

# **SUITABILITY ASSESSMENT OF SOILS OF OKEMESI ASSOCIATION FOR MAIZE, RICE AND CASSAVA PRODUCTION USING PARAMETRIC AND GIS-BASED METHODS**

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### DEDICATION

To the King eternal, immortal, invisible, the only wise God, the one whose grace suffices me in all things, unto Him be the glory, honour and majesty forever, Amen.

OBAFEMI AWOLOWO UNIVERSITY

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## ABSTRACT

The study characterized, assessed the suitability for the production of maize, rice and cassava using parametric and geographic information system approaches, compared the current land use with potential land use of soils of Okemesi Association and developed a management strategy. This was with a view to providing information on the suitability of the soils of Okemesi Association for crop production in the area.

The study was carried out at the immediate surroundings of Okemesi and Efon Alaaye settlements' area, in Ekiti State. Two toposequences, one at Efon Alaaye (ET) and the other at Okemesi (OT), were established and each was delineated into its physiographic units. A total of ten soil profile pits were established, described and sampled. The soil samples were analyzed for the particle-size distribution, pH, electrical conductivity, available phosphorus, organic matter, total nitrogen, exchangeable acidity, exchangeable bases and extractable micronutrients. The effective cation exchange capacity (ECEC) and base saturation were also computed. The site and soil properties were used to formulate the land characteristics and qualities used for parametric scores and GIS analysis.

The results showed that the colour, depth and texture of the soils varied in response to changes in slope position and drainage condition. Surface soil colour ranged from very dark gray (5YR 3/1) to dark yellowish brown (10YR 3/4) in soils on ET and dark reddish brown (5YR 3/3) to dark yellowish brown (10YR 3/4) on OT. The texture of the soils varied from slightly gravelly sand to very gravelly sandy clay, and slightly gravelly loamy sand to very gravelly sandy clay on ET and OT, respectively. The soils were slightly to strongly acid in reaction on ET and OT. Total exchangeable bases (TEB), total exchangeable acidity (TEA), the organic matter, total nitrogen and available phosphorus were generally low in soils on ET and OT. The



extractable micronutrients' (Cu, Fe, Mn and Zn) concentrations varied from low to medium in soils of the two toposequences. Parametric suitability evaluation showed that soils on the two toposequences were not suitable (NS) for the cultivation of maize, rice and cassava in their current condition, and the potential suitability of the soils for maize, rice and cassava were marginally suitable (S3) irrespective of the physiographic position. The GIS-based suitability ratings mapped the soils as S3 and NS for the cultivation of the three crops. This showed that parametric and GIS suitability rating approaches seemed not to give exactly the same results with respect to the marginal soils of Okemesi Association.

It was concluded that the soils of Okemesi Association are better reserved for nature conservation in order to prevent their rapid degradation as a way of managing the land resources.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background information

Soil as a natural resource, is one of the marvelous products of nature, without which there would be no life. This is because soil supports plants, which provide food for man and his livestock (Faniran and Areola, 1978; Summer and Wilding, 2000). Soil is also a product of interactions among parent material, relief, climate, organisms over a period of time. It covers most lands of the earth, but regarding its service for humans, soil is a limited and largely non-renewable resource (Blum, 2006).

Maize (*Zea mays*), Rice (*Oryza sativa*) and Cassava (*Manihot esculenta*) are important staple food crops playing dominant roles in the rural economy of Southwestern (SW) Nigeria. Rice is the world's most important staple food crop, and according to FAO (2001), four fifth of the world's rice is produced and consumed by small-scale farmers in low income developing countries where more than half of the population relies on rice as the major daily source of food. Maize on the other hand, is the most important cereal crop in Sub-Saharan Africa. Worldwide production of maize is 785 million tons, and the largest producer, the United States of America, produces 42% while Africa produces 6.5%, and the largest African producer is Nigeria with nearly 8 million tons (IITA, 2009a). In Sub-Saharan Africa, cassava is mainly a subsistence crop grown for food by small-scale farmers who sell the surplus. It grows well in poor soils with limited requirements. More than 228 million tons of cassava were produced worldwide in 2007, of which Africa accounted for 52%. In 2007, Nigeria produced 46 million tons making it the world's largest producer. According to FAO (2002) estimates, Africa exports only 1 ton of

cassava annually. Nearly every person in Africa eats around 80 kilograms of cassava per year. It is estimated that 37% of dietary energy comes from cassava (IITA, 2009b). In Nigeria, there is an ongoing campaign for the use of cassava flour as a substitute for wheat flour in baking and bread-making in order to reduce reliance on wheat flour importation and therefore, increase dependence on local raw material. In a bid to redress the country's undue dependence on 100% wheat flour for bread-making and other confectioneries, the Federal government came up with the policy of gradually increasing the substitution of high grade cassava flour from 10 to 40%. With this cassava bread initiative, especially the production of composite bread in commercial quantity, local farmers would have the opportunities to experience high returns (Awareness, 2014).

On the globe, about 3.2 billion hectares are used as arable land, which is about a quarter of the total land area (Scherr, 1999; Davis and Masten, 2003). Total agricultural land covers about 40–50% of the global land area (Smith *et al.*, 2007). The development and survival of civilizations have been based on the performance of soils on lands to provide food and further essential goods for humans (Hillel, 2009). Global issues of the 21st century like food security, demands of energy and water, climate change and biodiversity are associated with the sustainable use of soils (Lal, 2008, 2009; Jones *et al.*, 2009; Lichtfouse *et al.*, 2009). Nowadays, the population of the planet is growing dramatically (Liu *et al.*, 2006).

Land suitability evaluation is defined as the classification of lands in terms of their suitability for a given use. De La Rosa and Van Diepen (2002) stated that the main object of the land suitability evaluation is the prediction of potential capacity of the land unit for a given use without deterioration. However, the potential of the land for crop production to satisfy the

demand of the ever increasing population is declining as a result of severe soil degradation (Lal, 1994).

## 1.2 Statement of research problem

Early research efforts on soils of SW Nigeria were to solve some agricultural problems. Study by Smyth and Montgomery (1962) were geared towards solving the problem posed by poor yield of Cacao (*Theobroma cacao*). Later research efforts centered around suitability of soils other than Okemesi Association for selected crops. Soils of Okemesi Association are derived from quartz schist and massive quartzite parent rock. The soils have inherent low fertility status and are situated in strongly undulating to rolling terrain. Soils of Okemesi Association are regarded as marginal land for cultivation. A marginally suitable land has limitations which in aggregate could be severe for sustained application of a given use and will so reduce productivity or benefits, or increase required inputs, that the expenditure will be only marginally justified (FAO, 1976). Due to increase in the world's population, there is considerable need for increase in food production in order to meet food demand. This involves making use of good agricultural and marginal lands with or without amendments for food crop production.

## 1.3 Objectives of the study

The soils of Okemesi Association have their unique attributes and peculiarities. In view of these, the specific objectives of the study were to

- (a) characterize the soils of Okemesi Association;
- (b) assess the suitability of the soils for maize (*Zea mays*), rice (*Oryza sativa*) and

cassava (*Manihot esculenta*) production;

(c) compare the current land use of Okemesi Association with its potential land use; and

(d) develop a land management strategy for optimum sustainable crop production.

For more information, please contact [ir-help@oauife.edu.ng](mailto:ir-help@oauife.edu.ng)

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