretation of perceptions of the direct factors of soil degradation across the study communes. Kouandé, Péhunco, erosion, hunting, climate and forest exploitation contributed to the formation of axis 1, while Kérou, livestock farming and farming practices contributed to the formation of axis 2.

Figure 5 shows that, in the commune of Kouandé, erosion and hunting are perceived by farmers as the principal factors of soil degradation, in contrast to farmers in Péhunco, who consider forest exploitation and climate to be the main factors. Farmers in Kérou, meanwhile, regard farming practices and livestock farming as the principal factors of soil degradation.

3.2.2 Perception of indirect factors of soil degradation

Indirect factors of soil degradation are underlying factors that drive the direct determinants described above. The indirect determinants identified in this study are: population growth, urbanisation, natural-resource-management policy and regulations, agricultural colonisation, and land tenure.

3.2.2.1 Importance and consensus values of the indirect factors

The importance value of the indirect factors of agricultural land-use change is presented in Figure 6.

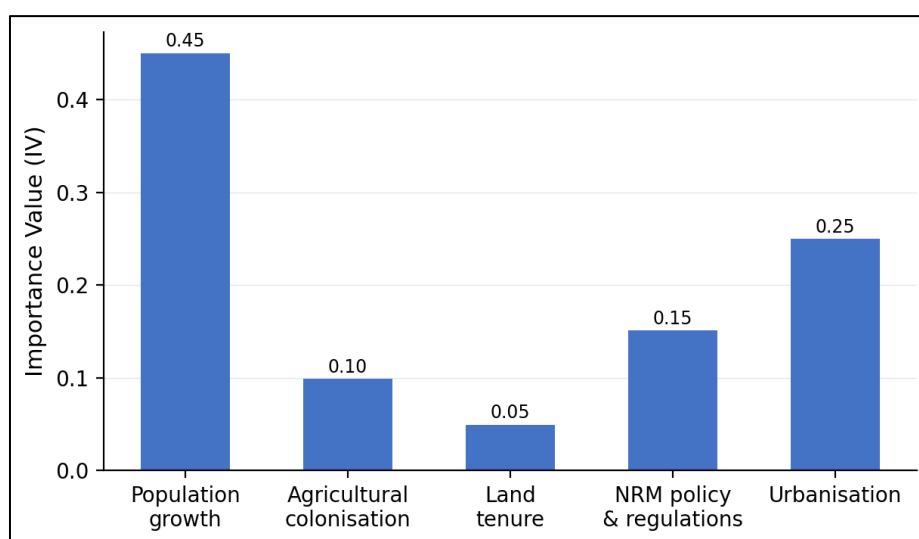


Figure 6: Importance value of the indirect factors of soil degradation in the 2 KP communes

Source: Field survey, December 2025. Legend: population growth; agricultural colonisation; land tenure; NRM policy and regulations; urbanisation

Figure 6 shows that population growth and urbanisation (0.45 and 0.25) rank highest among the indirect factors of soil degradation. Respondents consider these to be the most important indirect drivers of soil degradation in the 2 KP communes: as population growth and urbanisation intensify, the demand for agricultural land rises accordingly. Natural-resource-management policy and regulations, agricultural colonisation and land tenure (0.15, 0.10 and 0.05 respectively) are perceived by farmers as indirect factors with comparatively limited effects on soil degradation in the 2 KP communes; unfamiliarity with natural-resource-management regulations and policy may nonetheless lead farmers toward excessive exploitation of these resources. [Note: the original manuscript's narrative text states the agricultural-colonisation value as 0.16, whereas the underlying chart data reproduced in Figure 6 and independently corroborated by the hierarchization chart (Figure 9) in the original file gives 0.10 for this factor; the value of 0.10 is used here as the better-supported figure, but the author should confirm which is correct.]

The degree of agreement among the main stakeholders in their choice of indirect factors of agricultural land-use change was assessed through the consensus value of the choice of factors (Figure 7).

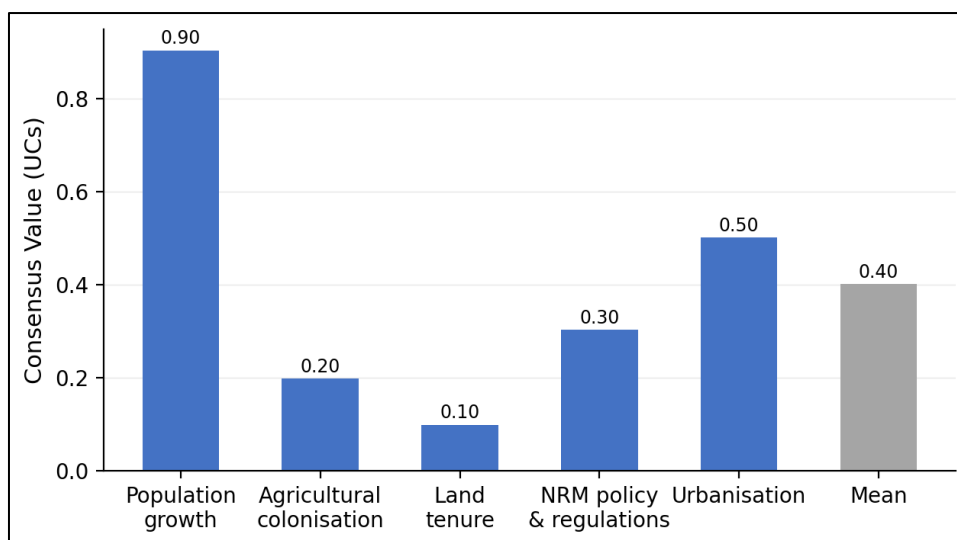


Figure 7: Consensus value of the choice of indirect factors of soil degradation in the 2 KP communes

Source: Field survey, December 2025. Legend: population growth; agricultural colonisation; land tenure; NRM policy and regulations; urbanisation

Examination of these values shows that the consensus values are very high for population growth and urbanisation (0.90 and 0.50) relative to the mean (0.40). The consensus values for land tenure and agricultural colonisation (0.10 and 0.20) are low relative to the mean. It follows that a substantial share of the population of the 2 KP communes perceives population growth and urbanisation as indirect factors of major importance in soil degradation, whereas there is weak consensus among farmers regarding the role of agricultural colonisation, land tenure and natural-resource-management policy and regulations.

3.2.2.2 Cross-tabulation of indirect factors by commune

Correspondence Factor Analysis was also applied to the indirect factors of soil degradation across the three communes; Figure 8 illustrates the projection of these factors and the three communes within the factorial-axis system.

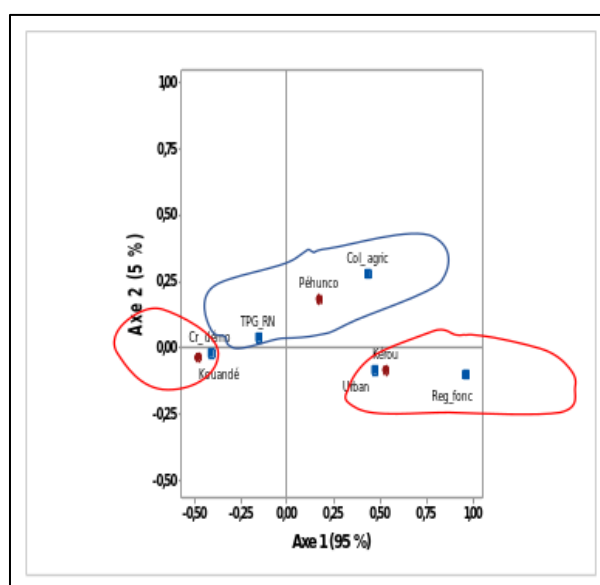


Figure 8: Correspondence-analysis projection of perceptions of the indirect factors of soil degradation in the 2 KP communes

Source: Field survey, September 2025. Legend: Cr_dém = population growth; Urban = urbanisation; Col_agric = agricultural colonisation; Reg_fonc = land tenure; TPG_RN = natural-resource-management policy and regulations

The projection shows that axis 1 explains 95% of the information relating to the indirect factors responsible for soil degradation, while axis 2 explains the remaining 5%, together accounting for the totality of the information. Kérou, Kouandé, Péhunco, land tenure, population growth and urbanisation contributed to the formation of axis 1, while

agricultural colonisation and natural-resource-management policy contributed to the formation of axis 2. This projection shows that land tenure and urbanisation are perceived by farmers in Kérou as the principal factors of soil degradation, in contrast to farmers in Kouandé, who consider population growth to be the principal indirect factor. Farmers in Péhunco, meanwhile, point to agricultural colonisation and natural-resource-management policy and regulations as the principal indirect factors. There is a favourable interrelation between the direct and indirect factors in driving the dynamics of agricultural land use.

3.3 Hierarchization of the factors responsible for soil degradation in the 2 KP communes

In the three study communes, the relative importance of the factors of soil degradation differs according to whether their effects are direct or indirect, and according to the farmers interviewed. The perceptions of farmers directly involved in this system were drawn upon extensively to properly characterise the phenomenon. Figure 9 illustrates the hierarchization of the factors responsible for soil degradation in the 2 KP communes.

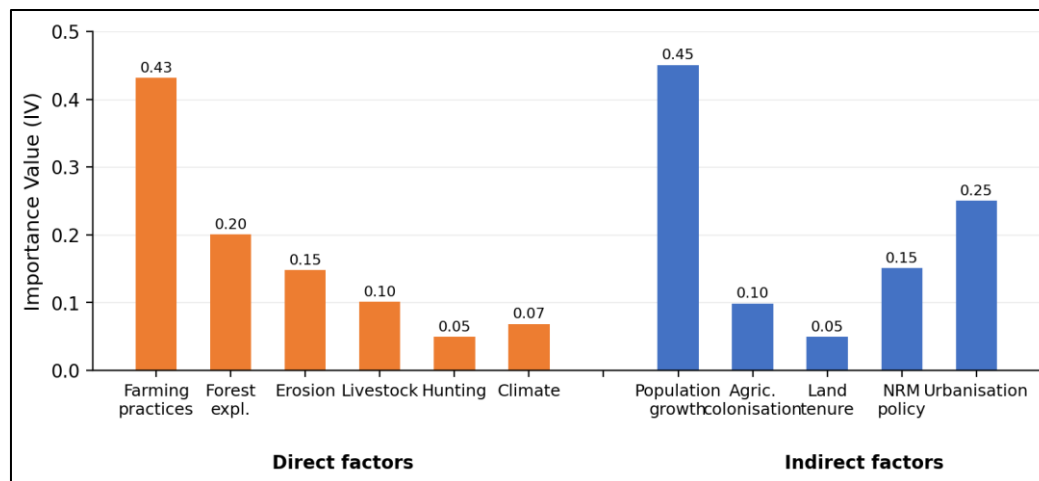


Figure 9: Hierarchization of the factors responsible for soil degradation in the 2 KP communes

Source: Field survey, December 2025

Among the direct factors, the importance value shows that farming practices are strongly perceived as the principal factor of soil degradation, while the effect of hunting on this degradation is perceived as negligible. Similarly, among the indirect factors, population growth is strongly perceived as the principal factor, while land tenure is weakly perceived as an indirect factor. The prominence of farming practices reflects the encroachment onto new agricultural land, driven on the one hand by population growth and, on the other, by the distances farmers travel in search of comparatively more fertile land. Farming practices and population growth thus show the highest importance values among, respectively, the direct and indirect factors underscoring the need to further examine the indicators farmers use to characterise the soil types encountered in the study area.

4 DISCUSSION

Several factors are responsible for soil degradation in the 2 KP communes, with effects that are particularly visible through the reduction of vegetation cover. Human economic activity is a major driver of change in agricultural landscapes. Tenté [16] showed that human activities are the principal factor disturbing plant formations in the Atacora range, identifying shifting cultivation, bushfires, overgrazing, the overexploitation of fuelwood and timber, and unregulated gravel extraction as the main activities involved. Similarly, Tovidé et al. [17] identified forest exploitation, agriculture, livestock farming, hunting and charcoal production as the principal pressures on natural resources in the Petit Kouffo watershed. In the 2 KP communes, farming practices, forest exploitation and pastoral activities likewise emerge as the principal factors of soil degradation.

Overgrazing, tree felling and the exposure of bare soil promote landscape degradation, and climatic conditions can aggravate these effects, in particular through rainfall erosion. These results nonetheless differ from those of Le Drezen and Ballouche [18], who attribute soil fragility and erosion more directly to agricultural intensification, new farming techniques and climatic change. In the ranking of soil-degradation factors in the 2 KP communes, farming practices and forest exploitation occupy the first ranks, which is consistent with the findings of Akpoyete [19], who ranks agricultural exploitation, forest exploitation, charcoal production, livestock farming and hunting among the principal factors of change in agricultural land.

In the villages studied, farmers possess indigenous knowledge and practices for soil restoration and conservation. These practices vary according to available resources, soil type, labour and cultivable land, and include biological practices such as fallowing and the use of soybean, mucuna, pigeon pea and *Stylosanthes*; cultural practices such as crop rotation, intercropping, mulching and penning; and mechanical practices such as stone bunds and the use of compost. These results are consistent with those of Gomgnimbou et al. [20], Coulibaly [21] and Ouorou Barré [9], who emphasise the importance of rotation, intercropping, fallowing, mulching, penning and organic inputs in restoring soil fertility.

Restoration practices also vary by sociocultural group. The Outamari favour intercropping and stone bunds, while the Fulani (Peulh) primarily use rotational penning of cattle and crop rotation. The Baatombu draw on soybean, pigeon pea and fallowing, while the Gourmantché and Lokpa make greater use of crop residues. These findings corroborate those of Akpo [22], who highlights the existence of restoration practices specific to different sociocultural groups, notably fallowing, crop rotation, intercropping and rotational cattle penning.

Furthermore, 45% of producers consider that indigenous strategies alone are insufficient to restore soils enough to sustain production across several hectares. Improved practices are therefore also used, notably chemical fertilisers, adopted by 85% of producers surveyed; by contrast, mucuna, *Stylosanthes* and compost remain little used, with 70% of producers reporting insufficient familiarity with them. These findings are consistent with those of Saïdou et al. [6], who show the importance of mineral fertilisers in improving soil fertility. Overall, improved practices rely mainly on urea, NPK fertiliser and organic amendments such as manure and compost, and producers draw a direct link between soil fertility and crop yield.

5 CONCLUSION

This study set out to analyse indigenous perceptions of the factors of soil degradation in the 2 KP communes (Kouandé, Kérou and Péhunco). Farmers' assessments show that nearly half of the land surveyed (45.71%) is perceived as poorly fertile. Among the direct factors, farming practices (IV = 0.43, UCs = 0.87) and forest exploitation (IV = 0.20) are perceived as the principal drivers of soil degradation, while among the indirect factors, population growth (IV = 0.45, UCs = 0.90) and urbanisation (IV = 0.25, UCs = 0.50) dominate. Correspondence Factor Analysis further shows that these perceptions are not uniform across the study area: erosion and hunting are more closely associated with Kouandé, farming practices and livestock farming with Kérou, and forest exploitation and climate with Péhunco – an important nuance for any locally targeted response, since it indicates that the relative weight of degradation drivers, and therefore the priority interventions, should be tailored to each commune rather than addressed uniformly across the 2 KP area.

Farmers in the study area are not without recourse: they mobilise a range of indigenous soil-fertility restoration practices fallowing, intercropping, crop rotation, mulching, penning, stone bunds and the use of leguminous cover crops alongside a growing reliance on chemical fertilisers, whose adoption (85% of producers) now exceeds that of several indigenous alternatives. Strengthening farmers' knowledge of under-used practices such as mucuna, *Stylosanthes* and compost, formalising land tenure, and integrating population and urbanisation pressures into local land-use planning, would help address both the direct and indirect drivers of degradation identified by this study. Future research building on these perception-based findings should seek to quantify the actual physical and chemical degradation of soils in the 2 KP communes, so as to test how closely farmers' indigenous perceptions track measured soil conditions.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

The author wishes to thank the farming households, village elders, communal authorities, and technical agricultural extension officers in the communes of Kouandé, Kérou, and Péhunco for their cooperation, availability, and valuable contributions during the field data collection.

Disclosure of Conflict of Interest

The author declares that there is no conflict of interest related to this study, its authorship, or its publication.

Statement of Ethical Approval

This study involved questionnaire surveys and field observations conducted with the free and informed participation of respondents. No experimental procedures involving human or animal subjects were undertaken that would have required formal institutional ethical approval.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the survey. Participants were informed about the purpose of the study and their participation was voluntary.

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