Research Article

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# Diagnostic Evaluation of Land Degradation Using Soil Physico-Chemical Indicators in Ikere-Ekiti, Southwestern Nigeria

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***Abstract***

*Land degradation assessment is essential for promoting sustainability, protecting ecosystems, and ensuring the well-being of present and future generations. This study assesses the extent and severity of land degradation across three locations in Ikere Ekiti, Nigeria: Ayewa Farm, Oke Otin Farm, and Ayodele Farm. Land degradation, marked by declining soil quality and reduced land productivity, threatens sustainable agriculture and environmental stability. The aim was to identify the extent, causes, and potential solutions for land degradation in the region. Surface soil samples were randomly collected from each location to evaluate soil physical and chemical properties through fieldwork and laboratory analysis, descriptive statistics was employed to summarize the soil physico-chemical properties collected from the three study sites. The results were compared with standard degradation indicators to determine the level of degradation. The study revealed that all three locations are moderately degraded resulting mainly from the effect of erosion and direct exposure to sunlight. The bulk density in all locations was generally non-degraded (class 1). Available phosphorus in Locations A and C was highly degraded (class 3), while Location B was non-degraded (class 1). Potassium content across the locations was non-degraded (class 1). Nitrogen showed moderate degradation (class 2), and base saturation was highly degraded (class 4). Exchangeable Sodium Percentage was highly degraded in Locations A and C (class 3) and very highly degraded in Location B (class 4). These findings emphasize the need for specific soil conservation practices to mitigate degradation and improve soil health. This research offers valuable insights into the dynamics of land degradation in Ikere Ekiti, providing a foundation for informed decision-making to enhance agricultural productivity.*

***Keywords***

*Land Degradation, Soil Quality, Ikere Ekiti, Soil Conservation, Agricultural Productivity, Environmental Stability*

## Introduction

Land degradation is a critical environmental challenge that threatens agricultural productivity, ecosystem health, and food security globally, particularly in developing countries like Nigeria (1). The degradation of land resources has resulted in declining soil fertility, reduced agricultural output, and increased vulnerability to climate change impacts (2). In Nigeria, where agriculture forms a substantial part of the economy, maintaining soil health is essential for sustainable development and poverty reduction (3). The Southwestern region, especially areas like Ikere Ekiti, has been experiencing significant land degradation driven by deforestation, unsustainable agricultural practices, and urban expansion.

Ikere Ekiti, an agrarian community in Ekiti State, is witnessing a gradual decline in soil productivity due to various forms of land degradation. The process is primarily driven by soil erosion, nutrient depletion, and inadequate land management, which collectively compromise the region's agricultural potential (4). The consequences of land degradation extend beyond reduced crop

yields to include adverse impacts on local livelihoods, increased food insecurity, and socio-economic instability (5). Recognizing soil conservation as a pivotal strategy for sustainable agriculture, it is crucial to evaluate the extent of degradation in vulnerable areas like Ikere Ekiti to inform effective soil management interventions.

While numerous studies have addressed land degradation in Nigeria, specific investigations focusing on the micro-environmental conditions in Ikere Ekiti remain limited (1, 4, 6). This study aims to bridge this gap by conducting an in-depth assessment of land degradation across three agricultural sites within the town. By examining soil physical and chemical properties, this research seeks to identify the underlying causes of degradation and propose viable conservation strategies tailored to the area's specific needs. This work contributes to the scientific understanding of land degradation in Ekiti State and provides practical recommendations for improving soil health and agricultural sustainability.

The objectives of this study are: (i) to assess the current state of soil degradation in Ikere Ekiti, (ii) to identify the key factors contributing to degradation, and (iii) to recommend sustainable soil conservation practices. The outcomes are expected to guide policymakers, farmers, and stakeholders in implementing effective soil conservation strategies to enhance agricultural productivity in Southwestern Nigeria.

## Materials and Methods

### Study Area

Ikere Ekiti is located in Ekiti State, Southwestern Nigeria, with coordinates approximately between latitudes 7°29'N and 7°37'N and longitudes 5°11'E and 5°21'E (7). The town spans an area of about 30 km² and is characterized by a tropical climate featuring distinct wet and dry seasons. The wet season, influenced by the southwest monsoon, occurs from April to October, while the dry season spans from November to March. The average annual rainfall in the region ranges between 1,200 and 1,500 mm, with temperatures fluctuating between 25°C and 30°C (8).

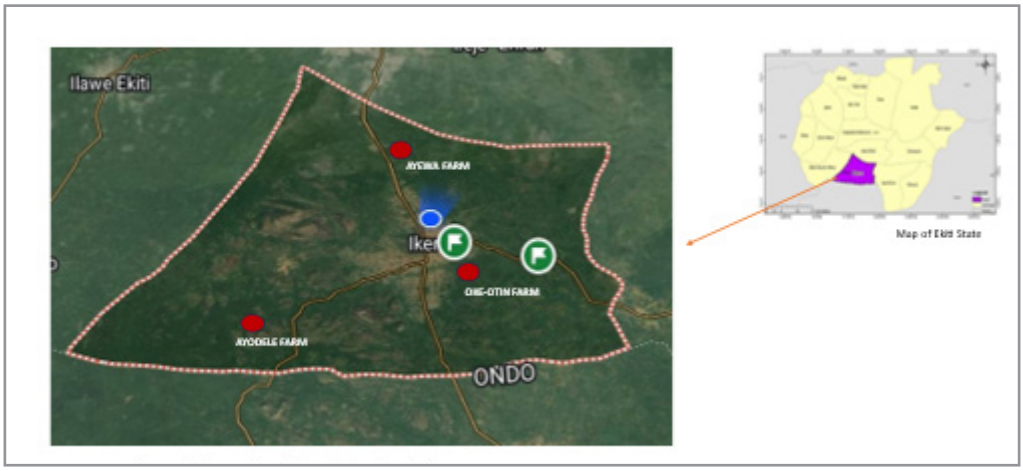


**Figure 1:** Location Map of the Study Area

The landscape of Ikere Ekiti is predominantly undulating, with elevations ranging from 250 to 450 meters above sea level, contributing to the area's susceptibility to soil erosion (9). Soils in this region are mainly derived from basement complex rocks, resulting in sandy loam to clayey textures. Vegetation is primarily derived savannah, interspersed with secondary forests and farmlands due to extensive agricultural activities (7, 9). The principal crops cultivated include yam (Dioscorea spp.), maize (Zea mays), cassava (Manihot esculenta), and leafy vegetables (9).

The region faces considerable environmental challenges, such as soil erosion, nutrient depletion, and loss of vegetative cover, which collectively exacerbate land degradation. These issues are further intensified by deforestation, unsustainable agricultural practices, and increasing population pressures (9). Therefore, understanding the specific soil characteristics and environmental dynamics of Ikere Ekiti is crucial for implementing effective soil conservation strategies tailored to this region.

### Experimental Procedures and Soil Sampling

The data collection process focused on field surveys and laboratory analyses to assess land degradation in Ikere Ekiti. Soil samples were collected from three selected sites: Ayewa Farm (location A), Oke Otin Farm (location B), and Ayodele Farm (location C) using a stratified random sampling approach. Samples were taken at a depth of 0-20 cm to capture topsoil conditions, where degradation effects are most pronounced (10). Five sampling points were identified at each site, and their coordinates were recorded using a handheld GPS device for accuracy.

Field assessments were performed to identify visible signs of soil degradation, such as erosion, compaction, and changes in vegetation cover. The collected soil samples were air-dried, ground, and sieved through a 2-mm mesh before laboratory analysis to determine key physico-chemical properties, including soil pH, organic matter content, bulk density, and concentrations of essential nutrients like nitrogen, phosphorus, and potassium (11, 12).

**Assessment Framework**

The assessment of land degradation in Ikere Ekiti was conducted using field observations and laboratory analysis of soil properties. Key indicators analyzed included bulk density, pH, organic matter, and essential nutrients such as nitrogen, phosphorus, and potassium. These indicators were chosen due to their influence on soil fertility and agricultural productivity (9, 13).

Degradation levels were classified following the FAO's guidelines (2019), with thresholds set to categorize the severity into non-degraded, moderately degraded, highly degraded and very highly degraded classes (as presented in Table 1 below). The degree of degradation as indicated by 1, 2, 3 and 4 means non-slightly degraded, moderately degraded, highly degraded and very highly degraded respectively. Measured values were benchmarked against these standards to assess the current state of the soils, identifying areas needing conservation interventions.

**Table 1:** Indicators and Criteria of Soil Degradation

| Indicator | Degree of Degredation | | | |
|---|---|---|---|---|
| **Ratings** | **1** | **2** | **3** | **4** |
| Soil bulk density (g/cm3) | < 1.5 | 1.5- 2.5 | 2.5-5 | >5 |
| Permeability | <1.75 | 1.25-5 | 5-10 | <0.08 |
| Content of Nitrogen (N%) | <0.03 | >0.13 | 0.08-0.10 | <0.08 |
| Available P (mg/kg) | <8 | 7-8 | 6-7 | <6 |
| Element of K (cmol/kg) | >0.16 | 0.14-0.16 | 0.12-0.14 | <0.12 |
| Content of ESP (%) | <10 | 10-25 | 25-50 | >50 |
| Base saturation (%) | <2.5 | 2.5-5 | 5-10 | >10 |

**Source:** Modified from FAO, 2019

**Statistical Analysis**

Descriptive statistics were used to summarize the soil physico-chemical properties collected from the three study sites: Ayewa Farm, Oke Otin Farm, and Ayodele Farm. Key indicators, including soil pH, bulk density, organic matter, and nutrient concentrations (nitrogen, phosphorus, potassium), were analyzed to determine the mean, standard deviation, and range for each parameter. This analysis helped identify variations in soil quality across the locations and highlighted areas with significant degradation.

## Results

The assessment of soil degradation across three locations in Ikere Community is presented in Table 2 and Fig. 2. The aggregate degradation classes, derived from various soil indicators (bulk density, available phosphorus, potassium, nitrogen content, base saturation, and exchangeable sodium percentage), showed moderate degradation levels. Specifically, Locations A and C had an aggregate class of 2.33, while Location B was slightly lower at 2.17. As depicted in the line chart, there are minimal variations across locations, indicating relatively uniform soil conditions throughout the study area.

**Table 2:** Degradation class of soils under study

| Indicator | Location A (Ayewa Farm) | Location B (Oke-Otin Farm) | Location C (Ayodele Farm) |
|---|---|---|---|
| Soil Bulk Density (g/cm³) | 1 | 1 | 1 |
| Available Phosphorus (mg/kg) | 3 | 1 | 3 |
| Potassium (Cmol/kg) | 1 | 1 | 1 |
| Nitrogen Content (%) | 2 | 2 | 2 |
| Base Saturation (%) | 4 | 4 | 4 |
| Exchangeable Sodium Percentage (ESP) | 3 | 4 | 3 |
| Aggregate Degradation Class | 2.33 (Moderate) | 2.17 (Moderate) | 2.33 (Moderate) |

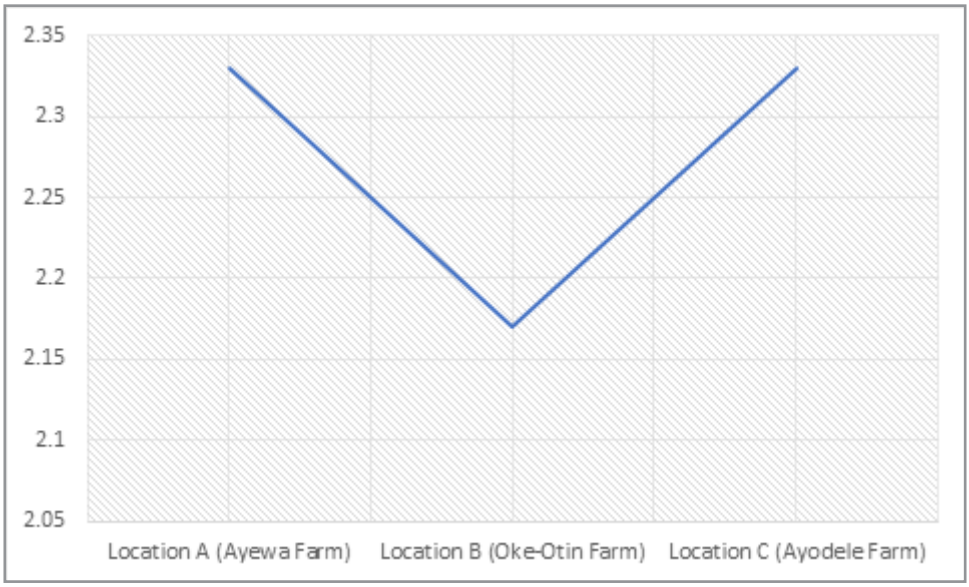


**Figure 2:** Aggregate Degradation Class Across the Locations
**Source:** Field Study

## Discussions

The moderate degradation levels observed across the sampled locations in Ikere Community reveal several important implications for agricultural productivity and soil management in the region. As indicated in Table 2, the soil bulk density levels across all three locations were classified as non-degraded, suggesting that soil compaction is not a critical issue. However, other indicators, such as available phosphorus, nitrogen content, and base saturation, highlight concerns regarding soil nutrient availability and fertility. The moderate levels of available phosphorus in Locations A and C, along with moderate nitrogen content across all locations, suggest nutrient limitations that could reduce crop productivity over time, aligning with findings from other studies on nutrient deficiencies in Nigerian soils (9).

The slightly elevated degradation class for base saturation and exchangeable sodium percentage (ESP) indicates potential challenges related to soil fertility and salinity. High base saturation can be a double-edged sword; while it implies the presence of essential cations like calcium, magnesium, and potassium, excessive saturation levels may also result in nutrient imbalances that hinder crop uptake (9, 13). Moreover, elevated ESP values, particularly in Location B, point to a risk of soil salinization, which could further impact crop growth and soil structure if not managed appropriately (14). These findings are consistent with other assessments in southwestern Nigeria, where soil degradation is often driven by poor nutrient management and increasing salinity, especially in areas subjected to intensive agricultural practices (9, 13).

The relatively uniform aggregate degradation classes across Locations A, B, and C, as shown in the line graph, indicate that soil degradation may be influenced by common factors such as similar land management practices, cropping systems, and climatic conditions across Ikere. However, the slightly higher degradation levels in Locations A and C could reflect localized effects, such as overexploitation of land for farming or insufficient replenishment of soil nutrients through organic or inorganic fertilizers. This is particularly relevant in regions where continuous cultivation without adequate fallow periods or nutrient input can accelerate soil nutrient depletion (15). In such cases, the compounding effects of nutrient mining and reduced organic matter content can progressively degrade soil quality and limit agricultural productivity (9, 10).

To address these challenges, there is a need for implementing sustainable soil management strategies. Enhancing soil organic matter through the use of compost, green manure, or crop residues can improve soil structure, nutrient availability, and water retention, which are crucial for maintaining soil health (15). Additionally, adopting conservation tillage and contour farming can help reduce soil erosion and prevent further nutrient losses, especially in sloped areas that are more prone to degradation. Considering the moderate degradation levels identified, timely interventions are essential to prevent the progression to more severe soil degradation, which could threaten food security in the region. Continuous monitoring and tailored soil management practices will be crucial to sustaining the agricultural potential of the soils in Ikere Community, ensuring they remain productive in the face of growing environmental pressures and land use changes (9, 10, 15).

## Conclusion and Recommendation

### Conclusion

This study assessed land degradation and soil conservation strategies in Ikere Ekiti, highlighting the critical role of soil management in mitigating environmental degradation. The findings demonstrate significant variations in soil fertility and erosion risks across the study area, emphasizing the need for tailored conservation measures. Soil degradation, primarily driven by improper land use and climatic factors, continues to pose a major challenge to sustainable agriculture. Effective land-use plan-

ning, alongside appropriate soil conservation strategies, can enhance land productivity and reduce degradation impacts. Further research on sustainable practices is essential for long-term soil management in the region (9, 13).

## Recommendations

To mitigate land degradation in Ikere Ekiti, it is recommended that farmers adopt soil conservation practices, such as contour farming and agroforestry, to reduce soil erosion. Additionally, integrating organic fertilizers and improved crop rotation can help enhance soil fertility. Collaboration with local agricultural extension services should be strengthened to promote sustainable farming techniques and increase community awareness on land degradation issues.


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