CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Nigeria stands as one of the leading producers of sesame in Africa, playing a significant role in the global sesame market. The country's favorable climate and agricultural potential make sesame cultivation a promising economic venture. However, sustainable sesame production hinges on understanding and optimizing soil conditions to meet the crop's specific requirements, such as adequate nutrient availability, proper pH balance, and favorable physical properties. The KwaraPoly commercial farm, recognized for its diverse agricultural activities, offers a unique opportunity to assess the feasibility of expanding sesame cultivation within the region. Conducting a detailed soil analysis will provide valuable insights into the suitability of the farm's soil for sesame production and contribute to strategies for enhancing sustainable agricultural practices in the area.

1.2 Statement of the problem

Despite sesame's economic and nutritional importance, its cultivation in Kwara State remains limited. Institutional farms like the Kwara State Polytechnic Commercial Farm have not been scientifically evaluated for sesame suitability. This lack of data hinders informed decision 1 making on crop diversification and land optimization. Hence, there is a need to assess whether the commercial farm is environmentally and agronomically fit for sesame production

1.3 Aim and Objectives:

The aim of this study is to assess the sustainability of Kwarapoly commercial farm soil for sesame production.

The Specific Objectives of this Study are to:

(i) determine the soil physical and chemical properties of the Kwara State Polytechnic commercial farm relevant to sesame cultivation.

(ii) analyze the climatic conditions of the area in relation to sesame growth requirements.

(iii) assess the topography and drainage characteristics of the commercial farm.

(iv) make recommendations on the feasibility of sesame production based on the findings.

1.5 Significance of the Study

This study offers valuable insights into the soil conditions essential for optimal sesame production, enabling farmers to adopt improved agricultural practices such as proper fertilization, soil amendment, and efficient crop management. By addressing soil deficiencies and enhancing productivity, it not only boosts farmers' yields and incomes but also strengthens the sesame value chain, supports agribusiness growth, and increases foreign exchange earnings.

1.6 Scope of the Study

The study is limited to the 20-hectare Kwara State Polytechnic Commercial Farm. It focuses on land suitability for sesame cultivation based on soil, climatic, and topographic parameters..

1.7 Limitations of the Study

Limitations include access to high-resolution remote sensing tools, time constraints, and reliance on secondary climate data. However, validated methods and expert consultations ensured data reliability.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of Sesame Production

Sesame (Sesamum indicum L.) is a widely cultivated oilseed crop known for its high oil content, reaching up to 60%, and protein content of around 20–25% (Pathak, Rai, Kumari &Bhat, 2014). In Nigeria, sesame has gained economic significance due to its demand in both domestic and international markets. According to Alegbejo (2007), Nigeria remains one of the leading producers of sesame in Africa, with the crop's economic potential especially pronounced in North-Central states such as Kwara. At Kwara State Polytechnic, sesame is beginning to gain attention in institutional farming as a potential diversification crop, although research efforts on the crop remain limited. The Department of Agricultural Technology recently initiated internal studies to assess soil compatibility with sesame, laying the groundwork for this present evaluation (KwaraPoly Soil Report, 2023).

2.2 Agronomic Requirements of Sesame Production

Sesame thrives best in well-drained, light-textured soils such as loam or sandy loam, with an ideal pH range of 5.5–8.0 to ensure optimal nutrient availability (Weiss, 2000). At KwaraPoly, upper sandy loam plots were found suitable for sesame cultivation, while lower clayey areas suffered poor drainage, increasing susceptibility to waterlogging and root diseases (Jimoh, 2021). Slight acidity (pH 5.4–6.2) in some plots suggests mild liming could improve nutrient uptake, particularly phosphorus, which was notably deficient despite moderate nitrogen levels (Akinrinde & Obigbesan, 2000). Organic matter content was generally low (below 2%), highlighting the need for compost or green manure to enhance fertility and microbial activity (Sharma & Anilakumar, 2012; KwaraPoly Soil Report, 2023).

Addressing drainage issues through raised beds, shallow ditches, and crop rotation with deep-rooted plants can further boost yield and resilience (Yohannes et al., 2015).

2.3 Land Suitability Assessment

The land suitability assessment for sesame cultivation focused on evaluating physical, chemical, and environmental conditions within the study area to determine optimal production zones. Key considerations included soil texture, slope, drainage, rainfall distribution, and temperature patterns. Using Geographic Information Systems (GIS) and Remote Sensing (RS), areas with well-drained sandy loam soils, gentle slopes, and adequate rainfall were identified as falling within the highly suitable (S1) and moderately suitable (S2) classes, based on the FAO (1976) classification. Findings align with Oyinloye et al. (2020), which reported that much of Nigeria's northern and central zones share these favorable characteristics. However, certain sections with heavy clay soils, poor drainage, or irregular rainfall were classified as marginally suitable (S3), indicating the need for targeted soil amendment, improved drainage systems, and water management strategies to enhance sesame productivity.

2.4 Soil Characteristics and Crop Performance

Field observations and soil analyses confirmed that sesame performance in the study area is closely linked to specific soil properties. The best results were recorded on well-drained sandy loam and loamy soils with moderate natural fertility, which supported healthy root development and efficient nutrient uptake. Loamy textures allowed for better aeration and root penetration, while poor drainage in heavier clay soils led to waterlogging and increased incidence of root diseases. Organic matter levels influenced microbial activity and nutrient availability, with higher contents supporting stronger crop growth. pH readings showed that slightly acidic to neutral soils (5.5–7.5) provided optimal conditions for sesame, consistent with earlier findings (Obigbesan & Aiyelari, 1992).

2.5 Climate and Sesame Cultivation

Climatic assessment for sesame within the project area was conducted using a combination of field weather records, farmer reports, and historical climate datasets. The findings indicated that sesame responded best in regions where average daytime temperatures consistently ranged between 27°C and 35°C, confirming earlier reports by Pathak et al. (2014). Although the crop tolerated extended dry periods, frost-prone areas and locations with prolonged wet spells during flowering showed noticeable reductions in pod formation. Seasonal rainfall totals between 500–1000 mm were generally adequate, but the timing proved more critical than the amount. Early seasonal showers supported uniform germination, while heavy rainfall events during flowering disrupted pollination and reduced seed set. These observations strengthen the case for sesame as a resilient crop option in climate variability and drought adaptation strategies.

2.6 Theoretical Framework

This study's analytical approach drew upon the FAO (1976) Land Evaluation Theory, applying it in a localized context to match the environmental and management conditions of the study sites with sesame's growth requirements. The evaluation process considered both biophysical factors such as soil drainage, fertility, and topography and socio-economic variables, including land tenure systems and farmer resource capacity.

2.7 Conceptual Framework

The conceptual model guiding this research illustrates how sesame productivity in the study area is determined by an interplay of environmental suitability, farmer practices, and policy support. In this framework, soil composition, rainfall patterns, and temperature regimes act as foundational elements that influence crop potential. Technical interventions such as targeted fertilizer use, drainage improvement, and timely planting enhance performance, while institutional factors, including extension service outreach and market access, influence adoption rates.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

The study used a descriptive survey and field experimentation design, combining soil sampling, laboratory analysis, satellite climate data, and physical land evaluation.

3.2 Study Area

Kwara State Polytechnic Commercial Farm is located in Ilorin and covers 20 hectares. The region lies in the Southern Guinea Savannah, with an average annual rainfall of 1,150 mm and temperature range of 22°C to 34°C.

3.3 Population of the Study

The population includes the farm's physical land features, soil profiles, climatic data, and agricultural personnel managing the farm.

3.4 Sampling Techniques and Sample Size

Thirty (30) soil samples were collected from the farm using a stratified random sampling technique. Soil was sampled at 0–15 cm depth. Climatic data were obtained from NASA POWER satellite database.

3.5 Methods of Data Collection

Soil Sampling: Tested for pH, organic matter, NPK, CEC, and texture.

Climate Data: Ten-year historical data (2014–2023) from NASA satellite.

Topography: Evaluated with GPS and clinometer.

Interviews: Conducted with farm personnel on historical land use.

3.6 Instruments for Data Collection

Instruments included soil auger, GPS, clinometer, laboratory tools, and interview guides.

3.7 Method of Data Analysis

Descriptive statistics and FAO land suitability classification were used. Land Suitability Index (LSI) scoring was applied to classify the farm.

3.8 Validity and Reliability

Data reliability was ensured by repeated soil testing and comparison with literature benchmarks. 3.9

3.9 Ethical Considerations

Permission was granted by farm authorities. Respondents were informed and consented to participation.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents and discusses the findings of the study based on data collected from the Kwara State Polytechnic Commercial Farm. Results are organized and discussed in line with the specific objectives as stated in chapter one.

4.1 Soil Properties of the Kwara State Polytechnic Commercial Farm

4.1.1 Physical Characteristics

Analysis of the 30 soil samples revealed the following dominant soil textures:

Table 4.1: Results of physical properties of the soil samples (average)

SOIL SAMPLES	AVERAGE PERCENTAGE OF SAMPLES
Sandy loam	(60% of samples)
Loamy sand	(30%)
Clay loam	(10%)

In **table 4.1,** the result shows that soil textures are favorable for sesame cultivation as they allow good drainage, root penetration, and aeration. According to Dossa et al. (2017), sesame performs best on sandy loam soils with moderate nutrient content.

Soil bulk density ranged from 1.25 g/cm^3 to 1.42 g/cm^3, which indicates good porosity for root development and water infiltration.

4.1.2 Chemical Characteristics

Table 4.2: Results of Chemical analysis (average)

Parameter	Mean Value	Sesame Optimum Range	Suitability
pH (Water)	6.3	5.5–8.0	Suitable
Organic Matter (%)	1.8	>1.5	Suitable
Total Nitrogen (%)	0.12	≥0.1	Suitable
Available Phosphorus (mg/kg)	9.6	8–15	Suitable
Exchangeable Potassium (cmol/kg)	0.38	≥0.3	Suitable
Cation Exchange Capacity (cmol/kg)	8.2	>6.0	Suitable

Table 4.2 b shows the summary of chemical analysis of the soil samples, all measured parameters fall within the recommended agronomic ranges for sesame cultivation (Ali et al., 2013). The slightly acidic pH and moderate organic matter content reflect typical savannah soils in Kwara State, making the land fertile enough for sesame growth with minimal input.

4.1.3 Climatic Suitability of the Study Area

Table 4.3: The results of climatic condition from 2014 – 2023 obtained from NASA achieve

Climatic Variable	Average Climatic condition from 2014- 2023	Sesame Optimal Range	Suitability
Annual Rainfall	1,150 mm	500–1,200 mm	Suitable
Mean Temperature	27.5°C	25°C–35°C	Suitable
Relative Humidity	62%	Moderate	Suitable
Sunshine Duration	6–8 hrs/day	>5 hrs/day	Suitable
Exchangeable Potassium (cmol/kg)	0.38	≥0.3	Suitable
Cation Exchange Capacity (cmol/kg)	8.2	>6.0	Suitable

Table 4.3 shows the results of historical climatic data (2014–2023) obtained from NASA POWER satellite datasets revealed the following averages: The climatic profile of the farm area aligns well with sesame's agronomic requirements. Rainfall in Ilorin and much of Kwara State is typically bimodal, with a dry period at the tail end of the growing season ideal for sesame harvest (Sharma & Singh, 2010). The average temperature and adequate sunshine support vegetative growth and seed filling.

4.1.4 Topographical and Drainage Characteristics

Table 4.4: Results of topographic assessment using GPS

Slope gradient	0–3% (classified as gentle slope)

Elevation range	270–310 meters above sea level
Drainage pattern	Well-drained throughout most of the land

Table 4.4 shows the topographic assessment using GPS and clinometer revealed that the terrain is gently undulating, a desirable feature for mechanized farming and water conservation. The gentle slope reduces runoff and supports moisture retention in the root zone. Drainage is sufficient to avoid waterlogging, which is crucial for sesame, a crop sensitive to excess moisture (FAO, 1976). No major erosion-prone areas were identified.

4.1.5 Composite Land Suitability Classification

Table 4.5: Land suitability index

Land Component	Suitability Score	Classification
Soil	S1 (Highly Suitable)	Meets all sesame requirements
Climate	S1 (Highly Suitable)	Rainfall and temperature optimal
Topography	S1 (Highly Suitable)	Ideal slope and drainage

Overall Land Suitability: S1 – Highly Suitable for Sesame Production

Based on the FAO land evaluation system, the study area was classified using the Land Suitability Index (LSI). The composite score for each factor in table 4.5.

4.1.6 Discussion of Findings in Relation to Objectives

Objective 1: Soil Evaluation

Findings show that the soil across the commercial farm has favorable pH, texture, and fertility levels. This confirms the suitability of the land for sesame, aligning with the results of studies by Ashri (2007) and Sadiq et al. (2019).

Objective 2: Climate Analysis

Climatic data met the optimal conditions for sesame, especially in terms of rainfall distribution and temperature. NASA satellite data affirmed that the area enjoys consistent sunshine hours and low humidity during the harvest period, minimizing post-harvest losses.

Objective 3: Topographic Assessment

The gently sloped and well-drained topography enhances the farm's agricultural viability. Sesame does not tolerate waterlogged soils, and the site's drainage capacity makes it ideal for this crop.

Objective 4: Feasibility Recommendation

Given the soil fertility, conducive climate, and topographic conditions, the Kwara State Polytechnic Commercial Farm is highly suitable for sesame cultivation. With minimal agronomic adjustments, the institution can introduce sesame as a viable training and commercial crop.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Summary

All investigated parameters indicate the farm is highly suitable for sesame. Soil fertility, favorable climatic conditions, and gentle topography support successful sesame production.

5.2 Conclusion

The Kwara State Polytechnic Commercial Farm is highly suitable (S1) for sesame cultivation. Adoption of sesame would enhance resource use, institutional training, and revenue.

5.3 Recommendations

(i) Introduce sesame cultivation in the farm.

(ii) Apply moderate fertilizer as needed.

(iii)Train staff and students on sesame agronomy.

(iv) Consider small-scale irrigation.

(v) Conduct further variety and market studies.

5.4 Contribution to Knowledge

The study shows that institutional farms in savannah zones can support sesame, bridging a research gap in crop suitability mapping.

Cost-benefit analysis of sesame production.

Region-specific pest/disease control strategy.

REFERENCES

Ali, N., Ghaffar, A., & Malik, M. (2013). Influence of soil fertility and organic matter on sesame productivity. African Journal of Agricultural Research, 8(20), 2402–2408.

Alegbejo (2007). Sesame (Sesamum indicum L.). In Genetic Resources, Chromosome Engineering, and Crop Improvement. CRC Press.

Dent, D., & Young, A. (1981). Soil Survey and Land Evaluation. George Allen & Unwin.

Dossa, K., Diouf, D., Wang, L., & Zhang, Y. (2017). Sesame production and its importance in the agricultural economy. Oil Crops Research, 4(3), 122–128.

FAO (1976). A Framework for Land Evaluation. Soils Bulletin 32. Rome. FAO.

(1976). A Framework for Land Evaluation. FAO Soils Bulletin No. 32.

FAO. (2020). Crop Prospects and Food Situation Quarterly Global Report.

FAO (2022). FAOSTAT Statistical Database. Food and Agriculture Organization of the United Nations. Alegbejo, M. D. (2017). Sesame production and constraints in Nigeria. Journal of Agricultural Extension, 21(1), 11–19.

Kwara State Ministry of Agriculture. (2022). Agro-climatic data report.

Obigbesan, G.O., & Aiyelari, E.A. (1992). Soil fertility and sesame productivity in Nigeria. West African Journal of Agriculture, 3(2), 45–52.

Oyinloye, M.A., Adepoju, K.A., & Ogunwale, A. (2020). GIS-based land suitability evaluation for sesame cultivation in Nigeria. Journal of Environmental Management, 275, 111231.

Ojo, M. A., & Ayodele, O. M. (2021). Land suitability assessment for sesame production in Central Nigeria. Journal of Soil and Water Conservation, 19(4), 45–52.

Pathak, H., et al. (2014). Agronomic practices for sesame under changing climatic conditions. Indian Journal of Agronomy, 59(2), 215–220.

Sadiq, M. S., Bala, A., & Yusuf, A. (2019). Land evaluation for sesame production in parts of Middle Belt Nigeria. Nigerian Agricultural Journal, 50(1), 57–66.

Sharma, A., & Singh, V. (2010). Climate variability and sesame yield. Agricultural Meteorology Digest, 15(2), 101–110.

Sys, C., Van Ranst, E., & Debaveye, J. (1991). Land Evaluation Part I: Principles in Land Evaluation and Crop Production Calculations. ITC, Ghent University.

Umar, B., Abdullahi, A., & Sulaiman, M. (2014). Comparative analysis of sesame production under different farming systems. Journal of Agricultural Extension, 18(2), 40–52.

Weiss, E.A. (2000). Oilseed Crops. Blackwell Science Ltd. Okpara, D.A., & Omaliko, C.P.E. (1995). Response of sesame to nitrogen and phosphorus fertilizers. Nigerian Agricultural Journal, 26(2), 89–95.