

#7579 SOIL FERTILITY MAPPING OF DRY SAVANNAH ZONE OF TOGO

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ABSTRACT

Increasing agricultural productivity, and therefore the production, requires a good knowledge of the soil fertility status and a sustainable nutrients management. The objective of this study is to map the spatial distribution of selected soil fertility parameters in the dry savannah agro-ecological zone that covers the regions of Savanes and Kara in Togo. Soil pH, available phosphorus (P), exchangeable potassium (K) and organic matter were determined in soil samples collected at 1000 m grid intervals (1/100 000). Based on the soil samples analysis data, GIS maps were designed using Arc GIS v10.5 software. The results showed that the soils in the area were slightly acidic ($5.5 < \text{pH} < 6.5$) while 62.5% of soils had low organic carbon levels ($< 2\%$). In the regions, the available phosphorus was low ($< 15 \text{ mg P/kg}$) in 94.3% of the agricultural soils. Exchangeable potassium was also low ($< 131 \text{ mg K/kg}$) in 97.5% of agricultural soils in this area. Results from soil samples tests showed a deficiency in the macro-nutrients (P and K) and a low organic matter content of the soils of the dry Savannah. Based on the soil fertility status determined, the crop needs and the environment conditions there is a need of reviewing the current fertilizer application rates recommended.

Keywords: Soil fertility maps, Dry Savannah, Togo

INTRODUCTION

Togo is mainly an agricultural country where agriculture employs about 70% of the active population. Although the agriculture, dependent on rainfall, it constitutes the main sector that drives the economy and the social development of the country. It is generally practiced by small farmers with low productivity due to various biophysical and low-level farming management constraints. Inadequate or poor rainfall distribution, and low levels agricultural soils in nitrogen (N) and phosphorus (P) greatly affect crop productivity (Bationo et al., 2003). Crop yields are generally limited as result of nutrients mining and soil fertility depleting due to inadequate or no fertilizer application, (Prabhavati et al., 2015). Soils are not only thirsty but also hungry (Wani, 2008).

Increasing agricultural productivity, and therefore production, requires a good knowledge of soil fertility status and land degradation indices at the national level. Unfortunately, Togo does not yet have maps on soil fertility status and the lack of a national soil information system limits land use planning for sustainable agricultural development.

With regard of the above-described situation of lack of soil fertility status, Togo have undertaken a study in 2017 with the objective of mapping the fertility of agriculture soils. This paper presents the results of the regions of Savanes and Kara located in the dry savannah agroecological zone of Togo.

MATERIALS AND METHODS

The Zone of Study

The agro-ecological zone of dry savannah in Togo comprising the regions of Savanes and Kara is located within 9 and 11° North and 0 and 1° East. The climate is of the Sudanian type characterized by two seasons, a rainy one from May to October and a dry one from November to April. The annual rainfall ranges from 600 to 1200 mm. Vegetation consists of vast grassy savannas.

Soil Sampling, Analysis and Mapping

Composite soil samples were collected on grid points of 1000 m interval (1/100,000) at 20 cm depth. A total of 10,849 samples were collected: 4,283 the region of Savanes and 6,566 in the region of Kara. Soil samples were air-dried and sieved using a 2 mm mesh sieve. pH and electrical conductivity were determined by Jackson, (1959) method, available phosphorus (P), exchangeable potassium (K) and organic matter (OM) were determined by the methods described by Olsen and Sommers (1982), Helmke and Sparks (1996) et Nelson and Sommers (1996) respectively.

Fertility maps were designed using ArcGIS 10th ed software and the inverse distance method for extrapolation.

Table 1. Soil fertility parameters classification

Nutrients	Fertility ratings				
	Very low	Low	Medium	High	Very high
Phosphorus (mg/kg)	< 8	8 - 15	15 - 23	23 - 30	> 30
Potassium (mg/kg)	< 90	90 - 131	131 - 170	170 - 200	> 200
Organic matter (%)	< 0,7	0,7 - 2	2 - 3,5	3,5 - 4,5	> 4,5
Soil reaction					
pH (H ₂ O)	< 5,5	5,5 - 6,5	6,5 - 7,5	7,5 - 8,5	> 8,5
	Acidic	Slightly acidic	Neutral	Slightly Alkaline	Alkaline

RESULTS AND DISCUSSION

Soil pH

Dry savannah soils are slightly acidic (85% of the soils, Figure 1) with an average pH value of 6.1 ± 0.5 (mean \pm standard deviation). This can be explained by the fact that most of the soils in the area are formed on acid parent materials (granite, gneiss, quartzite, etc.) (Lamouroux, 1969).

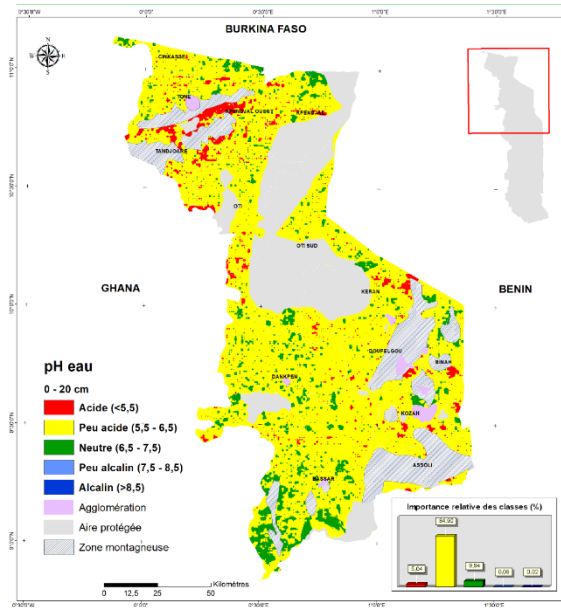


Figure 1. Soil pH distribution in dry savannah in Togo.

Organic Matter

The results revealed that soils in this area of Togo are poor in organic matter. About 63% has an organic carbon content less than 2% (Figure 2). This low soil organic matter content is due to the overuse of the soils for agricultural production without any adequate fertility management.

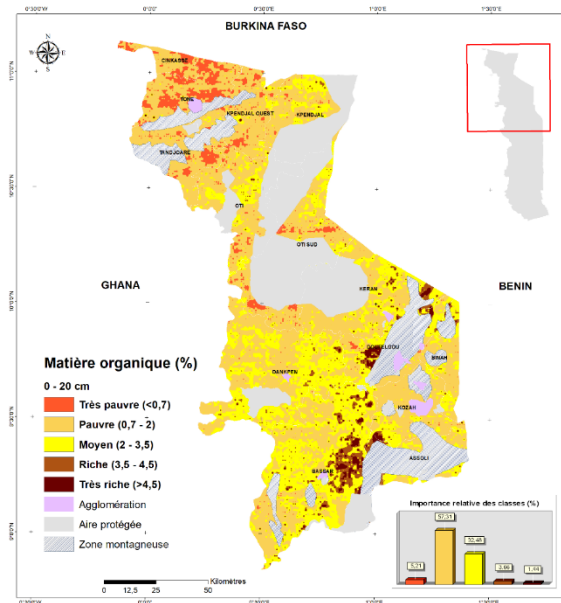


Figure 2. Soil organic matter distribution in dry savannah in Togo.

Available Phosphorus

The average available phosphorus content of dry savannah soils is 5.9 ± 6.3 mg P/kg. Figure 3 shows that 94.3% of the soils in the zone have a P content below 15 mg/kg. This P deficiency of the soils can be attributed to the native parent rock materials and to the overuse of the lands for agricultural production.

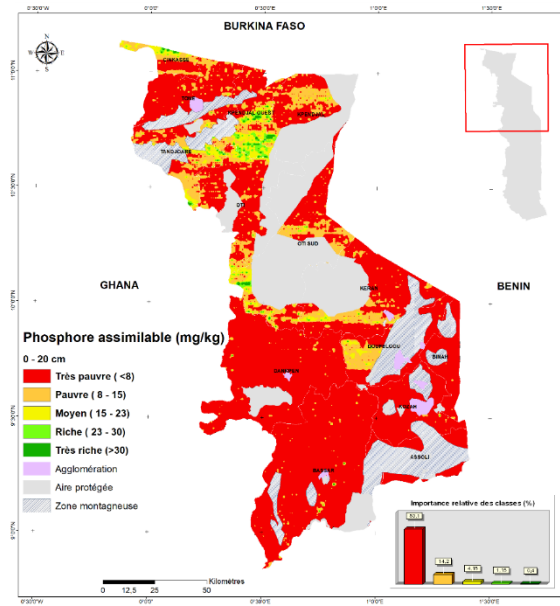


Figure 3. Map of the soil available phosphorus distribution in dry savannah in Togo.

Exchangeable Potassium

In general, the soils (97.5%) have a very low level of exchangeable potassium (< 131 mg/kg soil) with an average of 62.2 ± 50 mg K/kg soil. This low K content can be explained by a very low and partial release of potassium related to a relatively long and very marked dry season.

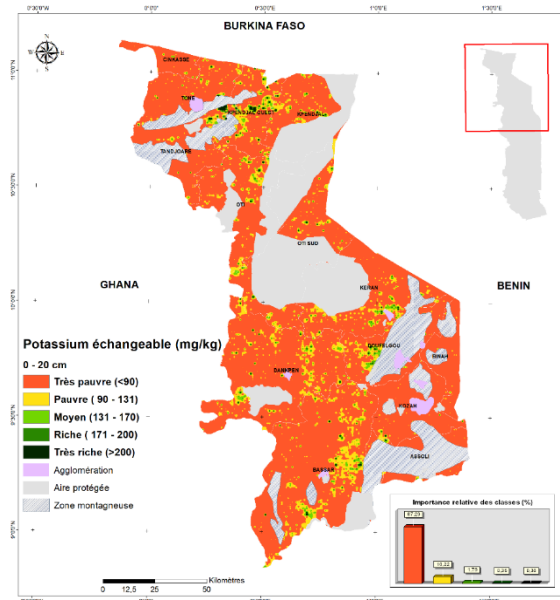


Figure 4. Map of the soil exchangeable potassium distribution in dry savannah in Togo.

CONCLUSIONS

The results of this study revealed a deficiency in the macro nutrients analyzed (P and K) in the dry savannah soils of Togo and a low organic matter content. With to this overall low

level of fertility of the agricultural soils in the studied areas, there is a need to review the current recommendations of fertilizer rates to be applied on crops. The new fertilization formula should take into consideration the soil fertility status, crop needs and the environment conditions.

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