ASSESSING SOIL FERTILITY IN COTTON CROPPING SYSTEMS UNDER CHANGING CLIMATE CONDITIONS IN CÔTE D'IVOIRE

Ismail KONE * & Kouadio Konan-Kan Hippolyte
Kwame Nkrumah University of Science and Technology, University Felix Houphouet Boigny

1. Introduction

Climate change poses a threat to our ability to ensure global food security, eradicate poverty, and achieve sustainable development. Soil fertility management issues are at the centre of debates on the sustainability of agricultural production systems in West Africa where famers are concerned with "soil fatigue". Soil fertility degradation through nutrient depletion, mainly by erosion and/or crop removal, is one of the threats facing agricultural systems in Côte d'Ivoire. This affects a large part of the northern territory of Côte d'Ivoire, especially the fragile ecosystems of the northern cotton basin, and eventually leads to the reduction in soil fertility and, consequently a decline in the land productivity. **This work is crucial in the understanding of the evolution of soil fertility from the periods to 2013 to 2021 under climate change conditions in the cotton basin of Côte d'Ivoire.**

2. Causes of climate change

- **Global warming**
  - With the global average temperature rising to 1.1°C above pre-industrial levels in 2019, the decade from 2011 to 2021 was the warmest one ever observed. The need to limit global warming to 1.5°C is acknowledged by the international community.
- **Greenhouse gases**
  - Many of these greenhouse gases are produced naturally, but due to human activity, some of them are becoming more prevalent in the atmosphere, most notably ***carbon dioxide (CO_2), methane, nitrous oxide, and fluorinated gases.***

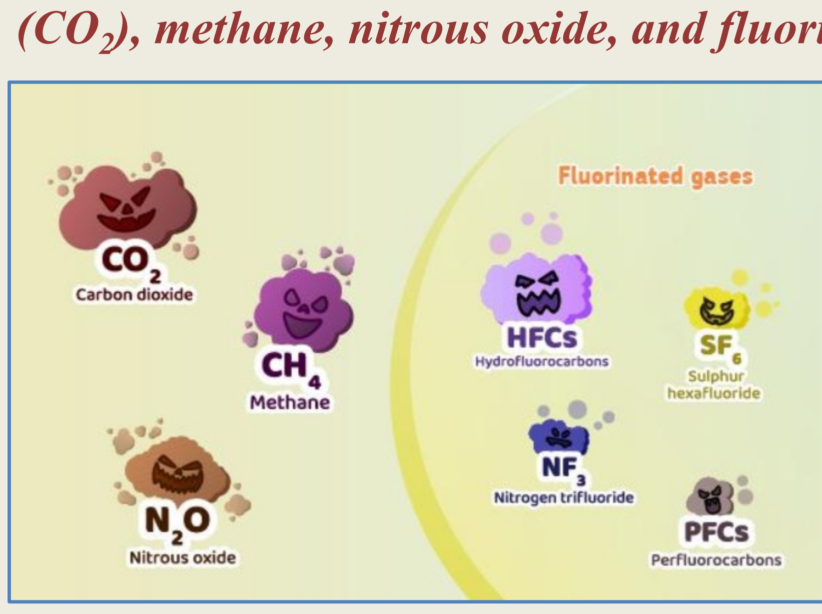

Figure 1: The main greenhouse gases

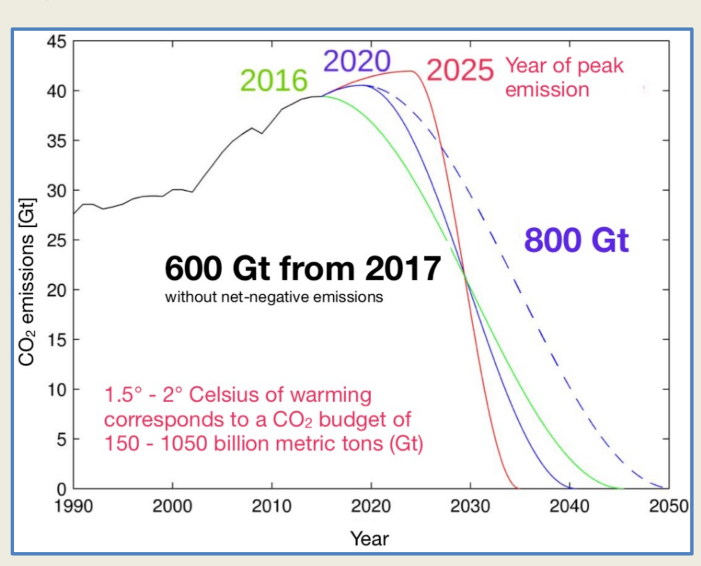

Figure 2: The emission of CO_2

- **Causes for rising emissions**
  - **Burning coal, oil and gas** produces carbon dioxide and nitrous oxide.
  - **Cutting down forests (deforestation)** by absorbing CO_2 from the atmosphere, plants help in regulating the climate. ***This advantageous effect is lost when trees are cut down, and the carbon they have stored is released into the atmosphere, increasing the greenhouse effect.***
  - **Increasing livestock farming,** Cows and sheep produce large amounts of methane during the digestion of their food.
  - **Fertilisers containing nitrogen**, produce nitrous oxide emissions.

3. Methodology: Soil sampling and laboratory analysis

- Soil sampling was carried out at each site in the study area during two periods, he first being in 2013 and the second in 2021 during which topsoil was taken to a depth of 0-20 cm and characterized, with a total of 64 composite soil samples using the soil auger;

- The physico-chemical parameters are (pH, total N, exchangeable Ca, K, Mg and Na, CEC, Base satiurarion, Sand, Silt and Clay content). The laboratory analytical techniques used for the evaluation of the physico-chemical parameters of soil samples in 2021 were almost the same as the methods carried out in 2013.

Method of assessing soil fertility levels:

- **Class 0**, optimal fertility level: no limitation, the soil characteristic is optimal;
- **Class, I**, high fertility level: soils are in this class when the characteristics have no or only four slight limitations;
- **Class II**, medium fertility level: soils are in this class when the characteristics do not present more than 3 moderate Limitations;
- **Class III**, low fertility level: soils are in this class when their characteristics show more than 3 moderate limitations associated with one severe limitation;
- **Class IV**, very low fertility level: soils are in this class when their characteristics present more than one severe limitation.

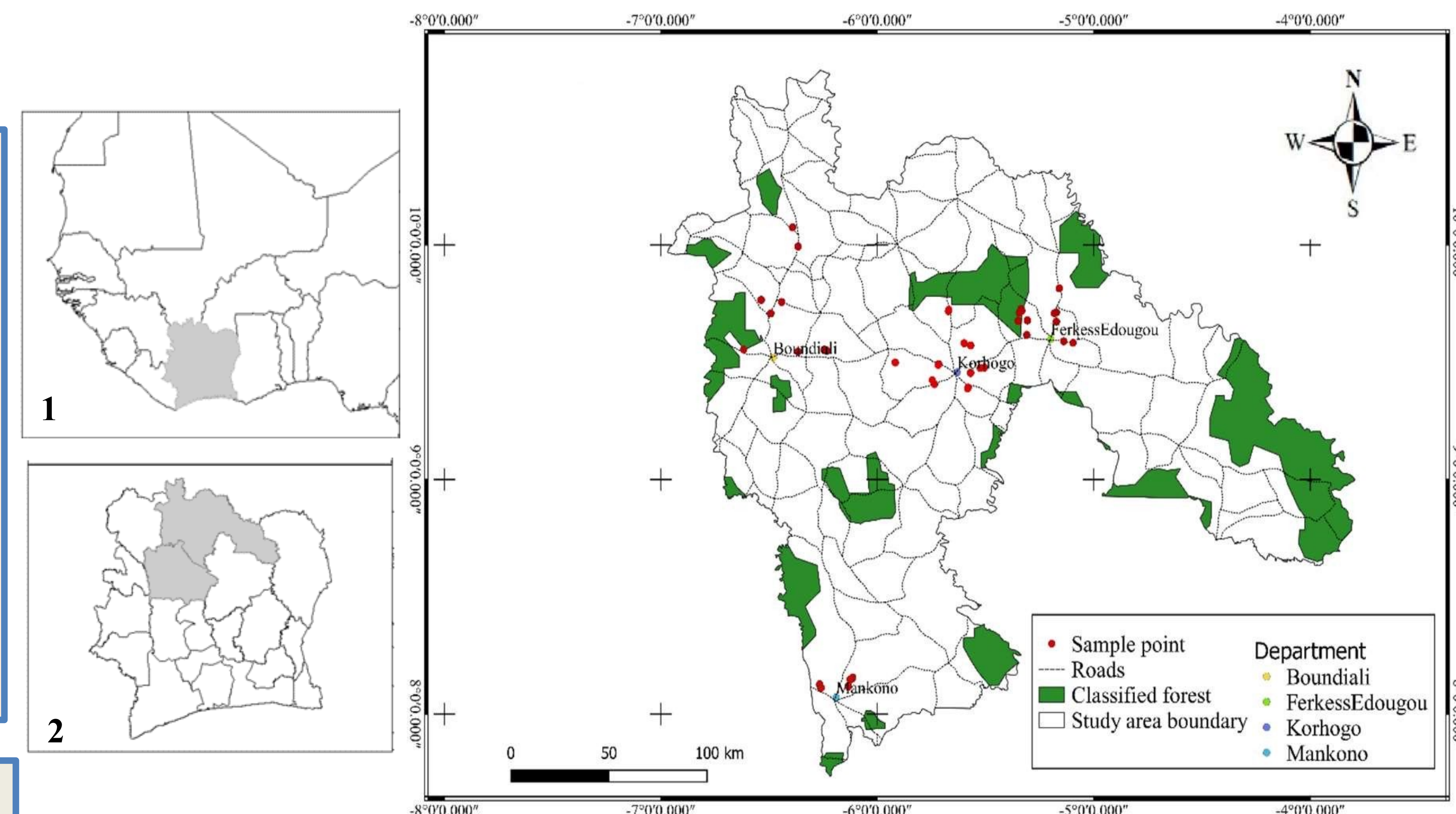

Figure 3: Location of villages where samples were taken

4. Results & Discussion

- The differences observed in soil nutrient levels during the period 2013 to 2021 show an improvement in soil fertility levels with respect to exchangeable bases and partly CEC, although the absolute concentrations remain low in relation to the nutrient requirements for cotton cultivation. This increase in exchangeable bases could be explained by the increasing use of mineral fertilizer and manure. Although there is a slight increase in soil chemical parameters during the 2013 and 2021 periods, these values are still below the average required for each mineral.

Table 1: Soil fertility status for the year 2013 and 2021 with results/differences

Parameters	Unit	KOROGHO		FERKESSEDOUGOU		BOUNDIALI		MANKONO	
		Average values							
		2013	2021	2013	2021	2013	2021	2013	2021
pH		6.3	6.5	6.4	6.6	6.4	6.8	6.4	7.1
N	%	0.071	0.071	0.096	0.068	0.062	0.068	0.064	0.067
CEC	Cmol+/kg	6.65	6.93	5.72	7.28	7.28	7.43	4.28	8.1
BS	%	38.62	55.15	48.75	59.19	24.42	58.54	39.76	59.38
SEB (Ca, Mg, K, Na)	Cmol+/kg	2.55	3.89	2.94	4.42	1.62	4.43	2.82	5.52
Most limiting factors		CEC, SEB		CEC,SEB		CEC,SEB		CEC	
Soil fertility class		IV		IV		IV		III	
Level of fertility		**Very low level**		**Very low level**		**Very low level**		**Low level**	

5.Conclusions

- ✓ Soil and plants management can assist in reducing greenhouse gas emissions and attenuate the risk of climate change;
- ✓ **The relevance of soil physicochemical parameters in the sustainable management of cotton productivity ;**
- ✓ The soils are important **greenhouse gases (GHG)** absorbers, depositors, and transmitters.
- ✓ The soils in the study area were in a state of degradation and less favourable for cotton cultivation;
- ✓ The most limiting chemical properties are CEC and SEB.

Acknowledgments

References

[1] Raymond, R. Weil, N.C.B. (2014). The Nature and Properties of Soils, Global Edition by Raymond R. Weil, Nyle C. Brady.
[2] https://climate.ec.europa.eu/climate-change/causes-climate-change_en
[3] https://www.eea.europa.eu/signals/signals 2015/articles/soil-and-climate-change
[4] https://www.fao.org/climate-change/en/
[5] https://www.gktoday.in/topic/peatlands-in-himalayan-region/#:~:text=Peatlands%20in%20India%20have%20been,are%20mangroves%20and%20delta%20regions.