LANDS EVALUATION IN HYDROMORPHIC ENVIRONMENT : CASE OF DEVELOPED RICE LOWLAND SOILS IN THE PROVINCE OF ZIRO, BURKINA FASO.

ABSTRACT

Sustainable soil management became a major concern for rice farming in Burkina Faso. Rained rice production offers potential thanks to the national rice policy oriented towards the developing of lowlands. However, effective soil fertility management through the promotion of good agricultural practices is essential in this agricultural area to meet the goal. It involves the evaluation of the land, as it can provide important information on which to base rational decisions on land management. A study was carried out in order to promote soil fertility sustainable management on two rice-growing lowlands in the province of Ziro. The soils of the sites were characterized and sampled for the physicochemical parameters analysis. The suitability of the soils for rice cropping was thus assessed. It emerges from the study that the dominant soils in the developed rice lowlands are hydromorphic soils. The hydromorphic soils are suitable types of soils for rice production. The results on the physical parameters show that the soils of the lowlands mainly have a coarse surface texture. The organic matter content is low and the pH values vary from weakly to very strongly acidic. The useful soil water reserve is medium to high. The contents of the major nutrients (N, P and K) are very low as are the values of the CEC, which indicates a low level of chemical fertility of the soils according to the complete range. The evaluation of rice lowlands revealed that soils are moderately suitable for rice production and their major constraint is the availability of nutrients. Current producer practices related to soil fertility management are unfavorable to sustainable land management. The study shows the need for appropriate crop fertilization, better management of crop residues and periodic monitoring of fertility essential parameters for the sustainability of soil productivity.

Keywords *Rice lowlands*, soil quality, land assessment, Burkina Faso

1. INTRODUCTION

In Burkina Faso, as in other countries in the West Africa region, rice, once considered as a luxury food, has become a staple food for all segments of the population. The annual consumption is exceeding 400,000 tons and growing at a rate of around 5.6% per year (MASA, 2013). Among the cultivated cereals, rice ranks fourth after sorghum, millet, and maize in terms of both area and production (INERA, 2008). It is the most widely cultivated cereal in the world, with nearly 150 million hectares (Ahmadi et al., 2002), and constitutes a food source for more than 40% of the world's population (ADRAO, 1996).

However, the study carried out by Djané in 2009 showed that national rice production is far from keeping up with the evolution of consumption. Recently, the demand for rice is estimated at 840,000 tons per year, for an average annual national production of 324,611 tons between 2010 and 2019 and it is expected that the national demand could reach 1,500,000 tons by 2025 (Koutou et al., 2021). As a result, Burkina Faso is increasingly importing massive quantities of rice to fill the national production deficit. This resulted in significant outflows of foreign currency, around 40 billion CFA francs for 2006 alone (Yaméogo, 2007; INERA, 2008). So, actions must be taken, otherwise this hemorrhage of currencies could harm the development of our already fragile economy.

In these conditions, the increase in the national rice production becomes a priority for the country. This is why the government of Burkina Faso has developed, to boost the rice sector (DGPER, 2010), plans, programs and projects through hydro-agricultural developments (developed perimeters and lowlands) (MAHRH, 2011). Among the actions undertaken, we note the Project for the Rehabilitation of Dams and the Development of Perimeters and Lowlands (PRBA) in the provinces of Boulkiemdé, Sanguié, Ziro and Balé. The PRBA has therefore developed five lowlands in the province of Ziro to contribute to the increase in national rice production and the increase in the income of producers.

However, the development of lowlands and irrigated perimeters that can contribute to increasing rice production are unfortunately limited by their very high implementation costs (Segda et al., 2014). It would then be necessary to optimize the management of the already developed perimeters and lowlands. Indeed, authors have already pointed out that the yield in rainfed rice cultivation can be greatly improved as the yields achieved are still very far below the potential or achievable yields (Wopereis et al., 2001; De Vries et al., 2011). The production potential of lowland rice (production only limited by the climate and the performance of the variety used) in Burkina Faso can reach 5-7 t/ha, but the current average yields are 1.5-2 t/ha (Traoré, 2016), i.e. less than 50% of the potential of the area and that of the rice varieties cultivated (De Vries et al., 2011).

The weakness of the productivity of the lowland rice fields would be linked to several constraints, including the decline in soil fertility and the non-compliance with technical itineraries (Dakouo, 2010). In addition, the soils in Burkina Faso are poor in organic matter, nitrogen, and phosphorus (Bationo, 1998; Segda et al., 2014). Furthermore, the soils of the rice fields generally have a very variable chemical functioning due to the variation in hydromorphic conditions, which is favorable to the proliferation of certain diseases and various toxicities (ferrous toxicity) (ADRAO, 2006).

It is then shown that agricultural production, especially that of rice, is particularly dependent on the characteristics of the land (Morelle and Lejeune, 2000). To do this, it is essential to know the cultural suitability of the soils of the developed perimeters in order to propose a scheme for their sustainable management with a view to preserve the well-being of the beneficiary populations (Manzelli et al., 2015). The evaluation of land produces adequate results that assist in decision-making, as it remains one of the main studies that provides important information on which rational decisions for sustainable management of soil resources will be based (determination of land use patterns, input requirements...) (FAO, 2007).

The mainl objective of this work is to contribute to good productivity and sustainable valorization of lowland rice fields. The specific objectives are:(i) to carry out a morphological and physico-chemical characterization of the soils of the lowlands; (ii) to evaluate, using soil quality indicators, the suitability of the lands of the developing lowlands.

MATERIAL AND METHODS

Sites of the study

The study was conducted in the province of Ziro, in the Central-West region of Burkina Faso. It involved two (2) rice-growing lowlands distributed in two (2) communes of the province. These are the lowlands of Tékourou (33.42 ha) in the commune of Gao and Boulé (32.67 ha) in the commune of Bakata. Figure 1 indicates the location of the lowlands in the province of Ziro. The Ziro province has a rainfall regime which varies depending on the latitude. Most of the North is subject to a North Sudanian type climate while the southern part of the province is in the South Sudanian type. During the last ten years (2011 to 2020), the quantities of water recorded have varied depending on the study sites. In the commune of Gao, the average quantity of water recorded over the last ten years was 874.2 mm compared to 923 mm of water in Bakata.

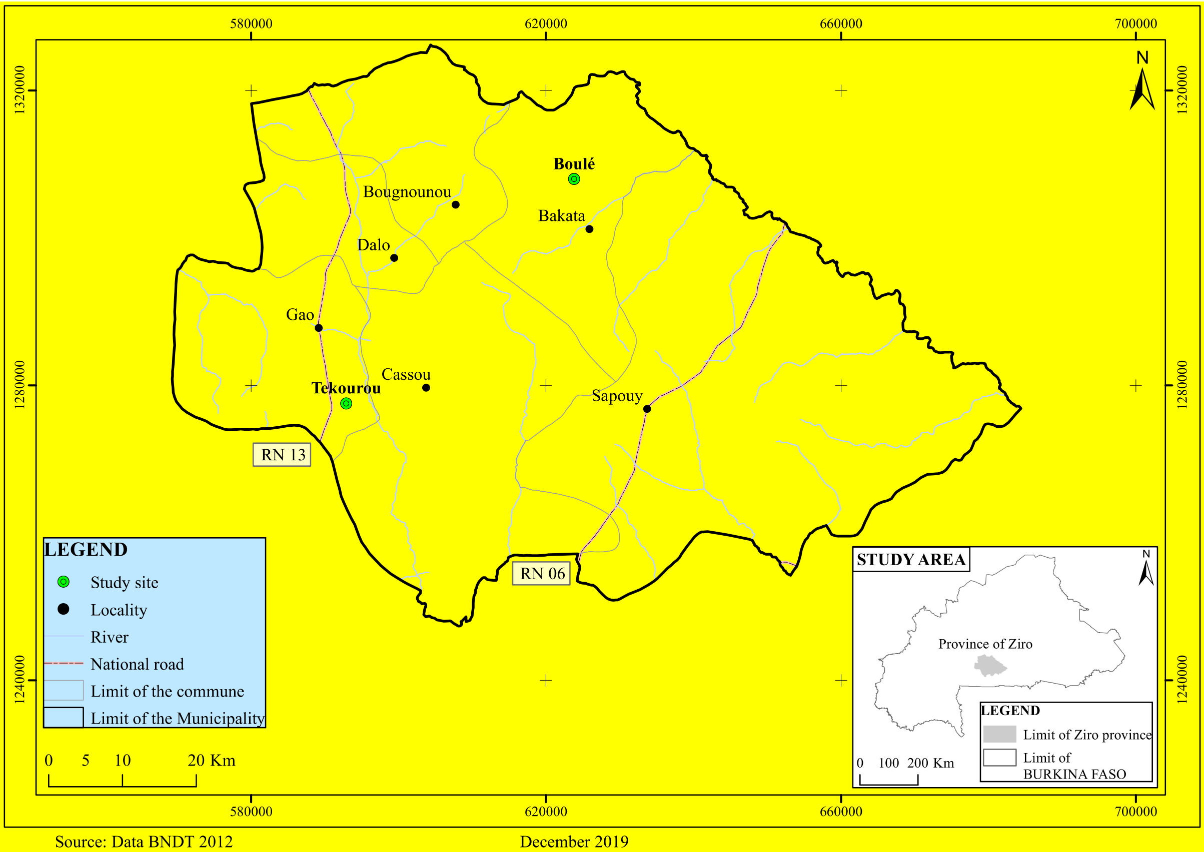

Figure 1: Study sites location in the province of Ziro

Experimental details

Soil prospecting

A field trip was carried out to characterize the soils of the lowlands. The method of the prospecting adopted is that of the systematic grid. The scale of the study was 1/10,000 with a density of one observation per hectare. The pits were opened using picks and shovels. They were described according to the FAO guidelines (1994). The soil colors were determined using the MUNSELL code or “Soil Color Charts” version 1994. The soil classification was that of the Commission of Pedology and Soil Cartography (CPCS, 1967). Correlations with the WRB (2014) were established.

Soil samples taking for laboratory analysis

The number of sampling points retained is 20 per lowland, or 10 per soil unit. According to the systematic grid, the coordinates of the sampling points were previously generated using ArcGIS software and integrated into a GPS to allow their identification in the field. Soil cores taken from each suitability unit or soil type were mixed and homogenized in a plastic bucket to obtain a composite sample of approximately 500 g. The composite samples collected were packaged in labeled plastic bags and sent to the laboratory for analysis.

Physico-chemical analysis of soil samples in the laboratory

The following relevant parameters were determined: particle size in 3 distribution, pF 2.5, 3.0 and 4.2, organic matter content, total nitrogen, pHwater, total phosphorus, assimilable phosphorus, total potassium, available potassium, cation exchange capacity, exchangeable bases (Ca^{2+}, Mg^{2+}, K^+ and Na^+) and electrical conductivity. Total organic carbon was determined by the Walkley and Black method (1934). The soil samples were first mineralized by the KJELDAHL method, which consists of attacking the sample with boiling concentrated sulfuric acid in the presence of a selenium-copper catalyst for nitrogen determination. The determination of total P was done by automatic colorimetry and the assimilable P by BRAY 1method.The dosage of total and available potassium were determined with a flame photometer by comparing the intensities of the radiation emitted by the K atoms with those of the standard solutions. The exchangeable cations were displaced from the adsorbent complex by a solution of silver nitrate ($AgNO_3$) and thiourea (H_2NCSNH_2). The Ca^{2+} and Mg^{2+} cations were measured using the atomic absorption spectrometer, then Na+ and K+ using flame emission. The Cation exchange capacity was measured from the extraction solution of exchangeable bases. The measurements of pH values were made by the electrometric method using an electrode pH meter and the electrical conductivity using a conductivity meter.

Assessment of lowland lands

It consisted of comparing the requirements of the rice cropping to the qualities or morphological and analytical characteristics of the soil. The rice cultivation requirements retained were obtained from the land evaluation manual (BUNASOLS, 1990). The relevant qualities retained and which are involved in the assessment of land for the type of use envisaged are: the thermal regime (c), the availability of water (m), the availability of nutrients (n), the availability of oxygen (w), rooting conditions (r), erosion risk (e), land degradation risk (d).

Data analysis and processing

The data from the analyzes were interpreted according to international standards FAO (1976) adapted by BUNASOLS to the agro-ecological conditions of Burkina Faso and contained in technical documentation n°6, "Manual for land evaluation" (BUNASOLS, 1990).

3. RESULTS AND DISCUSSION

. RESULTS

Types of soils in the Boulé lowland

The pedological study of the Boulé lowland highlighted two (02) subgroups of soils from the class of iron and manganese sesquioxide and the class of hydromorphic soils. Each subgroup corresponds to a cartographic unit. These are the subgroups of hydromorphic leached tropical ferruginous soils (WRB: Eutric Endo-Gleyic Lixisols) and low-humidity hydromorphic soils with surface pseudogley (WRB: Orthieutric Gleysol).

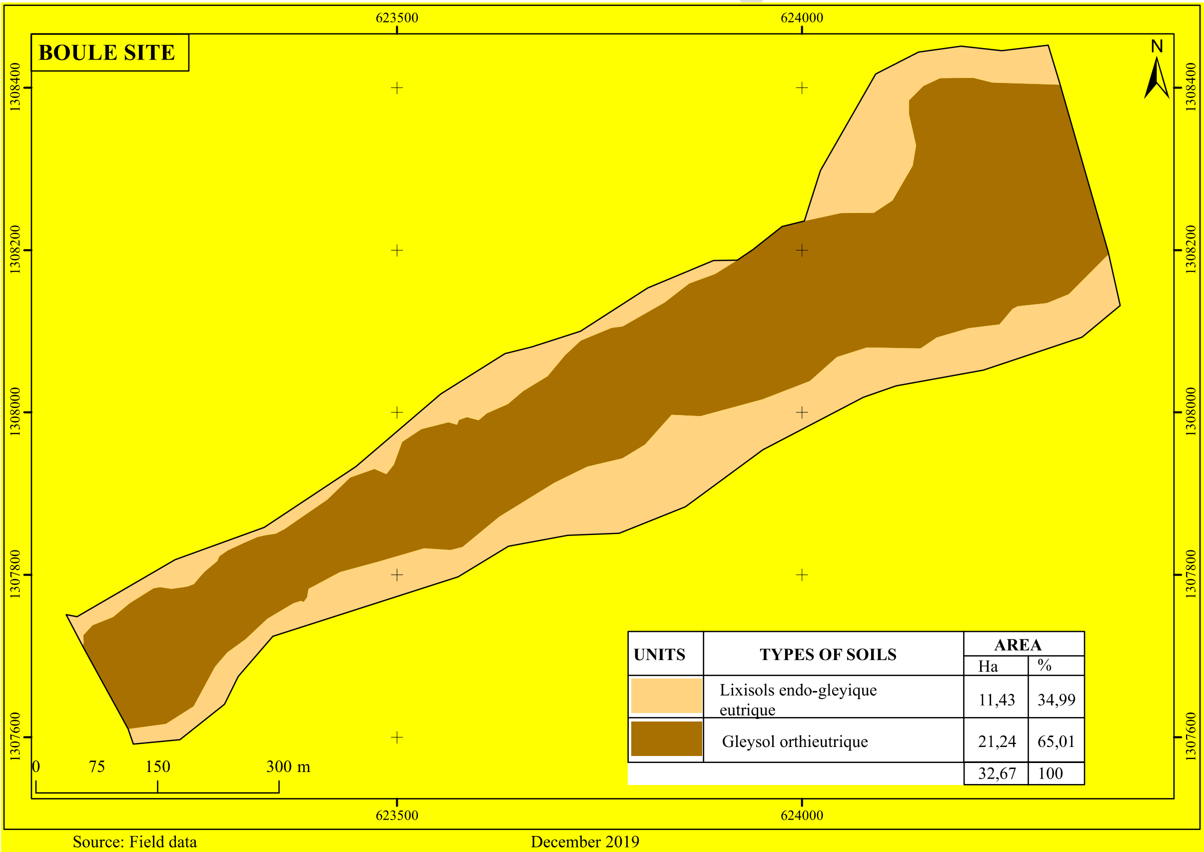

Figure 2: Soils of Boulé lowland

The leached tropical ferruginous soils (WRB: Eutric Endo-Gleyic Lixisols) are deep (depth > 60 cm) and are characterized by the presence of redox mottles and a few friable iron-manganese concretions at depth. The friable appearance of the concretions as well as the presence of numerous mottles indicate the manifestation of a semi-permanent hydromorphic condition at depth. These soils were encountered on both slopes of the lowland. The color of the matrix varies from grayish brown (10 YR 5/2) at the surface to light gray (10 YR 7/2) in the intermediate horizons and very pale brown (10 YR 7/3) at depth. The texture is silty clay loam (LAS) at the surface, clay loam (AL) in the intermediate horizons, and clayey (A) at depth. Redox mottles of yellowish brown (10 YR 5/8) and light gray (10 YR 7/1) color were observed at depth at a concentration of about 10 to 20%. The structure is weakly developed subangular blocky with medium and coarse fine elements throughout the profile. The root system is quite well developed with fine, very fine, and medium-sized roots. The consistency is slightly firm overall. Roots are abundant in the surface horizons and quite abundant at depth. Drainage is normal in the first 50 centimeters and moderate beyond. Biological activity is well developed throughout the solum.

The low-humidity hydromorphic soils with surface pseudogley (WRB: Orthieutric Gleysol). are also deep soils (> 60 cm) and characterized by the presence, at depth, of fairly well individualized pseudogley and fairly significant redox spots. This type of soil essentially occupies the central zone of the bottomland along its entire length. On all the soil pits carried out, the color of the matrix varies from gray (10 YR 6/1) on the surface, to light brownish gray (10 YR 6/2) in the intermediate horizons, and brown (10 YR 5/ 2) in depth. The texture is clayey-silty (AL) on the surface and clayey (A) at depth. Rusty spots are visible on the surface while yellowish brown (10 YR 5/8), light gray (10 YR 7/2) and black (10 YR 2/1) spots are observed at depth. These spots are quite numerous (around 20%) over the entire pit. The structure is weakly developed subangular polyhedral with medium fine and coarse elements. Biological activity is well developed in the surface horizon and weakly developed at depth.

Analytical characteristics

The two soil units of the Boulé site named ZBB1 and ZBB2 present textural heterogeneity, namely medium and fine for ZBB1 and ZBB2 respectively (Table 1). The same trend is observed for the useful water reserve which is high in unit ZBB1 and very high in the unit ZBB2. The organic matter contents are also disparate in the two units, including low levels for ZBB1 and medium levels for ZBB2 (table 1). The soils of the site are poor in nitrogen and total potassium and very poor in assimilable phosphorus as well as available potassium. Regarding total phosphorus, its contents are medium (ZBB1) to high (ZBB2) (table 1). The sum of the bases indicates low values while the cation exchange capacity is very low whatever the unit considered. The saturation rate is high in unit ZBB1 and medium in unit ZBB2 while the pH is moderately acidic overall (Table 1). The soils are non-saline in accordance with the recorded electrical conductivity values. The current fertility level varies according to the two units of the site with low levels for ZBB1 and medium for ZBB2 (table 1).

Table 1: Analytical results of Boulé site

		ZBB1		**ZBB2**	
		Values	Appreciation	Values	Appreciation
Soil organic matter (%)		0.657	Low	1.083	Medium
Nitrogen (%)		0.04	Low	0.055	Low
Phosphorus	Available (ppm)	3.92	Very low	4.74	Very low
	Total (ppm)	329	Medium	512	Hight
Potassium	Available (ppm)	10.1	Very low	10.95	Very low
	Total (ppm)	630	Low	882	Low
CEC ($cmol^+/kg$)		3.33	Very low	7.43	Very low
Base saturation rate (%)		61	Hight	59	Medium
Sum of base ($cmol^+/kg$)		2.03	Low	4.41	Low

(pH water)		6.05	Weakly acidic	5.65	Weakly acidic
Ratio C/N		10	Normal	11	Normal
Electric conductivity (dS/m)		0.21	Not saline	0.1	Not saline
Useful water reserve (%)		8.71	Hight	21.32	Very Hight
Texture	Clay (%)	23.92	Medium	46.76	Fine
	Silt (%)	7.45	Silty-clay-sand)	40.26	(Clay-
	Sand (%)	68.63		18.98	Silty)
Level of soil fertility		25.75	Low	27	Medium

Source: Land Use Analysis Results, 2023

Types of soils in the Tékourou lowland

In the Tékourou lowland, three (03) cartographic units were identified. They correspond to the subgroups of soils belonging to the class of hydromorphic soils and to the class of iron and manganese sesquioxide soils according to the CPCS classification (1967). The three subgroups of soils encountered are:

- moderately deep leached indurated tropical ferruginous soils (WRB: Endopetroplinthic-ferric Lixisol);
- leached tropical ferruginous soils with stains and concretions (WRB: Ferric Gleyic Lixisol);
- low-humid hydromorphic soils with surface pseudogley (WRB: Orthieutric Gleysol). Figure 3 shows the soil types of the Tékourou lowland.

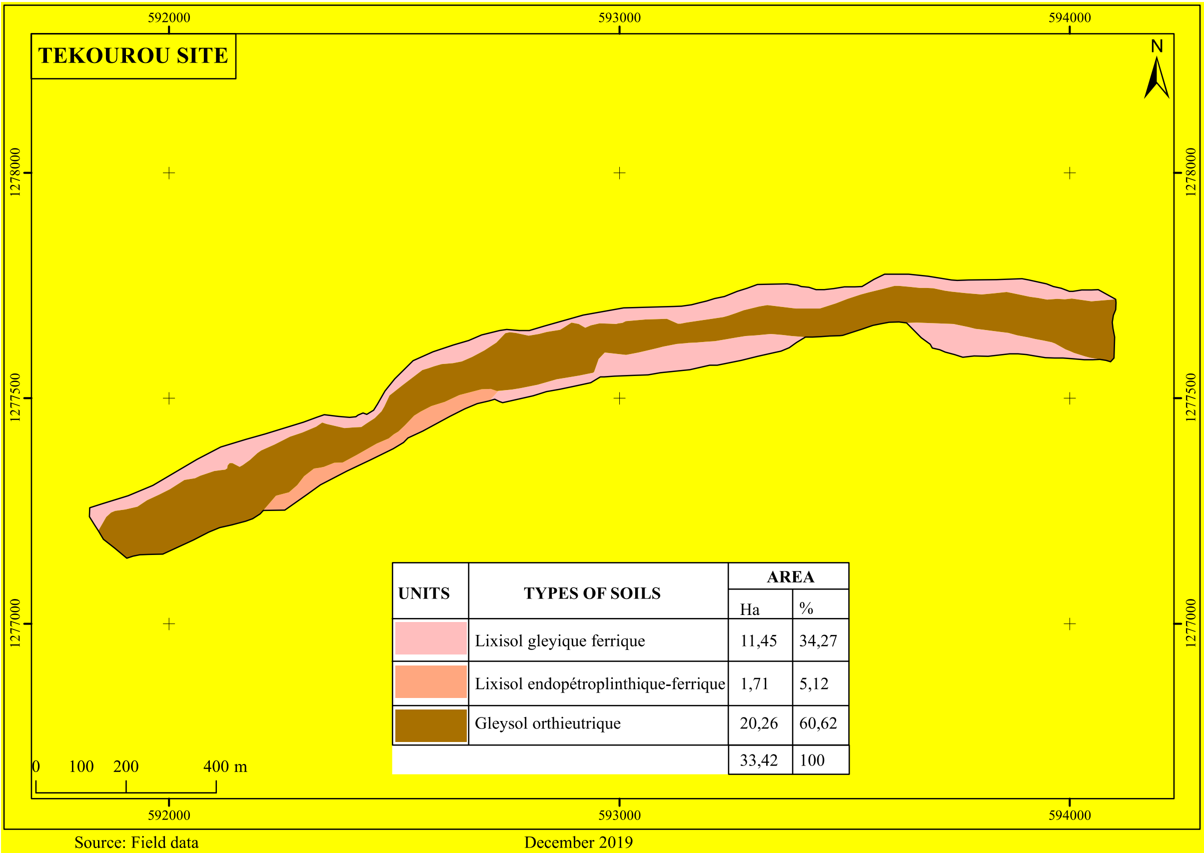

Figure 3: Soils of Tékourou lowland

The moderately deep leached indurated tropical ferruginous soils (WRB: Endopetroplinthic-ferric Lixisol) are soils whose depth is limited by a ferruginous crust (40 to 60 cm). They were encountered on the northern slope.The color of the matrix varies from dark brown (10 YR 3/3) on the surface to dark yellowish brown (10 YR 3/6) at depth. Light yellowish-brown spots (10 YR 6/4) are visible at depth. The texture is loamy-sandy (LS) on the surface and loam-clay-sandy (LAS) at depth. The structure is weakly developed subangular polyhedral with medium and fine elements. The gravelly load includes ferruginous and ferro-manganic concretions, the percentage of which is approximately 15% on the surface and 30% at depth. The consistency is crumbly and the pores are numerous. The roots are also numerous. Biological activity is well developed throughout the solum.
The leached tropical ferruginous soils with stains and concretions (WRB: Ferric Gleyic Lixisol) are deep soils (>60 cm) characterized by the presence of numerous ferruginous concretions at depth. The color of the matrix varies from pale brown (10 YR 6/3) on the surface to grayish brown (10 YR 5/2) in the intermediate horizons and strong brown (7.5 YR 5/6) at depth. Gray spots (10YR5/1) are observed in the last 67 centimeters at rates varying between 5 and 10%. The texture is loamy-sandy and loamy-clayey, respectively in the first and second horizon. It is clayey on the last two. The contents of ferruginous and ferro-manganic gravels are between 10 and 15% for the first and the last two horizons. On the other hand, the second horizon records 30% of these elements. The structure is weakly developed, subangular polyhedral up to 88 cm and massive beyond. The consistency is not firm overall. The roots are numerous in the surface horizons and quite numerous at depth. Activity is well developed throughout the solum.
The low-humid hydromorphic soils with surface pseudogley (WRB: Orthieutric Gleysol) are also deep soils (>60 cm) and characterized by the presence, at depth, of fairly well individualized pseudogley and fairly significant redox spots. This type of soil essentially occupies the central zone of the bottomland along its entire length. The matrix color varies from brown (10 YR 5/3) on the surface and in the intermediate horizons to
light grayish brown (10 YR 4/2) in depth. The texture is silty-clay-sandy (LAS) on the surface, clayey-silty (AL) in the intermediate horizons and clayey (A) at depth. Rusty spots are visible only on the surface while yellowish brown (10 YR 5/8), light gray (10 YR 7/2) and black (10 YR 2/1) spots are visible in

depth. These spots are few in number (around 15%) over the entire pit. The structure is weakly developed subangular polyhedral throughout the solum, with a not very firm consistency. The gravel load is zero. These soils have fairly good porosity and fairly abundant root development. Biological activity is well developed in the surface horizon and weakly developed at depth.

Analytical characteristics

The Tékourou site also presents textural heterogeneity on the two units ZGT1 and ZGT2 (coarse on the unit ZGT1 and medium for ZGT2) as indicated in Table 2. The useful water reserve is medium in unit ZGT1 and very high in unit ZGT2 (Table 2). The level of organic fertility is low overall. The C/N ratio is normal in both units, which reflects good decomposition of organic matter. The soils of the site are poor in nitrogen, total potassium and assimilable phosphorus and very poor in available potassium. Regarding total phosphorus, it indicates medium levels in unit ZGT1 and high levels in the second unit (table 2). The sum of the bases presents low values for the entire site while the cation exchange capacity is very low (table 2). The saturation rate is medium while the pH is strongly acidic in unit ZGT1 and very strongly acidic in unit ZGT2. Electrical conductivity values indicate that the soils at the site are non-saline. The current level of fertility is overall low (Table 2).

Table 2: Analytical results of Tékourou site

		ZGT1		ZGT2	
		Values	Appreciation	Values	Appreciation
Soil organic matter (%)		0.548	Low	0.664	Low
Nitrogen (%)		0.027	Low	0.04	Low
Phosphorus	Available (ppm)	6.53	Low	2.27	Very low
	Total (ppm)	256	Medium	402	Hight
Potassium	Available (ppm)	6.74	Very low	8.84	Very low
	Total (ppm)	504	Low	756	Low
CEC ($cmol^+/kg$)		3.46	Very low	4.14	Very low
Base saturation rate (%)		57	Medium	57	Medium
Sum of base ($cmol^+/kg$)		1.96	Low	2.36	Low
(pH water)		5.5	Weakly acidic	4.55	Very acidic
Ratio C/N		12	Normal	10	Normal
Electric conductivity (dS/m)		0.15	Not saline	0.21	Not saline
Useful water reserve (%)		9.02	Medium	14.23	Medium

Texture	Clay (%)	11.76	Coarse (Silty-sand)	22.54	Fine (Clay-Silty)
	Silt (%)	21.57		4.35	
	Sand (%)	66.67		73.11	
Level of soil fertility		24.75	Low	23.5	Low

Source: Land Use Analysis Results, 2023

Suitability of lowland soils for rice cultivation

The soils of the Boulé lowland (leached hydromorphic tropical ferruginous soils and hydromorphic soils with little humus with surface pseudogley) have on the whole a medium suitability for the practice of rice farming (S2n) while having an availability constraint in nutrients (table 3).

Table3: Suitability of Boulé lowlands

Land quality / Soil types	Nutrients availability (n)	Water availability (m)	Oxygen availability (w)	Rooting conditions (r)	Rice cropping suitability
The leached tropical ferruginous soils	S2	S1	S1	S1	S2n
The low-humidity hydromorphic soils with surface pseudogley	S2	S1	S1	S1	S2n

Source: Land Use Analysis Results, 2023

Two of the three types of soils inventoried in the Tékourou lowland, leached tropical ferruginous soils with stains and concretions and hydromorphic soils with little humus and surface pseudogley, present a medium suitability for rice production (S2n and S2nm respectively) (table 4). These indicated soils have in common a nutrient limitation but also a water availability constraint only for tropical ferruginous soils leached with stains and concretions. Regarding medium-deep leached indurated tropical ferruginous soils, they are marginally suitable for rice cultivation due to the limited useful depth, the high gravel load but also the coarse texture on the surface (table 4). They present constraints similar to those of tropical ferruginous soils leached with stains and concretions.

Table4: Suitability of Tékourou lowlands

Land quality / Soil types	Nutrients availability (n)	Water availability (m)	Oxygen availability (w)	Rooting conditions (r)	Rice cropping suitability
Leached tropical ferruginous soils	S2	S3	S1	S1	S3nm
Hydromorphic soils	S2	S2	S1	S1	S2nm
Medium-deep leached indurated	S2	S1	S1	S1	S2n

tropical ferruginous soils	

Source: Land Use Analysis Results, 2023

DISCUSSION

Lowland soil types

The study of the lowlands essentially revealed three pedological units according to the CPCS, namely low-humidity hydromorphic soils with surface pseudogley, leached hydromorphic tropical ferruginous soils and leached tropical ferruginous soils with spots and concretions. According to Zombré (1993) the three types of soils highlighted by this study are dominant in the lowlands. These soils are characterized by riparian vegetation (*Mitragina inermis*, *Anogeissus leiocarpus*, *Ficus sycomorus* sub-species *gnanphalocarpa*, *Cercocephalus latifolia*, *Mimosa pigra*) but also by hydraulic functioning which links the topography. According to Lawson (2001) the two elements indicated fundamentally characterize the lowlands. In the lowlands, the coarse texture is found in most cases in the lateral parts while the medium and fine textures are observed in the central parts of the lowlands. This observation confirms the work of Lavigne et al (1996) who showed that there is no typical texture of lowland soil and that any range of textures can be encountered there.

Physico-chemical characteristics of lowland soils

In the lowlands, the dark colors (grayish brown and brownish gray) of the surface horizons observed would be linked to the presence of organic matter but also a temporary hydromorphy induced by an oscillating water table. Hydromorphy appears in mapped lowland soils as rusty and grayish spots. Low-humid hydromorphic soils with surface pseudogley also have pale or whitish gray spots (pseudogley). These same observations were made by Fournier (1998) in a diagnostic study of Sudano-Sahelian lowlands. Across all the lowlands, 60% of the soils have a coarse texture (sandy-loamy or sandy-loamy) making them filtering and not allowing the maintenance of a layer of water. However, CIRAD-GRET (2009) indicates that in rainfed cultivation, rice requires soil rich in nutrients, a fine texture (loamy-clayey, clayey-sandy, clayey-loamy), to medium (loamy and loamy-clay-sandy).

The low clay contents observed in the soils could explain the medium values of the useful water reserve recorded. These results agree with those of Somé and Dembélé (1991) who proved that the lower the proportion of fine elements in the soil, the lower the useful water reserve.The common point of the soils studied is that they all have pronounced deficiencies in nitrogen and phosphorus, which nevertheless constitute the basis of good productivity. This is also justified by the fact that the soils of Burkina are naturally poor in nitrogen and phosphorus. These results are consistent with those obtained by BUNASOLS (1988).

The pH analysis showed that the soils are acidic. This can promote the presence of exchangeable aluminum which causes risks of aluminum toxicity for rice crops. The acidity of these soils can be explained by the intensive use of mineral fertilizers (92% of producers) compared to organic manure (8% of producers). Pernes-Debuyser and Tessier (2002) proved that considerable variations in pH are observed following the use of ammonia fertilizers leading to acidic plots with low CEC essentially saturated with aluminum cations.

The low level of potassium available in the lowlands could be linked to the acidification of the soils due to the loss of cations (Ca2+, K+, Mg2+, etc.) which would be replaced by the adsorbent complex by acid ions (H+). This is not specific to the soils of the sites studied but concerns all soils in Burkina Faso as certain authors have highlighted (Peiri, 1989; Lompo et al. 2009).

The CEC values of the soils of the different lowlands are very low. The CEC varied from 3.33 to 7.47 (cmol+/kg) against the standard varying from 10 to 25 (cmol+/kg). It was very poor across all sites. This would be due to the low level of organic matter and clay observed in the different localities. These results confirm those obtained by "Alexandre et al., 2012" and "Koull and Halilat., 2016". Indeed, these different authors have shown that the CEC is closely linked to the level of organic matter and the level of clay in the soil. For rice production in Southeast Asia tropical soil, recent productivity gains were largely based on increasing the use efficiency of the applied nutrients through integrated and site-specific approaches (Becker et al., 2023).

Cultural suitability of soils for rice cropping

For all five lowlands, the majority (90%) of the soils have a medium suitability for rice production. The soil unit's low humus hydromorphic soils with surface pseudogley, leached hydromorphic tropical ferruginous soils and leached tropical ferruginous soils with spots and concretions are moderately suitable for rice cultivation with a major constraint being the availability of nutrients. In addition to the constraint of nutrient availability, tropical ferruginous soils leached with stains and concretions have another one linked to water availability.

CONCLUSION

Rational use of land constitutes an essential approach that can contribute to improving the productivity of developed lowland lands. This study contributed to a better knowledge of the morphological and physicochemical characteristics of the lowlands, their suitability for rice cultivation as well as the current management of soil fertility by producers.

The evaluation of the rice-cropping lowland lands revealed that the low-humid hydromorphic soils with surface pseudogley and the leached hydromorphic tropical ferruginous soils are moderately suitable for rice production and have as a major constraint the availability of nutrients. As for medium-deep leached indurated tropical ferruginous soils, they have a marginal suitability for rice cultivation given the useful depth limited by induration but also the high gravel load. The constraints linked to these soils are the availability of nutrients and water.

The study carried out could serve as a tool for improving the developments carried out by the PRBA in the sense that it could help to review the sizing of the sites which will take into account the suitability of the soil for rice production. It made it possible to establish the reference state of chemical soil fertility, which will guide decision-making regarding appropriate fertilization. This study will facilitate easy monitoring of the evolution of this fertility over time, a guarantee of sustainable land management in developed rice-cropping lowlands. The results provide recommendations for local governments regarding land management and support for farmers, such as organic fertilizer subsidies, training in land management techniques etc.

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