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Land Suitability Analysis of Coffee (*Coffea arabica*), Pineapple (*Ananas comosus*) and Mango (*Mangifera indica*) for Sustainable Agriculture and Food Security in Burkina Faso, West Africa

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ABSTRACT: Land suitability assessment is critical for sustainable agricultural planning, especially in Burkina Faso's Sudano-Sahelian zone, where soil deterioration and nutrient deficits limit perennial crop development. Pineapple, coffee, and mango are commercially attractive crops that have the potential to diversify rural livelihoods and increase food security. The objective of this study is to evaluate the land suitability for pineapple, coffee, and mango based on the soil physical and chemical properties in Saaba. A soil profile was conducted to determine the physical features, and soil samples were collected and examined to determine the chemical characteristics. Physical soil parameters, such as texture, rooting medium, and depth, showed high appropriateness (S1) for pineapple and mango. However, coffee was classified as not suitable (N) because to its shallow soil depth (<40 cm). Chemical characteristics indicated an appropriate pH (5.7-5.8). Exchangeable potassium (48.54-79.25 mg/kg) was consistently classed as highly suitable (S1) across all crops. However, available phosphorus levels were dangerously low (0.88-2.44 mg/kg), resulting in a "not suitable" (N) rating for all samples and crops. Organic matter differed significantly: Sample 1 (0.73% OM) was classed as non-suitable for all crops, whereas Samples 2 and 3 were moderately acceptable (S2) for pineapple and mango but only marginally appropriate (S3) for coffee. The primary limitations to land suitability for perennial crops in the study area are severe phosphorus deficiency and organic matter depletion. Although pH and potassium are favorable, sustainable production of pineapple, coffee, and mango requires interventions such as phosphorus fertilization and organic matter restoration. Pineapple and mango are more adaptable to current soil conditions, while coffee should be grown in areas with higher organic matter and robust soil management.

KEYWORDS: Land assessment, Perennial crops, Soil fertility, Sustainable agriculture

1. INTRODUCTION

Agriculture continues to be the backbone of Burkina Faso's economy and rural life, employing more than 80% of the workforce and contributing significantly to national GDP (World Bank, 2017). This is the primary source of jobs, revenue, and food, as well as a substantial contribution to improving livelihoods and reducing poverty in this region, particularly in rural areas (Workneh, 2020). Smallholder growers with 5 hectares or fewer account for over 80% of total agricultural production. Women make up more than half of the agricultural workforce and generate over 66% of the food consumed in the country (Mukasa *et al.*, 2015). Burkina Faso's development goals prioritize self-sufficiency in staple foods, but a growing population is causing "foncière pressure" competition for limited land between agriculture, cattle, and urban growth (Sourgou H. *et al.*, 2024). The demographic rise leads to smaller farm holdings, faster conversion of marginal soils to cultivation, and short-term, input-intensive techniques that deplete nutrients. Recent surveys of the country's agro-forestry parklands show that demographic and climatic strains are degrading the soils that support rural livelihoods (Gaisberger H. *et al.*, 2017). Climate-risk evaluations highlight the vulnerability of Burkina Faso's agriculture to rising temperatures and irregular rainfall, which can lead to nutrient loss and reduced soil regeneration capacity (El Bilali H., 2021). Consequently, in Burkina Faso, millions of people remain food insecure, with agricultural production fluctuating significantly from year to year and the country's reliance on rain-fed agriculture makes rural lives particularly unstable, as even slight weather shocks can cause significant production losses (UNDP, 2020).

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Ensuring food security and sustainable agricultural development therefore requires diversification beyond traditional cereal-dominated systems. Although cereals account for the majority of cultivated land, the Sudanian zone of Burkina Faso provides ideal ecological conditions for horticultural and perennial crops such as fruits, roots, and tubers (CGIAR, 2026). Among fruit crops, the mango occupies a pivotal position in terms of socio-economic and nutritional significance, representing a substantial fraction of national fruit output and contributing to the livelihoods of rural households (Vayssières J.-F. *et al.*, 2012). Other high-value crops, including coffee and pineapple, also exhibit considerable market potential, capacity for income generation, and nutritional advantages; however, their cultivation is currently constrained and lacks spatial planning (Faso observateur, 2025). Identifying appropriate ecological zones for these crops has the potential to increase agricultural revenue, strengthen resistance to climate change, and boost food diversity.

Since the compatibility of crop requirements and environmental circumstances is a major determinant of crop performance, land suitability analysis is an essential tool in agricultural planning. Choosing appropriate locations for certain crops maximizes productivity, lowers production risk, and promotes commercially successful agricultural systems (Chemura A. *et al.*, 2020). Land suitability studies play an important role in informing decision makers about the potential and limits involved with using a specific land region. The land suitability analysis considers the land attributes, physiographic data, and user-specific requirements (Elsevier, n.d.). Assessing a land's suitability status aims to conserve the ecological value in areas or regions that are vulnerable to natural deterioration by forecasting the land's potential in relation to its land use limits (Budianto *et al.,* 2021).

Therefore, this study aims to determine whether these three crops pineapple, coffee, and mango are suitable for an area and can provide sustainable benefits both financially and in terms of agricultural sustainability. Supporting agricultural planning, encouraging climate-resilient farming practices, and enhancing food security and rural livelihoods in West Africa are the goals of this research.

2. MATERIEL AND METHODS

2.1. Study area

The study site covers an area of half a hectare (5,000 m²) and is located on the edge of the rural commune of Saaba. It is situated in the Centre region, specifically to the east of Ouagadougou. Its coordinates are 30P 06677531 E; 1370506 N, and it is easily accessible via National Road No. 5 on the Ouagadougou-Po axis." Due to the small size of the study area and the uniformity of slope, soil color, drainage condition, and land management history observed during preliminary field inspection, the site was considered as a homogeneous land unit. Therefore, land mapping unit (LMU) delineation based on regional soil maps was not applied.

2.2. Tools and material

This research requires tools for sample collection, including hoes, crowbars, hammers, rings, GPS, clinometer, plots, cutters, trowels, cameras, and buckets. The laboratory analytical tools included a digital scale, spectrophotometer, burette, back-and-forth shaker, film bottles, volumetric and measuring pipettes, centrifuge, digestion tubes, fume cupboards, Erlenmeyer flasks, beakers, test tubes, measuring glass, oven, and crucibles.

2.3. Soil sampling

Soil sampling was conducted using a soil auger following a composite sampling technique. The sampling points were collected along the diagonal of the site. Soil samples were taken from the soil depth of 0-25 cm at different locations of the site. These samples are samples of undisturbed soil used for the analysis of all parameters. This is a critical step in land suitability analysis, because it provides the baseline data on soil fertility, texture, structure, and chemical properties that determine whether land can support specific crops.

2.4. Soil profile observation

At a representative site, a soil pit was dug down to a depth of 120 cm in order to facilitate land evaluation. The field specified the soil's morphological features, such as its horizon depth, color (according to the Munsell Soil Color Chart), structure, and root distribution.

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2.5. Land Suitability Evaluation

Land suitability is examined for three crop commodities, including pineapple, coffee, and mango. This score is based on the FAO's Framework for Land Evaluation (FAO, 1976). This evaluation used a matching method to compare land suitability class data with soil analysis results from samples collected at the research location. The final results reveal restrictions on land suitability classifications. The limiting criteria are assessed to determine if the plant commodities are suitable for growing on the site. The land was classified into four suitability classes:

- S1: Highly suitable
- S2: Moderately suitable
- S3: Marginally suitable
- N: Not suitable

Table 1 summarized land suitability parameters for the three selected fruits (pineapple, coffee, and mango).

Table 1. Land suitability class assessment parameters for pineapple, coffee, and mango

		Land Suitability Class			
Parameters	Commodity	S1	S2	S3	N
Temperature (tc)	Pineapple	17–20	15–17; 20–30	10–15; 30–35	<10; >35
	Coffee	25–28	20–25; 28–32	32–35	<20; >35
	Manggo	18–26	15–18; 26–30	10–15; >30	<10
Water Availability (wa) Rainfall (mm)	Pineapple	1,000–2,000	500–1,000; 2,000–3,000	250–500; 3,000–4,000	<250; >4,000
	Coffee	1,500–2,500	2,500–3,000; 1,250–1,500	3,000–4,000	3,000–4,000
	Manggo	1,200–2,000	1,000–1,200; >2,000	750–1,000	<750
Root Medium (rc)	Pineapple	Fine, Slightly Coarse, Moderate	--	Moderately Coarse	Coarse
	Coffee	Fine, Slightly Coarse, Moderate	--	Inhibited, Slightly Fast	Coarse, Highly Inhibited, Fast Coarse
	Manggo	Fine, Slightly Coarse, Moderate	--	Very Fine, Moderately Coarse	Coarse
Soil Depth	Pineapple	<60	60–140	140–200	>200
	Coffee	>100	75–100	50–75	<50
	Manggo	<60	60–140	140–200	>200
Nutrient Retention (nr) - CEC	Pineapple	>16	<16	--	--
	Coffee	>16	≤16	--	--
	Manggo	>16	≤16	--	--
pH	Pineapple	5.5–7.3	5.0–5.5; 7.3–8.0	<5.0; >8.0	--
	Coffee	6.0–7.0	5.5–6.0; 7.0–	<5.5; >7.6	--

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			7.6		
	Manggo	5.0–6.5	4.6–5.0; 6.5–7.5	<4.6; >7.5	--
C-Organic	Pineapple	>1.2	0.8–1.2	<0.8	--
	Coffee	>1.2	0.8–1.2	<0.8	--
	Manggo	>1.2	0.8–1.2	<0.8	--
Available Nutrients					
N-Total (%)	Pineapple	>0.21	0.15–0.21	0.10–0.15	<0.10
	Coffee	>0.21	0.16–0.21	0.10–0.15	<0.10
	Manggo	>0.21	0.11–0.2	0.05–0.1	<0.05
P2O5 (mg/kg)	Pineapple	>20	10–20	5–10	<5
	Coffee	>20	15–20	10–15	<10
	Manggo	>20	10–20	5–10	>5
K2O (cmol/kg)	Pineapple	>0.4	0.3–0.4	0.2–0.3	<0.2
	Coffee	>0.6	0.3–0.6	0.1–0.3	<0.1
	Manggo	>0.5	0.3–0.5	0.1–0.3	<0.1
Slope (%)	Pineapple	<8	8–15	15–30	>30
	Coffee	<8	8–15	15–30	>30
	Manggo	<8	8–15	15–30	>30

Source: (Djaenudin et al., 2011)

2.6. Data analysis

Soil test analysis was conducted at the National Soil Office. Parameters analyzed in land suitability evaluation include soil texture, pH (H2O), organic C content, available potassium (K-available), and available phosphorus (P-available). Rainfall data, information obtained from the official website of "Weather chain Burkina Faso" and then the average is calculated for analysis purposes.

3. RESULTS AND DISCUSSION

3.1. Climate

The climate data through the annual temperature and the annual rainfall for the past 5 years are shown in Figure 1 based on data taken from "the weather chain, Burkina Faso". Between 2020 and 2024, the climatic analysis of Ouagadougou, Burkina Faso, shows an average annual rainfall of 877.3 mm and an average temperature of 29.42 °C. These values are compatible with the semi-arid Sudanese climate zone, which has a brief rainy season (June-September) and a lengthy dry season (October-May).

According to the suitability categorization and average yearly rainfall, pineapple farming is moderately suitable (S2), with relatively high rainfall and warm temperatures that promote growth and fruit development. Similarly, coffee and mango are rated as marginally suitable (S3) since they have ideal ecological requirements. Overall, rainfall is the main climatic limitation in the area, particularly for perennial tree crops. Seasonal drought likely affects flowering synchronization, fruit set, and final yield (Sakiroh S. *et al.*, 2021).

According to the suitability classification and average annual temperature, the three plantations pineapple, coffee and mango was classified as moderately suitable (S2). The recorded temperature is therefore generally favourable; however, combined heat and moisture deficit can induce premature fruit drop and reduce fruit size. These findings emphasize the need of incorporating climatic data into site suitability studies to ensure that crop diversification strategies are consistent with ecological reality.

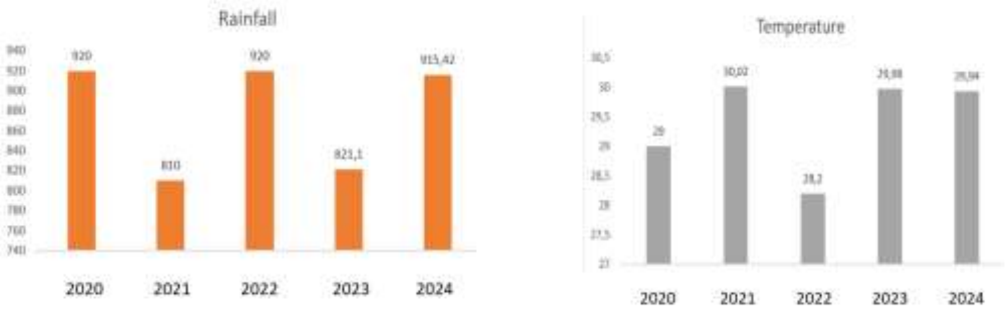

Figure 1. Temperature and Rainfall Graph from 2019 – 2020 in Saaba, Burkina Faso

3.2. Physical properties

3.2.1. Soil profile observation

We dug the pit at the coordinates: 30 P 0679636 E; 1355384 N until we encountered an obstacle at a depth of 120 cm and it is presented in the Figure 2. Our observations have shown us that this is a soil with a usable depth of less than 40 cm and a profile with three horizons:

- A first layer, 0 to 15 cm thick, grayish in colour (10YR6/3) when dry and brown (10YR4/3) when wet. The texture is sandy-silty with 5% ferruginous gravel. The structure is a weakly developed subangular polyhedral. The pores and roots are numerous, ranging from very fine to medium and fine. Biological activity is well-developed.
- A second layer, 15 to 30 cm thick, brownish in colour (10YR6/6) when dry and (10YR4/6) when wet. The texture is silty-sandy with 20% ferruginous gravel. The structure is a weakly developed subangular polyhedral. The pores and roots are numerous and very fine, and biological activity is well-developed.
- A third layer, between 30 and 40 cm deep, is brown (10YR4/6) when wet. Its texture is clayey with 50% ferruginous gravel. The structure is weakly developed subangular polyhedral. The pores are numerous and fine, while the roots are sparse and very fine, and biological activity is low.

The morphological characteristics obtained following the description of the Commission for Pedology and Soil Mapping (CPSM, 1967), allowed us to identify a single soil subgroup belonging to a single soil class: the class of soils with iron and manganese sesquioxide's. The soil subgroup described is that of shallow, leached, indurated tropical ferruginous soils.

Figure 2. Soil profile

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3.2.2. Physical properties classification

The physical properties of soils in the study area were analyzed to determine their suitability for high-value crops such as pineapple, coffee, and mango. The results of the physical properties obtained through the soil profile are shown in the Table 2.

Table 2. Results of the soil physical properties

Sample	Texture	Root medium	Soil depth
Sample 1	Sandy loam	Fine, Slightly Coarse, Moderate	<40
Sample 2	Sandy loam	Fine, Slightly Coarse, Moderate	<40
Sample 3	Sandy loam	Fine, Slightly Coarse, Moderate	<40

The evaluation of soil physical properties revealed significant implications for crop suitability in the study area. Texture, Root medium and soil depth were assessed against the ecological requirements of pineapple, coffee, and mango and are presented in the Table 3.

Table 3. Land suitability classification from soil physical parameters

		Sample 1		Sample 2		Sample 3	
Parameters	**Commodity**	**Result**	**Corresponding class**	**Result**	**Corresponding class**	**Result**	**Corresponding class**
Texture	Pineapple	Sandy loam	S1	Sandy loam	S1	Sandy loam	S1
	Coffee		S2		S2		S2
	Manggo		S1		S1		S1
Root medium	Pineapple	Fine, Slightly Coarse, Moderate	S1	Fine, Slightly Coarse, Moderate	S1	Fine, Slightly Coarse, Moderate	S1
	Coffee		S1		S1		S1
	Manggo		S1		S1		S1
Soil depth	Pineapple	<40	S1	<40	S1	<40	S1
	Coffee		N		N		N
	Manggo		S1		S1		S1

Texture, rooting medium, and effective soil depth were among the physical attributes of the soil that were assessed in order to ascertain their impact on crop development and land suitability.

For the soil texture, we found that Soils in all three samples were classified as sandy loam, which is ideal for pineapple (S1) due to its excellent drainage and aeration. Mango also showed great compatibility (S1) in these conditions, indicating its adaptation to sandy loam soils. Coffee, on the other hand, was classed as moderately appropriate (S2) because optimal development demands finer-textured soils with greater water retention capacity. This type of soil has a well-balanced ability to retain water, build a stable structure, offer adequate aeration, and maintain a reasonable soil temperature (Easton & Bock, 2015).

These findings are consistent with those of Zolekar et al. (2024), who stressed soil texture as a key factor of crop-specific adaptability in semi-arid environments.

The root medium was consistently classified as fine to slightly coarse, with moderate consistency, which aided root penetration and nutrient uptake. All three crops pineapple, coffee, and mango were classified as highly suitable (S1) under this parameter. A good rooting medium ensures high oxygen diffusion rates for respiration, reduces mechanical resistance, and facilitates easy root penetration, all of which support healthy plant growth (Watson, G. W. *et al.*, 2014). This outcome is in line with FAO standards from 2022, which emphasize how crucial high-quality root media is to the survival of perennial crops.

For coffee, soil depth turned out to be a limiting factor. Coffee was categorized as not appropriate (N) in all samples with depths reported at less than 40 cm, indicating that it needs deeper soils to sustain large root systems. Coffee requires deep soils, usually larger than 100 cm, due to its enormous root system and constant water requirement. Shallow soil (<40 cm) severely inhibits water intake and causes quick plant stress during dry periods (DaMatta *et al*., 2019). On the other hand, because of their less demanding root systems in terms of depth, pineapple and mango were categorized as very suited (S1). Pineapple roots are shallow and usually concentrate within the top 15-30 cm of soil, which allows them to grow in relatively shallow soil (Bartholomew et al., 2020). Mango, although capable of forming deep taproots, can adapt to somewhat shallow soils assuming appropriate aeration and drainage (Litz, 2009).

3.3. Soil chemical characteristics

The chemical parameters of the soil at the Saaba experimental site were assessed using composite samples obtained at depths ranging from 0 to 25 cm prior to the start of the study. The analysis results are reported in Table 4 below.

Table 4. Results of soil chemical parameters

Sample	Organic matter (MO)	Organic Carbon (C)	Phosphorus (P)	Potasssium (K)	pH (H2O)
Sample 1	0.73	0.42	2.44	48.54	5.80
Sample 2	2.00	1.16	2.40	79.25	5.70
Sample 3	1.52	0.88	0.83	51.51	5.70

To assess the suitability of the Saaba experimental site for pineapple, coffee, and mango cultivation, the observed soil chemical parameters were compared to normal land requirements. The classification follows the FAO framework, which is divided into four categories: S1 (Highly Suitable), S2 (Moderately Suitable), S3 (Marginally Suitable), and N (Not Suitable). The results are reported in Table 5.

Table 5. Land suitability classification from soil chemical characteristics

		Sample 1		Sample 2		Sample 3	
Parameters	**Commodity**	**Value**	**Corresponding class**	**Value**	**Corresponding class**	**Value**	**Corresponding class**
pH (H_2O)	Pineapple	5.80	S1	5.70	S1	5.70	S1
	Coffee		S2		S2		S2
	Manggo		S1		S1		S1
Phosphorus (P) (mg/kg)	Pineapple	2.44	N	2.40	N	0.83	N
	Coffee		N		N		N
	Manggo		N		N		N
Potassium (K) (mg/kg)	Pineapple	48.54	S1	79.25	S1	51.51	S1
	Coffee		S1		S1		S1
	Manggo		S1		S1		S1

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Carbon organic (C) (%)	Pineaple	0.42	S3	1.16	S2	0.88	S2
	Coffee		S3		S2		S2
	Mango		S3		S2		S2
Organic matter (%)	Pineapple	0.73	N	2.00	S2	1.52	S2
	Coffee		N		S3		S3
	Mango		N		S2		S2

3.3.1. Soil pH

Soil pH values ranging from 5.70 to 5.80 are optimal for pineapple and mango, both classified as highly suitable (S1). They grow best on slightly acidic soils with a pH of 5.5-6.0, which assures nutrient availability (particularly zinc, copper, iron, and manganese) (Shokalu *et al*., 2019), optimizes macronutrient uptake, and reduces waterlogging. Studies show that sandy or loamy soils with this pH range are good for root development and fruit quality (Hossain, 2016). Coffee, however, was classified as moderately suitable (S2), since it prefers slightly more acidic conditions (5.0–6.5). Research reveals that optimal growth conditions for Coffea species often occur within a pH range of 6.0 to 6.5. However, cultivation succeeds across a greater spectrum (Alvim & Kozlowski, 2013). These results are consistent with those of Mena *et al*. (2025), who highlighted the significance of soil pH for crop resilience and nutrient solubility.

3.3.2. Available phosphorus

Phosphorus levels were critically low in all samples (0.83-2.44 mg/kg), resulting in a categorization of "not suitable" for all three crops. Phosphorus deficit is thus the most important chemical constraint in the research area. Tropical soils often contain high levels of iron and aluminum oxides, which strongly fix phosphorus and reduce its availability to plants (Weil & Brady, 2017). Low phosphorus supply inhibits root development, flowering, and fruit formation. Insufficient phosphorus affects blooming intensity and fruit set in perennial crops such as coffee and mango, whereas severe deficiency stunts growth and causes delayed maturity in pineapple (DaMatta *et al*., 2019; Bartholomew *et al*., 2020). The extremely low P levels suggest that fertilizer application or phosphate amendment is critical for long-term crop production.

3.3.3. Potassium

In comparison to phosphorus, potassium levels were adequate in all samples. All samples tested extremely appropriate (S1) for pineapple, coffee, and mango, with values ranging from 48.54 mg/kg to 79.25 mg/kg. Potassium is commonly referred to be a "quality element" for perennial crops because of its various physiological activities, such as osmotic control (Meena, N. *et al.*, 2024). In fact, Potassium governs the opening and closing of stomata, allowing the plant to successfully manage water stress and maintain cell turgor. It also activates more than 60 enzymes involved in protein synthesis, photosynthesis, and sugar metabolism. It improves fruits quality by stimulating the transfer of sugars (photosynthates) from leaves to fruit, hence boosting size, color, and flavor (Liaqat, S. *et al.,* 2022). According to Handayania et al. (2022), biochemical activities in pineapple plantations are supported by adequate potassium availability, while Asare et al. (2024) discovered that conservation agricultural methods in Burkina Faso help to maintain high soil potassium levels.

3.3.4. Soil Organic Carbon and Organic Matter

The organic carbon (C) level varied from 0.42% in Sample 1 (marginally appropriate, S3) to significantly higher values in Samples 2 and 3, which achieved moderately suitable (S2) classification for pineapple and mango. The organic matter (OM) followed a similar trend, with Sample 1 (0.73% OM) classified as N for all crops, while Samples 2 and 3 achieved S2 for pineapple and mango but remained S3 for coffee. These findings must be viewed within the context of Burkinabè soil dynamics. Soil organic matter loss is a significant degrading process that threatens agricultural sustainability in West Africa. Research on soil organic carbon management and adequate fertilizer recommendations has shown that organic matter levels below key thresholds reduce soil productivity (Bationo, A. *et al*, 2018). The low organic matter in Sample 1 suggests advanced soil organic matter depletion, most likely caused by continuous farming with insufficient organic inputs. In Burkina Faso, studies on determining soil nutrient capacity for updating fertilizer recommendations under soil and water conservation strategies highlighted the necessity of organic matter management (Youl, S. *et al.*, 2018). The improvement in S2 in Samples 2 and 3 indicates a better soil management history or more favorable textural conditions for organic matter stability. However, coffee's constant S3 classification based on organic matter demonstrates the crop's high sensitivity to topsoil organic condition. Research on integrated soil fertility management in West Africa has shown that coffee and other perennial crops establish root systems that rely largely on well-structured, organic-rich surface horizons to acquire nutrients and water (Maro, G. *et al.*, 2024). Research in Burkina Faso has shown that techniques like as integrated nutrient management, the use of composted organic additions, and reduced tillage can reduce oxidation of existing organic matter. In Burkinabè, such integrated soil fertility management practices serve as the foundation for long-term perennial crop yield (Ouédraogo E. *et al.*, 2001).

3.4. and suitability evolution

Land suitability evaluation is a process used to determine a piece of land's qualities and suitability for a given commodity's growing needs (Wijaya et al., 2024). It needs information on soil quality and the environment, which are gathered by sampling in a particular location. The topography, climate, soil conditions, soil quality, and other physical environmental attributes of the area under evaluation are all included in the land suitability assessment for agricultural characteristics (Iswan *et al*., 2019).

Based on the results, it can be seen that the site of Saaba have several limiting factors for the growth of the commodities pineapple, coffee and mango. The first limiting factor is the soil depth that is not suitable for coffee plantation. For a good distribution in the soil, coffee's roots require a soil depth up to 100 cm (Defrenet E. *et al.*, 2016). The second limiting factor is the low level of phosphorus which class the three commodities as non-suitable. it would be necessary to apply mineral P fertilizers to adjust the level of phosphorus in the soil (Khan A. *et al.*, 2023). Low phosphorus availability is strongly linked to soil acidity and to increase the pH might increase also the level of phosphorus. So, as a solution, we need to apply agricultural lime ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$) in the soil (Altland & Jeong, 2016). The final limiting factor is the low level of organic carbon and organic matter which class the commodities as either marginally suitable or not suitable. To face this challenge, we should organic amendments such as poultry manure (very effective), compost or green waste compost in order to increase carbon sequestration, improve soil structure and enhance microbial activity ensuring sustainable agricultural productivity (Omokaro, G. O. *et al.*, 2024).

4. CONCLUSION

The land suitability evaluation, which incorporates meteorological, physical, and chemical characteristics, reveals distinct variances in crop adaptability across the research area. Pineapple was regularly rated as the most favorable crop, with S1 ratings for soil texture, rooting medium, depth, pH, and potassium availability. Its ability to withstand semi-arid environments and tolerate sandy loam soils making it an attractive alternative for diversification and intensification. Mango also shown great suitability (S1) under most parameters, particularly soil pH and potassium, despite mild restrictions in organic carbon and organic matter, indicating the need for fertility management. Coffee production was limited due to shallow soil depth (<40 cm) and poor phosphorus levels, resulting in classifications ranging from marginal (S2) to not acceptable. While coffee can benefit from enough potassium and a reasonable pH, its ecological needs are not entirely supplied under current conditions. In general, the area has a great deal of potential to support the sustainable production of mango, coffee, and pineapple using crop-specific fertilization techniques and proper soil management. In order to maximize resource use efficiency, boost agricultural output, and support long-term food security and sustainable agricultural growth, site-specific management based on homogeneous land units is highly advised.

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