ASSESSING THE SUITABILITY OF KWARA STATE POLYTECHNIC COMMERCIAL FARM SOIL FOR SESAME PRODUCTION

BY

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF AGRICULTURAL AND BIO-ENVIRONMENTAL ENGINEERING TECHNOLOGY, CENTRE FOR CONTINUING EDUCATION, KWARA STATE POLYTECHNIC, ILORIN.

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CERTIFICATION

I, hereby declare that this research project titled ASSESSING THE SUITABILITY OF KWARA STATE POLYTECHNIC COMMERCIAL FARM FOR SESAME PRODUCTION Was carried out by BOBOYE BOLUWATIFE TEMILOLUWA ND/23/ABE/PT/0026 is my own work and has not been submitted by any other person for any degree or diploma in any higher institution. I also declare that the information provided therein are mine and those that are not mine are properly acknowledged.

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DEDICATION

I dedicate this project entirely to God Almighty, whose boundless grace, wisdom, and strength have carried me from the beginning to the completion of this work. His divine guidance provided perseverance during challenges and inspiration in moments of doubt. Truly, without His mercy and blessings, this accomplishment would not have been possible.

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Above all, I am deeply indebted to my family for their steadfast support, understanding, and sacrifices throughout my academic pursuit. Their love, motivation, and belief in me have been the driving force behind this achievement.

ABSTRACT

This study assessed the suitability of the Kwara State Polytechnic Commercial Farm, Ilorin, for sesame (Sesamum indicum L.) production. The evaluation was based on soil properties, climatic data, and topographical characteristics. A total of 30 soil samples were collected and analyzed for physical and chemical properties, including texture, pH, organic matter, nitrogen, phosphorus, and potassium content. Climatic data covering a 10-year period (2014–2023) were obtained from NASA satellite databases. Topographical assessment was conducted through field survey using GPS and clinometer tools. Results showed that the farm's soil is predominantly sandy loam and loamy sand, with favorable pH (6.3), moderate organic matter, and adequate nutrient levels. Climatic conditions, including rainfall (1,150 mm/year), temperature (27.5°C), and sunshine duration, were all within optimal ranges for sesame. The terrain is gently sloping (0–3%) with good drainage. Based on FAO land suitability classification, the farm was rated as "Highly Suitable (S1)" for sesame production. The study recommends sesame adoption in the farm's crop program and highlights the potential for institutional training, research, and commercialization.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Sesame production remains a key component of Nigeria’s agricultural sector, with the nation ranking among Africa’s top contributors to the global market. The combination of favorable agro-climatic conditions and extensive arable land positions the crop as a viable source of economic growth. Achieving consistent and sustainable yields, however, requires a detailed understanding of the soil environment, including nutrient status, pH levels, and structural composition. The commercial farm at Kwara State Polytechnic, known for its broad crop portfolio, presents an ideal setting for evaluating the potential expansion of sesame cultivation. A comprehensive soil assessment at this site will not only clarify its capacity to support sesame growth but also inform broader efforts to promote long-term, environmentally sound farming practices within the region.

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 Kwara State Polytechnic commercial farm soil for sesame production while 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

The findings from this research provide a clearer understanding of the soil characteristics required for high-performing sesame cultivation. Such knowledge empowers farmers to implement better production strategies, including targeted nutrient management, soil enrichment, and effective field practices. In turn, these improvements contribute to the expansion of agribusiness opportunities and enhance the country's capacity to generate foreign exchange through sesame exports.

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

2.0 LITERATURE REVIEW

2.1 Overview of Sesame Production

Sesame (*Sesamum indicum* L.) is an important oilseed crop cultivated extensively across tropical and subtropical regions, prized for its remarkable oil yield that can reach 60% and its substantial protein concentration of about 20% to 25% (Pathak, Rai, Kumari, & Bhat, 2014). In Nigeria, sesame plays a vital role in the agricultural economy due to its increasing demand in both local consumption and the export trade. Alegbejo (2007) notes that Nigeria remains one of Africa's top sesame-producing nations, with production potential particularly strong in North Central states such as Kwara. Recently, Kwara State Polytechnic has shown growing interest in sesame cultivation as part of institutional farming programs aimed at diversifying crop options. Despite this interest, scientific studies on sesame at the institution are still limited. To address this gap, the Department of Agricultural Technology has begun preliminary soil suitability trials, serving as the basis for the present research work (KwaraPoly Soil Report, 2023).

2.2 Agronomic Requirements of Sesame Production

Sesame performs optimally on light-textured, well-drained soils such as loam or sandy loam, with a favorable pH range between 5.5 and 8.0 for maximum nutrient absorption (Weiss, 2000). Investigations at KwaraPoly revealed that upper sandy loam plots were more suitable for sesame, whereas lower-lying clay soils exhibited poor drainage, making them prone to waterlogging and root-related diseases (Jimoh, 2021). Slight soil acidity (pH 5.4–6.2) in certain locations suggests that mild liming could enhance phosphorus availability, which was observed to be deficient despite adequate nitrogen content (Akinrinde & Obigbesan, 2000). Organic matter levels were consistently low, under 2%, underscoring the need for organic amendments such as compost or green manure to boost fertility and microbial activity (Sharma & Anilakumar, 2012; KwaraPoly Soil Report, 2023). Furthermore, practices such as constructing raised beds, introducing shallow drainage ditches, and rotating with deep-rooted crops can help alleviate drainage problems and improve yields (Yohannes et al., 2015).

2.3 Land Suitability Assessment

The assessment of land suitability for sesame in the study area considered a range of physical, chemical, and climatic characteristics to identify the most favorable production zones. Parameters such as soil texture, slope, drainage capability, rainfall distribution, and temperature regimes were analyzed. Utilizing Geographic Information Systems (GIS) alongside Remote Sensing (RS) techniques, areas with sandy loam soils, gentle slopes, and adequate rainfall were classified as highly suitable (S1) or moderately suitable (S2) according to the FAO (1976) classification system. These findings align with Oyinloye et al. (2020), who reported similar suitability patterns across much of northern and central Nigeria. Conversely, areas with heavy clay soils, poor drainage, or inconsistent rainfall patterns were categorized as marginally suitable (S3), indicating a need for interventions such as soil improvement, drainage enhancement, and water management to increase productivity.

2.4 Soil Characteristics and Crop Performance

Soil properties were found to be directly linked to sesame crop performance in the project area. The best growth was recorded on sandy loam and loam soils with good drainage and moderate inherent fertility, which encouraged robust root development and efficient nutrient uptake. Loamy soils facilitated better aeration and root penetration, while heavy clay soils suffered from water retention problems that promoted root disease incidence. Organic matter played a significant role in influencing microbial activity and nutrient cycling, with higher levels supporting healthier plant growth. Soil pH measurements indicated that slightly acidic to neutral conditions (5.5–7.5) were most favorable for sesame, which corresponds with the results of earlier studies (Obigbesan & Aiyelari, 1992).

2.5 Climate and Sesame Cultivation

Climatic evaluation for sesame production in the study zone drew on local weather records, farmer observations, and historical climate datasets. Results showed that sesame thrived best where daytime temperatures consistently ranged from 27°C to 35°C, supporting the findings of Pathak et al. (2014). While the crop demonstrated tolerance to periods of drought, frost-prone zones and areas experiencing extended rainfall during flowering saw reductions in pod set. Seasonal rainfall totals of 500–1000 mm were found to be sufficient, but the distribution was more important than the total. Early rains promoted uniform germination, whereas heavy downpours during flowering negatively affected pollination and seed formation. These results reinforce sesame's potential as a climate-resilient crop suitable for drought adaptation strategies.

2.6 Theoretical Framework

The theoretical basis for this study is anchored in the FAO (1976) Land Evaluation Theory, adapted to local conditions to align sesame's agronomic requirements with the environmental and management realities of the study sites. Both biophysical factors, including soil drainage, fertility, and slope, and socio-economic factors, such as land tenure arrangements and farmer resource availability, were taken into account to provide a comprehensive evaluation framework.

2.7 Conceptual Framework

The conceptual approach adopted in this research demonstrates how sesame productivity in the study area is shaped by the interaction of environmental suitability, agronomic practices, and institutional support. Within this model, variables such as soil texture, rainfall timing, and temperature ranges form the physical foundation for yield potential. These are complemented by management practices, including targeted fertilizer applications, drainage control, and timely planting, which enhance crop performance. Additionally, institutional elements such as extension services, policy incentives, and market accessibility play a critical role in determining the rate of adoption and sustainability of sesame cultivation in the region.

CHAPTER THREE

3.0 MATERIALS AND METHODS

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

The study area is Kwara State Polytechnic Commercial Farm, it 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

4.0 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℃	25℃ – 35℃	Suitable
Relative Humidity	62%	Moderate	Suitable
Sunshine Direction	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 GP

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

5.0 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.

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