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

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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 **AJILEYE KAOSARAT OLUWATUNMININU** ND/23/ABE/PT/0024 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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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

Nigeria holds a strong position as one of Africa's top sesame producers, with the crop playing a crucial role in the global market. The country's warm climate and fertile lands make it an ideal place for sesame farming, offering farmers a chance to tap into its growing demand. However, growing sesame successfully isn't just about planting seeds about understanding what the crop needs to thrive. Sesame depends on healthy soil, rich in nutrients like nitrogen and phosphorus, with the right pH levels and good drainage to support its growth. This is about more than just agriculture; it's about creating opportunities for farmers, strengthening the economy, and securing Nigeria's place in the global sesame trade.

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

This research will provide valuable information for agricultural planning, especially within institutional settings. It will help Kwara State Polytechnic utilize its land more efficiently, support student training, and promote sesame as a viable commercial crop. The findings could also serve as a model for similar assessments in other regions.

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 recognized as one of the oldest cultivated oilseed crops globally, valued for its edible seeds and premium-quality oil. Often referred to as the "queen of oilseeds," sesame is notable for its high oil content, which ranges from 44% to 60%, and its rich nutritional composition. Globally, leading producers of sesame include Sudan, India, Myanmar, China, Nigeria, and Ethiopia (FAO, 2022).

In Nigeria, sesame has increasingly become an important cash and export crop, contributing significantly to the country's foreign exchange earnings. The crop thrives particularly in the Middle Belt and northern regions, such as Benue, Nasarawa, Jigawa, and Taraba states (Alegbejo, 2017). Its drought tolerance, minimal input requirements, and adaptability to diverse agro-ecological zones make it well-suited to smallholder farming systems.

2.2 Agronomic Requirements of Sesame Production

Successful sesame cultivation is influenced by specific agronomic conditions. The crop performs best in well-drained, moderately fertile soils and thrives in warm climates, with ideal temperature ranges between 25°C and 35°C. Although sesame is drought-tolerant, it requires moderate annual rainfall of 500–1000 mm and is highly sensitive to waterlogging (Weiss, 2000).

Key agronomic practices include timely land preparation, sowing at the onset of rains, appropriate spacing (usually 30–45 cm between rows), and early weed control, particularly within the first month after planting. While sesame can grow with minimal fertilization, the application of nitrogen and phosphorus fertilizers can enhance yield in nutrient-deficient soils (Okpara & Omaliko, 1995).

2.3 Land Suitability Assessment

Land suitability assessment is crucial for optimizing sesame production. It involves evaluating physical and environmental parameters such as soil type, topography, drainage, rainfall, and temperature to determine the land's capacity to support sesame cultivation.

Modern techniques, including Geographic Information Systems (GIS) and Remote Sensing (RS), have been widely applied in assessing land suitability. According to the FAO (1976) framework, land is categorized into suitability classes: highly suitable (S1), moderately suitable (S2), marginally suitable (S3), and not suitable (N).

In Nigeria, studies have identified extensive areas in the northern and central regions as moderately to highly suitable for sesame cultivation, owing to favorable soil conditions, optimal slope gradients, and rainfall distribution (Oyinloye et al., 2020).

2.4 Soil Characteristics and Crop Performance

Soil properties greatly influence sesame growth and yield, with well-drained sandy loam or loamy soils of moderate fertility being the most suitable. Loamy soils are particularly beneficial because they allow good root penetration, aeration, and nutrient absorption. Adequate drainage is also crucial, since poor drainage can lead to waterlogging, root diseases, and stunted growth.

Organic matter improves soil structure, supports microbial activity, and enhances the availability of nutrients, while soil pH in the slightly acidic to neutral range (5.5–7.5) provides the best conditions for sesame production.

In addition to these natural soil characteristics, fertility management practices play a vital role in ensuring good crop performance. The use of organic manure enriches the soil and improves its quality, while balanced nutrient application helps sustain yield. However, excessive application of nitrogen fertilizers may result in vigorous vegetative growth at the expense of seed production, thereby reducing overall yield (Obigbesan & Aiyelari, 1992).

2.5 Climate and Sesame Cultivation

Climate is a major determinant of sesame productivity. Sesame requires a warm growing season and is highly sensitive to frost. The optimal temperature range for growth is between 27°C and 35°C. Though it can tolerate dry conditions, the crop needs about 500–1000 mm of rainfall annually for optimal growth.

The distribution and timing of rainfall are particularly important. Early-season rainfall is beneficial for germination, while excessive moisture during flowering and seed maturation phases can lead to reduced pollination, pest pressure, and yield loss (Pathak et al., 2014). Due to its resilience to drought, sesame is considered a climate-smart crop suitable for adaptation to changing environmental conditions.

2.6 Theoretical Framework

This study is underpinned by the Land Evaluation Theory developed by the FAO (1976), which provides a systematic methodology for determining the suitability of land for specific agricultural purposes. The framework involves matching the physical and socio economic characteristics of land with the ecological and agronomic requirements of the intended crop in this case, sesame.

This theoretical foundation is essential for identifying optimal land areas, improving resource use efficiency, and promoting sustainable land management for sesame production.

2.7 Conceptual Framework

The conceptual framework for this study illustrates the interaction between environmental, technical, and institutional factors in determining sesame productivity. It connects key variables such as soil properties, climate (rainfall and temperature), and agronomic practices with institutional elements like land use policies and extension services. The framework is adapted from Dent and Young (1981), emphasizing that sesame yield is not solely determined by natural conditions but also by the effectiveness of land management and policy intervention.

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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