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SPATIAL ANALYSIS OF SOIL PH AROUND THE GOUNDI-DJORO LOWLAND IN THE COMMUNE OF REO (BURKINA FASO)

Abstract: Hydrogen potential (pH) is one of the key parameters for assessing the chemical fertility of a soil. The aim of this study is to assess soil pH for sustainable agriculture around the Goundi-Djoro lowlands. The methodological approach is based on documentary research, household surveys, soil sampling followed by laboratory analysis using the potentiometric method. Soil pH values were processed according to the FAO standards in force in Burkina Faso. The spatial distribution of these values was determined using ordinary kriging on ArcGIS. The results show that the extremely acidic, very strongly acidic and strongly acidic pH classes represent 12.04%, 27.56% and 28.93% of the study area respectively. These three pH classes cover lithosols on cuirass, less evolved soils and leached tropical ferruginous soils. On the other hand, soils with weakly acidic to neutral (15.8%), slightly alkaline (4.28%) and medium alkaline (3.89%) pH levels occupy small portions of the site. These pH levels relate to eutrophic tropical brown soils (poorly evolved, ferruginized and hydromorphic). All in all, the soils on the Goundi-Djoro site are highly acidic, with an average pH of 5.45. To remedy this problem, 94% of farmers surveyed use manure or compost, either by spreading or burying it. These organic fertilizers help reduce soil acidity and promote the solubility of nutrients essential for agricultural production.

Keywords: soil, pH, lowland, municipality of Reo, Burkina Faso

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Introduction

The agricultural productivity of soil is mainly linked to its physical, chemical, and biological fertility. This fertility is determined based on parameters such as organic matter, nitrogen, phosphorus, potassium, exchangeable bases, and hydrogen potential (pH). According to BUNASOLS (1990), pH is one of the essential parameters for assessing the chemical fertility of soils, regardless of the range used (minimal or complete). It influences the availability of soil nutrients necessary for plant growth (BUNASOLS, 1990, Ballot & al., 2016). In fact, different nutrients are available for absorption by plants at different soil pH levels. At pH levels below 7, the soil is acidic, while at pH levels above 7, the soil is basic or alkaline. Different crops therefore grow at different pH levels. Nevertheless, it is recognized that pH values between 5.5 and 7.0 are favorable for most crops, as they can provide them with a greater variety of nutrients (Mbonigaba & al., 2009, Segda & al., 2014, FAO, 2022).

Research conducted in West Africa indicates that some soils are moderately acidic, slightly acidic to neutral, and sometimes alkaline. According to Akassimadou & Yao-Kouamé (2014), the soils of the lower M'be II valley in central Côte d'Ivoire have a moderately acidic pH of 5.5. Similarly, slightly acidic to neutral pH levels (6.6) have been recorded in the eutrophic brown soils of Bagré, Burkina Faso (Segda et al., 2014).

However, other studies show that soils in West African countries generally lack organic matter and nutrients (Kissou & al., 2018). In addition, they are increasingly exposed to significant acidification (Konkobo & al., 2022). Indeed, Biaye & al. (2021) showed that the soils of the rice fields in the commune of Mlomp, Senegal, are highly acidic, with pH values ranging from 4.4 to 5.9. Similarly, those of the Niaouli lowlands in southern Benin are highly acidic (Hodomihou et al., 2011).

According to various authors, the factors contributing to soil acidity are mainly poor agricultural practices, excessive use of mineral fertilizers (NPK, urea), and loss of vegetation cover (Konfé et al., 2019, Biaye et al., 2021, Konkobo et al., 2022).

Soil acidity has harmful effects on both its fertility and agricultural productivity. An acidic pH means that the soil contains very few nutrients and exchangeable bases. Soil acidity limits the dissolution of metallic elements, nutrient assimilation, and the activity of soil microorganisms. It also leads to a reduction in the amount of nitrogen and phosphorus, which are essential for plant growth (Mbonigaba et al., 2009). Under these conditions, high soil acidity can cause a decline in agricultural yields (Koulibaly et al., 2014), particularly in rice cultivation (Biaye et al., 2021).

These various authors have addressed soil acidity within the broader context of soil fertility studies. Furthermore, these studies are conducted on a larger scale without spatialization of pH values. In the municipality of Réo, which is the geographical setting for this study, very few studies have been conducted specifically on soil acidity. However, some work on monitoring soil fertility is being carried out as part of the development of low-lying areas. It is therefore necessary to assess the level of soil acidity in this municipality, particularly in low-lying areas, which are subject to high agricultural pressure. Indeed, in Burkina Faso, rainfall variability (Yanogo & Yameogo, 2023, Yameogo & Sawadogo, 2024) and land degradation negatively affect agriculture. These pedoclimatic constraints have forced many farmers to direct their agricultural activities towards lowlands, considered more favorable than glaciais and interfluves (Zoungrana, T., P. 2010). However, the rush of farmers towards

lowlands could in turn accentuate the degradation of soil fertility (Bassole et al., 2023a) in general and modify their pH in particular.

This study raises the issue of the availability of scientific knowledge on the physical and chemical characteristics of soils, particularly their acidity levels. On the other hand, it raises the issue of farmers' awareness of soil acidity around low-lying areas. Thus, the objective of this study is to assess soil pH for sustainable agriculture around the Goundi-Djoro lowlands in the commune of Réo, Burkina Faso.

The present study is unique in three ways. First, it is conducted on a detailed scale of 1:20,000. Indeed, soil studies at more detailed scales, such as 1:20,000, or even 1:10,000 or 1:5,000, allow for a better characterization of the agricultural potential and constraints of soils (BUNASOLS., 1989). Next, this study determined the types of soil around and within the shallow water area by digging soil pits. Then, the pH of the surface horizons of each soil type was measured in the laboratory. Finally, the spatial distribution of pH values was determined by interpolation using ordinary kriging on ArcGIS.

The results of this study have revealed the geographical limits of the different soil pH values around the shallow water area. They will also enable informed choices to be made in terms of which crops to grow on the site. Finally, these results can better guide farmers in their strategies for restoring soil fertility in general and reducing acidity levels in particular.

Materials and Methods

Materials

Biophysical characteristics of the study area

The geographical setting of the study is the commune of Reo, located in the north-east of the province of Sanguié. This province is located in the Centre-West Region of Burkina Faso. Covering an area of 432 km², the commune of Reo is located between 12°11' and 12°28' North Latitude and between 2°24' and 2°37' West Longitude (Reo Town Hall, 2019). It is made up of 9 city sectors plus 12 administrative villages, including Goundi-Djoro.

The actual geographical area concerned by the present study is the agricultural zone around the Goundi-Djoro village lowland, located to the south of the Reo commune. This agricultural area covers 526.52 ha. It is located between 12°12' and 12°13' North Latitude and between 2°3' and 2°27' West Longitude (figure 1, below). The lowland occupies around 75.04 ha of this area. It is crossed by a well-marked watercourse and comprises a floodable part (major bed) and a flooded part (minor bed). It is surrounded by glacia and armoured mounds covered with shrub savannah parkland. On the other hand, the vegetation is of the tree park savannah to shrub park savannah type on the functional glacia and tree park savannah (fruit trees) on the lowland (Bassole et al., 2023b).

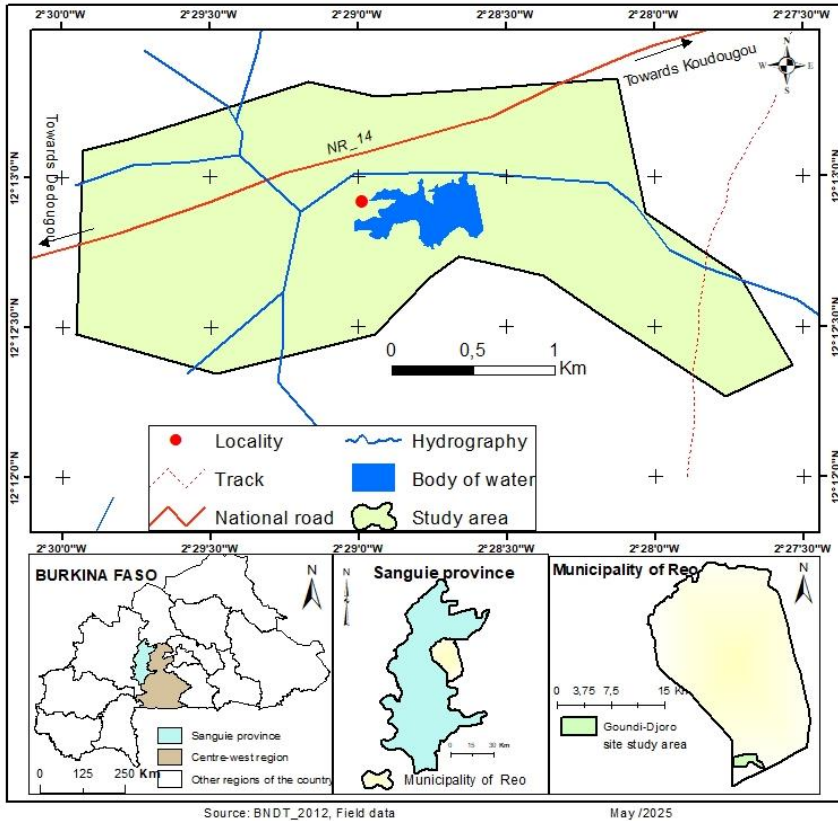


Fig. 1. Geographical location of the study area (Goundi-Djoro)

The agricultural area around the Goundi-Djoro lowlands, located on the granitoid basement, has nine types of soil (figure 2, below). The dominant soils are superficial leached tropical ferruginous soils (26.72%), eutrophic tropical ferruginous brown soils (20.97%), poorly developed lithic erosion soils (16.71%), hydromorphic tropical eutrophic brown soils (10.8%), and shallow leached tropical ferruginous soils (8.35%).

These different types of soil are used for agriculture in a Sudano-Sahelian climate. The main crops grown are cereals (sorghum, millet, rice), legumes (peanuts, beans, cowpeas) and tubers (cassava, potatoes) during the rainy season. During the dry season, vegetable crops (onions, tomatoes, cabbage, carrots, cucumbers, etc.) are mainly grown in low-lying areas and along the edges.

The main threats to soils relate to agricultural and pastoral activities, excessive use of mineral fertilizers, gold panning, logging, and bush fires. These threats and the nature of the soils are factors that can negatively influence pH values.

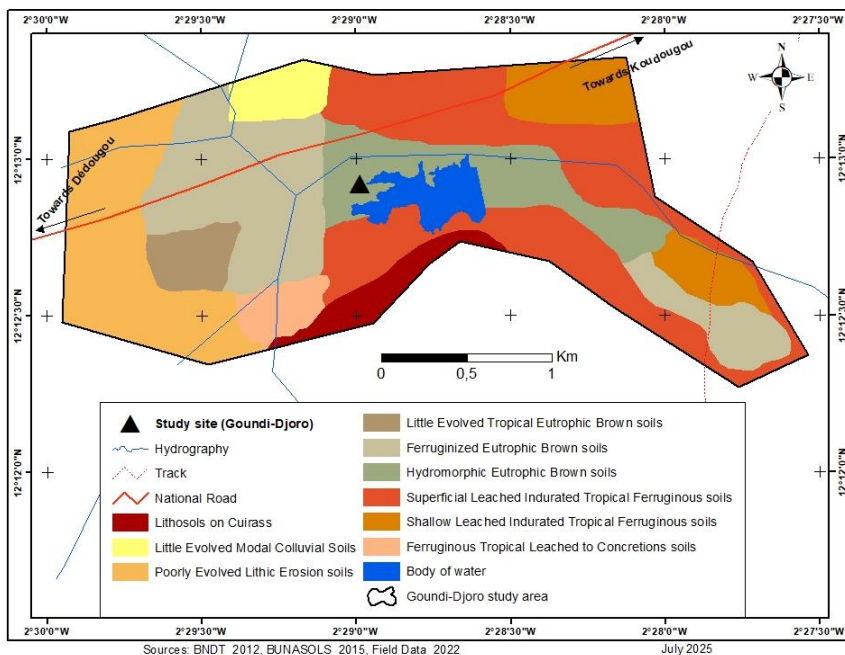


Fig. 2. Types of soil around the Goundi-Djoro shoal

Data and Tools

The primary data consisted of hydrogen potential (pH) water readings and survey data. To collect soil water pH data, a set of tools was assembled. Firstly, a GPS was used to locate the coordinates of the sampled points. Then, an auger, a pickaxe, plastic bags, a marker pen and jute bags were used respectively to collect, condition, code and store the soil samples. Finally, these samples were analyzed in an analysis laboratory, and ArcGIS 10.8 software was used for the maps.

The survey data collected are both quantitative and qualitative. They concern farmers' perceptions of soil acidity. These data are collected using a digitized questionnaire designed in the Kobocollect application contained in cell phones. Other information is collected manually using interview and observation sheets.

The secondary data used are documentary, image and map data. Data relating to images and maps include the 30 m resolution Landsat satellite image from 2020, accessible via the Google earth interface, the National Topographic Data Base (BNDT) from the Institut Géographique du Burkina dating from 2012, and the morpho-pedological map of the Sanguié province, at a scale of 1:100,000, produced in 2003 by BUNASOLS. These vector data were used to produce the thematic maps.

Methods

Methods for delimiting the study area around the lowlands

The study area around the lowland was delimited by a personal intuitive approach, but certain hydro-geomorphological elements were also considered. The aim was to take account of the lowland “*stricto-sensu*” and the geomorphological units surrounding it. Consequently, drainage networks and topography (watersheds) were taken into account when demarcating the boundaries. To do this, a Landsat satellite image from 2020 (included in Google Earth) with a resolution of 30 m was used. On this image, ArcGIS 10.8 software was used to select calibration points, using geographic coordinates around each lowland. Fieldwork was then carried out to confirm these points and make any necessary corrections. At the end of this fieldwork phase, the site’s geographical study area was mapped out (Figure 3, below).

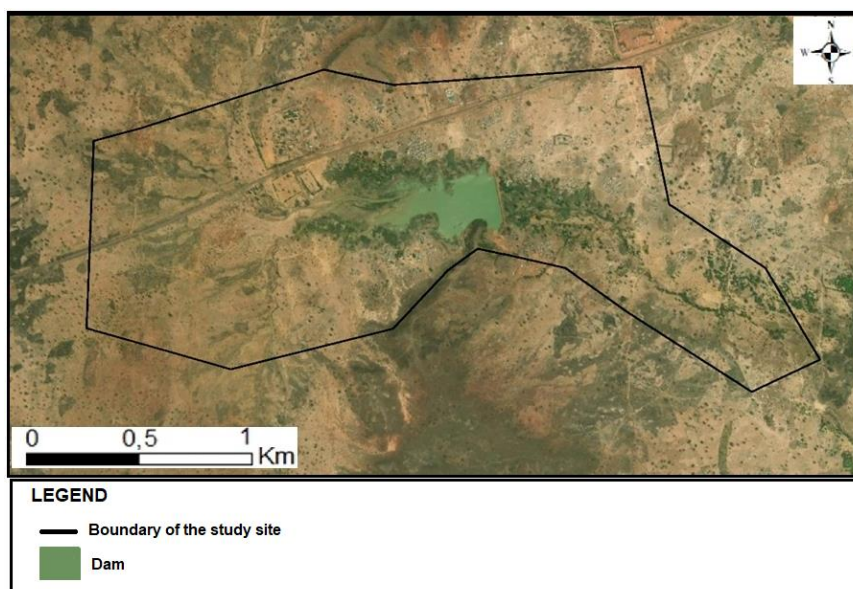


Fig. 3. Delimitation of the study area around the Goundi-Djoro lowland

Soil sampling method

Soil sampling is carried out using the systematic center mesh technique. The first step is to create a square mesh of the study area. Each square is 500 m square, with a radius of 250 m at the center. Next, a spot sample of soil is taken from the center of each square. The distance between two central points is 500 m. Finally, the geographical coordinates of the sampled locations are shown on the survey maps (figure 4, below). The total surface area of the Goundi-Djoro study area is 526.52 ha for 31 sampling points, corresponding to one observation per 16.98 ha. The scale of the present study is therefore 1/20000th, in accordance with BUNASOLS standards. These standards stipulate that, for a study at the semi-detailed scale of 1/20000, one observation is required per 4 to 8 ha for complex terrain and one observation per 8 to 16 ha for less complex terrain (BUNASOLS, 1989).

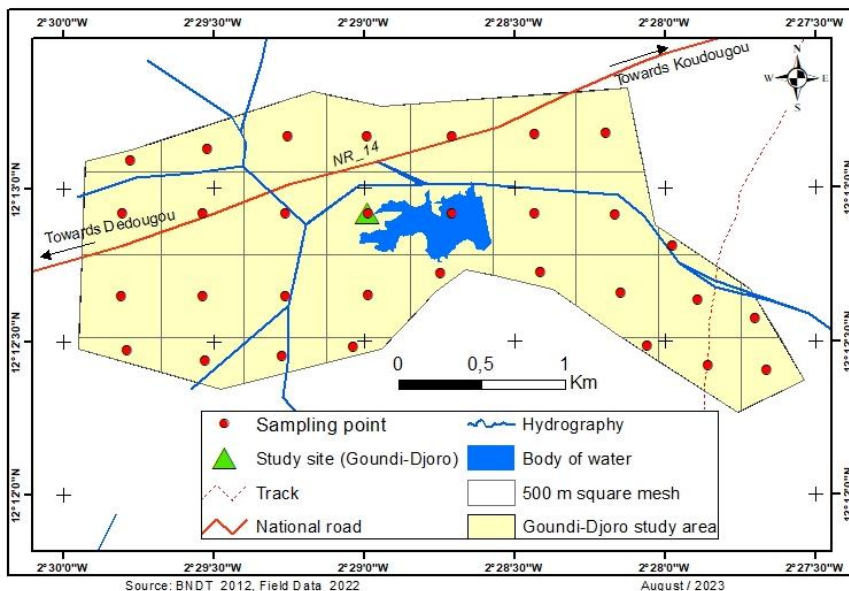


Fig. 4. Soil sampling plan for the Goundi-Djoro site

Soil sample analysis methods

The soil samples taken were analyzed at the BUNASOLS laboratory in Burkina Faso to determine water pH values using the potentiometric method. The process involves three main stages. First, a mixture of 20 g of soil (sample) and 50 ml of distilled water is stirred for 30 minutes. Next, this solution (the mixture) is left to stand for 30 minutes. Finally, a direct-reading pH meter with a glass electrode is used to measure the acidity of the solution. A soil-to-water ratio of 1/2.5 (current standard) is applied.

Criteria for interpreting soil pH values

Soil pH values are interpreted according to the FAO standards (1976) used by BUNASOLS in Burkina Faso. Thus, a soil is extremely acidic when its pH is below 4.5. On the other hand, when the pH is between 6.1 and 7.3, the soil is weakly acidic to neutral (table 1, below).

Tab. 1. Interpretation classes for soil water pH values

pH	Extremely acidic	Very Strongly acidic	Strongly acidic	Medium acidic	Weakly acidic to neutral	Slightly alkaline	Medium alkaline
		< 4,5	4,6-5,0	5,1-5,5	5,6-6,0	6,1-7,3	7,4-7,8

Source: BUNASOLS, 2023.

Methods for spatializing soil pH values

The spatial interpolation method, specifically ordinary kriging, was used in ArcGIS to determine the spatial distribution of soil pH values. There are several spatial interpolation techniques that generally produce varied and different results. However, for soil data, the most reliable and commonly used technique is ordinary kriging (Rebai & al., 2007, Bosser, 2012). For this study, a single soil sample was taken from the center of each 500 m square, with a radius of 250 m. As a result, the value of a soil sample is valid for an area of 25 ha. Spatial interpolation therefore consisted of assigning estimated values to unsampled sites based on those with known values within the same study area.

Survey data collection and processing methods

The field survey was carried out according to a reasoned choice and taking into account three criteria defined as follows: to be a farmer in the delimited study area, to be head of household or head of farm and to be at least 20 years old. Indeed, the older the farmer, the greater his know-how (Biga et al., 2021) and his knowledge of the temporal dynamics of soil fertility.

The « snowball » sampling technique is used for the socio-pedological survey. It consists of interviewing all farmers who meet the 3 above-mentioned criteria, until saturation point is reached. This technique is best suited to such studies, covering very small geographical areas (lowlands, irrigated perimeters, etc.) and specific target populations (farmers, market gardeners, nurserymen, etc.). The principle is to gather information from an individual interviewed in order to find others, practicing the same activity (Séhouéto et al., 2015). Thus, 115 producers were surveyed. Men represented 84.35% of the total sample, compared with 15.65% of women. Regarding the age criterion, 5.22% of farmers surveyed were aged between 20 and 30, compared with 94.78% aged 30 and over.

The main questions asked of farmers concerned their perceptions of soil acidity and the degradation of its physical and chemical fertility. They also took into account the biophysical indicators of soil with acidic, neutral, and alkaline pH levels, as perceived by the farmers. Similarly, producers gave their opinions on the factors contributing to soil acidity and its impact on soil fertility levels and agricultural yields. Finally, questions were asked about farmers' strategies for reducing soil acidity and restoring soil fertility.

The survey data were processed and analyzed using SPSS Statistics.25 and Excel, 2020. Quantitative data were translated into descriptive statistics covering frequencies, percentages, ordinary means (maximum, minimum), median and standard deviation.

Results

Distribution of soil pH values by sampling site

The distribution of soil pH values by class shows that the strongly acidic and very strongly acidic classes dominate, accounting for 29.63% and 29.64% respectively of the total number of sites sampled. In addition, extremely acidic soils were found at 11.11% of sites. Weakly acidic to neutral pH values account for 14.82%, while moderately acidic pH values are present in 7.41% of samples. Slightly alkaline and moderately alkaline pH values are found in low proportions. They represent 3.70% and 3.69% of all sampled points respectively (Table 2, below).

Table 2. pH classes by sampling point

pH classes	Number of points sampled	Percentage (%)
Medium alkaline	1	3,69
Slightly alkaline	1	3,70
Weakly acidic to neutral	4	14,82
Medium acidic	2	7,41
Strongly acidic	8	29,63
Very Strongly acidic	8	29,63
Extremely acidic	3	11,11
Total	27	100%

Source: Field data, june 2022

Water pH values by soil type

Analysis of the data in table 3 below shows a variation in water pH values according to soil type. Superficial Leached Indurated Tropical Ferruginous soils (FLIS), Shallow Leached Indurated Tropical Ferruginous soils (FLIPP) and Little Evolved Modal Colluvial Soils (PEACM) are very strongly acidic, with mean pH values of 4.68, 4.73 and 4.72 respectively. Strongly acidic soils include Ferruginous Tropical Leached to Concretions soils (FLC), with an average pH of 5.26; Poorly Evolved Lithic Erosion soils (PEEL), with an average pH of 5.4 and lithosols on cuirass (pH=5.19). In contrast, the Little Evolved Tropical Eutrophic Brown (BEPE), Ferruginized Eutrophic Brown (BEF) and Hydromorphic Eutrophic Brown (BEH) soils are weakly acidic to neutral, with respective mean pHs of 6.34, 6.54 and 6.96.

Table 3. Water pH values by soil type at Goundi-Djoro

Soil types	pH valeurs	Interpretation
Superficial Leached Indurated Tropical Ferruginous soils	4,68	Very strongly acidic
Shallow Leached Indurated Tropical Ferruginous soils	4,73	
Little Evolved Modal Colluvial Soils	4,72	
Ferruginous Tropical Leached to Concretions soils	5,26	Strongly acidic
Poorly Evolved Lithic Erosion soils	5,4	
Lithosols on Cuirass	5,19	
Little Evolved Tropical Eutrophic Brown soils	6,34	Weakly acidic to neutral
Ferruginized Eutrophic Brown soils	6,54	
Hydromorphic Eutrophic Brown soils	6,96	

Source: Field data, june 2022

For the Goundi-Djoro study area as a whole, the average pH of the soils is 5.45, with a median value of 5.16, indicating a high level of acidity. The lowest pH value (4.04) is measured on a shallow leached tropical ferruginous soil (FLIPP), which is therefore extremely acidic. On the other hand, the highest pH value (8.11) was recorded on a ferruginized tropical eutrophic brown soil (BEF). This soil is therefore moderately alkaline.

Water pH values by geomorphological unit

Four geomorphological units have been identified in the Goundi-Djoro study area. These are the high-slope glacis, the medium-slope glacis, the low-slope glacis and the lowland.

Soils on the upper glacis slope are extremely acidic, very strongly acidic and strongly acidic. On this unit, extremely acidic soils account for 33% of FLIPP, with a pH of 4.04. Very strongly acidic soils include PEACM, FLIS (70%) and FLIPP (67%). Highly acidic soils include PEEL and lithosols on cuirasses. On the mid-slope glacis, the soils are on the one hand very strongly acidic (30% of FLIS soils) and strongly acidic (FLC soils); on the other hand, they are weakly acidic to neutral (BEPE soils and 80% of BEF soils). On the lower slope glacis, the remaining 20% of BEF soils are weakly acidic to neutral, with a water pH of 7.07. Finally, at the lowland level, the hydromorphic tropical eutrophic brown soils (BEH) are weakly acidic to neutral (pH=6.51) and slightly alkaline (pH=7.41).

Spatial distribution of soil acidity levels in Goundi-Djoro

The spatial distribution of soil water pH values (figure 4 and table 4, below) shows that the extremely acidic, very strongly acidic and strongly acidic classes account for 12.04%, 27.56% and 28.93% of the study area respectively. These three pH classes occupy 68.53% of the mapped area. They are located to the west, east, south, southwest, north and northeast of the site. These pH classes cover lithosols on cuirasses, PEEL, PEACM, FLIS, FLIPP and FLC soils. These soils are acidic in nature.

On the other hand, moderately acidic pH levels account for a small proportion of the area, at 7.5%. Similarly, soils with weakly acidic to neutral pH, slightly alkaline pH and moderately alkaline pH occupy small portions of the site, at 15.8%, 4.28% and 3.89% respectively. These pH levels are located in the central-western, central-northern, central and south-eastern parts of the site. They cover the BEPE, BEF and BEH soils (figure 5 and table 4, below).

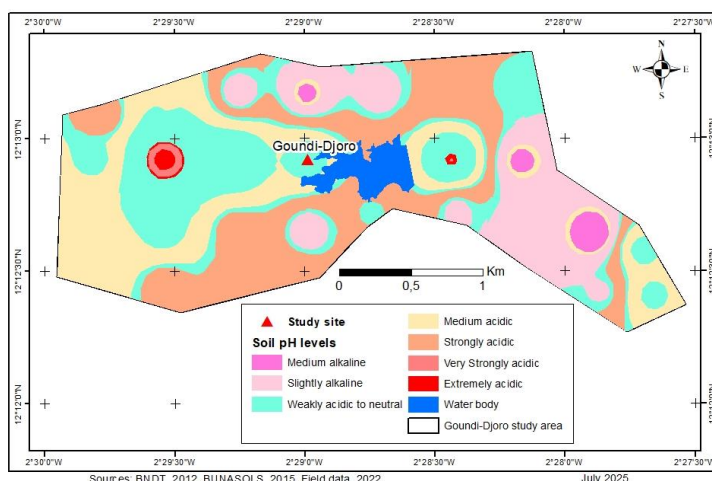


Fig. 5. Spatial distribution of pH classes in Goundi-Djoro soils

Table 4. Soil pH values by spatial distribution

Classes	Area in ha	Percentage (%)
Medium alkaline	20,48	3,89
Slightly alkaline	22,54	4,28
Weakly acidic to neutral	83,19	15,8
Medium acidic	39,49	7,5
Strongly acidic	152,30	28,93
Very Strongly acidic	145,12	27,56
Extremely acidic	63,4	12,04
Total	526,52 ha	100%

Source: Field data, June 2022

Farmers' perceptions of soil acidity

The results of the survey show that 95.65% of farmers are aware of the acidity of the soils around the Goundi-Djoro lowland. These farmers base their assessment of soil acidity on a number of indicators. These include the presence of weeds on the soil, such as *Striga hermonthica* (82.60%), the outcropping of ferruginous armour (62.21%), the red color of the soil (56.52%), the absence of microorganisms (earthworms, termites) on the soil (78.26%), and the stunted or stunted state of the plants (51.30%).

Factors and consequences of soil acidity according to farmers

The process of soil acidity over time is called acidification. Soil acidity is linked to a number of factors. According to 86.95% of the farmers interviewed on the site, soil acidity is due to its nature. For them, "red" soils, i.e. tropical ferruginous soils, are more acidic than other types of soil. Other factors were mentioned by the growers surveyed. These included bush fires (85.21%), vegetation degradation (64.34%) and excessive use of chemical NPK fertilizers (68.70%). Goundi-Djoro farmers also perceive the consequences of soil acidity. According to them, it leads to soil impoverishment and lower agricultural yields.

Farming practices to reduce soil acidity

Farming practices to reduce soil acidity at the Goundi-Djoro site are part of the process of restoring soil fertility. Thus, 94.09% of farmers surveyed use compost/manure, 87.73% have chosen zai improved with manure, 67.73% use mineral fertilizers (NPK and urea) and 43% have opted for mulching.

Discussion

Strongly, very strongly and extremely acidic pH soils

The results indicate that Goundi-Djoro soils are strongly acidic, with an average pH of 5.45. The combination of strongly, very strongly and extremely acidic classes represents 70.37% of the delimited area. These results are similar to those of Konkobo & al, (2022) and Hassimiou Hali-dou & al, (2020). Research by Biaye & al, (2021) also reported high soil acidity in rice fields in the commune of Mlomp, Senegal, with pH values ranging from 4.4 to 5.9. The results of the present study also confirm those of Hodomihou & al, (2011) in the Niaouli lowland in southern Benin and those of Mbonigaba & al, (2009) in Rwanda.

Medium acidic, weakly acidic to neutral, slightly alkaline and Medium alkaline pH soils

The results of the present study show that the tropical eutrophic brown soils of Goundi-Djoro are moderately acidic, with an average pH of 6.62. This class represents 7.40% of the study area. However, weakly acidic to neutral, slightly alkaline and moderately alkaline soils are poorly represented, accounting for 14.82%, 3.70% and 3.71% of the mapped part of the site respectively. These results are in line with those of Segda & al, (2014) who found a weakly acidic to neutral pH (6.6) in eutrophic brown soils from Bagré (Burkina Faso). This result is also similar to that of Da et al, (2008). These authors found weakly acidic to neutral pH values of 6.2 and 6.24 in the lowland and depression soils respectively. These results are also in line with those obtained in the humid tropical domain as in Benin and Côte d'Ivoire. Indeed, the work of Kimba (2014) showed that the soils of the Houéli-Gaba lowland in Benin are weakly acidic to neutral. In central Côte d'Ivoire, research by Akassimadou & Yao-Kouamé (2014) found moderately acidic pH values (5.5) in the lowland soils of the M'be II valley.

Farmers' perception of soil acidity

The results of the survey show that farmers are well aware of the acidity of the soils around the Goundi-Djoro lowland. Their perceptions are based on a number of biopedological indicators, such as the presence of weeds on the soil like *Striga hermonthica* (82.60%), the outcrop of ferruginous armourstone (62.21%), the red color of the soil (56.52%), the absence of microorganisms (earthworms, termites) on the soil (78.26%) and the stunted or stunted state of the plants (51.30%). These results are similar to those of Sakandé & al, (2022), in the provinces of Tuy and Mouhoun and Ouedraogo et al, (2022) in the locality of Samandeni, Burkina Faso.

Factors and consequences of soil acidity according to farmers

Soil acidity is caused by several factors. Soil type (86.95%), bush fires (85.21%), vegetation degradation (64.34%) and excessive use of chemical NPK fertilizers (68.70%) are the main factors in soil acidity cited by Goundi-Djoro farmers.

With regard to soil type, the results of the study show that lithosols on cuirass (LC), less evolved soils (PEEL, PEACM) and tropical leached ferruginous soils (FLIS, FLIPP and FLC) are

more acidic than tropical eutrophic brown soils (BEPE, BEF, BEH), which are moderately acidic and slightly acidic to neutral. Thus, according to Koulibaly & al, (2014) and Konfé & al, (2019), the iron and aluminum contained in ferruginous soils are the sources of their acidity. Similarly, soil acidity, particularly in surface horizons, is thought to be linked to the excessive use of mineral fertilizers-NPK, Urea-, (Konfé & al., 2019, Konkobo & al., 2022). In addition, the work of Biaye & al. (2021) has shown that the degradation of vegetation cover in the rice fields of Mlomp (Senegal) is one of the factors contributing to soil acidity. The presence of vegetation promotes biological activity and the supply of nitrogen and organic matter to the soil. Nitrogen and organic matter improve soil pH, helping to reduce acidity.

The farmers of Goundi-Djoro also perceive the impact of soil acidity. These include soil impoverishment and reduced agricultural production. This shows that water pH plays a major role in soil quality. It influences the availability of nutrients, necessary for plant growth (BUNASOLS, 1990, Ballot & al., 2016). Under these conditions, high soil acidity is a major constraint to crop development, particularly rice cultivation (Biaye & al., 2021). A high level of soil acidity leads to a reduction in nitrogen and phosphorus levels, which are essential for plant growth (Mbonigaba & al., 2009). For this reason, Koulibaly & al, (2014) indicate that the acidity of cultivated soils is one of the causes of lower agricultural yields.

Farming practices to reduce soil acidity

Farming practices to reduce soil acidity at the Goundi-Djoro site are part of the process of restoring soil fertility. Thus, 94.09% of farmers surveyed use compost/manure, 87.73% have opted for zaï improved with manure, 67.73% use mineral fertilizers (NPK and urea) and 43% have opted for mulching.

Scientific studies have shown that excessive use of chemical fertilizers (NPK, urea) increases soil acidity, whereas the use of organic fertilizers can raise soil pH levels and reduce acidity. For example, the results of the experiment by Konfé & al. (2019) show that soils treated with liquid organic fertilizer (turbobio) had higher pH levels than those treated with mineral fertilizers (NPK, urea). This was due to the fixation of iron and aluminum (sources of soil acidity) by the organic matter contained in the liquid organic fertilizer. In addition, this organic matter increased exchangeable bases, which in turn boosted pH values.

Conclusion

The study reveals that the soils around the Goundi-Djoro lowlands on the granitoid bedrock are highly acidic, with an average pH of 5.45 and a median pH of 5.16. This soil acidity is linked to the nature of the soil, vegetation degradation, a lack of organic matter in the soil, and the excessive use of mineral fertilizers. The level of soil acidity is therefore a cause for serious concern. Aware of this situation, farmers in low-lying areas have adopted cultivation techniques aimed at correcting soil pH. They use organic manure or compost, either by spreading it on the soil or burying it. These organic fertilizers help reduce soil acidity and promote the dissolution of nutrients essential for agricultural production. Farmers are implementing other agricultural practices. These include the use of natural phosphate, vegetated stone barriers, mulching, and crop rotation. These practices boost biological activity, supply the soil with nitrogen and organic matter, and correct soil pH levels.

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