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INDIGENOUS KNOWLEDGE ON LAND EVALUATION AND SOIL FERTILITY MANAGEMENT AMONG RURAL FARMERS IN MUBI NORTH LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA

***[1]Danjuma I. Garandi, [1]Hassan Saad Tanko, [1]Hyelnacha A. Bukar, [2]Abbas Bashir, [2]Mohammed Saadu Dasin, [2]Paulinus I. Chukwu, [3]Peter Gabul, and [4]Phelimon Wesley**

[1]Department of Geography and Environmental Sciences, Adamawa State University Mubi, Adamawa State, Nigeria.
[2]Department of Geography, Modibbo Adama University Yola, Adamawa state, Nigeria.
[3]Department of Agric. Economics, Federal University of Agriculture Mubi, Adamawa State, Nigeria.
[4]Department of Geography, Federal University of Agriculture Mubi, Adamawa State, Nigeria.

*Corresponding authors' email: igarandi97@gmail.com

ABSTRACT

The study was carried out to analysed the indigenous knowledge system on land evaluation and soil fertility management among rural farmers in selected communities in Mubi North. Understanding farmers' indigenous knowledge on land evaluation and soil fertility management practices means understanding local realities that are important for sustainable agricultural productivity. This study was conducted in three rural communities in Mubi North to evaluate the perception of rural farmers on traditional land evaluation and soil fertility management practices through direct and indirect interviews. Structured questionnaires were administered to 100 rural farmers in three farm settlements. The major local methods of evaluation adopted by majority of the farmers include the vigour of native vegetation, presence of certain indicator plants and visual appraisal. Fertility ranking of the farmers correlated with values of Organic carbon ($r = 603^*$ $p < 0.05$) and Available P. ($r = 647^*$ $p < 0.05$) obtained from laboratory analysis. Though a large proportion of farmers (72 %) have applied chemical fertilizers (mainly to arable crops) at one time or the other, cultural methods such as multiple cropping (intercropping) and cover cropping are employed to manage soil fertility in their farms. Rural farmers demonstrated significant knowledge of their soils and the environment acquired by experiences that have been tested by many years of living close to the farmland. In view of the importance in applying a holistic approach to study land evaluation, local soil knowledge provides key linkages between ancient and modern soil management.

Keywords: Indigenous knowledge, Land evaluation, Rural farmers, Soil fertility

INTRODUCTION

Sustainable management of land for agricultural and non-agricultural purposes requires basic understanding of the resources to be managed (Paradzayi and Ruther 2002). Land resource surveys and the subsequent soil survey interpretation -qualitative and quantitative land evaluation- have been used to classify and quantify land classes with soil characteristics or attributes that control agricultural productivity as well as vulnerability to degradation (Lin *et al* 2005). In developing countries such as Nigeria, information from land inventories rarely gets to the farmer; rather they are most times filtered through the extension agents (Ahmed and Salisu 2021).

The optimism that greeted the FAO framework for land suitability classification (FAO 1976, 2007) has gradually given way to a realization that its focus on static land use planning is not appropriate to today's network society where multiple stake holders negotiate land use (Barrera-Bassols *et al.*, 2001). Also, according to Bacic *et al.* (2003), some important questions that remain unanswered by soil inventories and land evaluation reports include the usefulness to the clients (in this case, farmers) and if the information supplied land evaluation reports are actually being used for land use planning.

A common fault in current land evaluation systems worldwide is that interpretations of technical data are rarely tailored to the specific needs of individual decision makers and are usually carried out according to fixed evaluation systems (Ryder, 2003). While maps are usually presented in scales of 1:25,000 or smaller, implying a minimum delineation of 2.5 ha, farmers' fields in many cases are no more than 0.5ha. While the methodology evaluates general land utilization types (LUTs) and physical aspects of land suitability, farmers use a variety of technologies including soil conservation practices, multiple cropping, relay intercropping, etc. to grow a wide range of crops taking decisions based on available resources and their experience or 'local knowledge' *(*Giulio, 2018).

The knowledge that people in a given community or environment have developed over time and continue to develop is often referred to as 'indigenous' or 'local' or 'traditional' or 'indigenous technical knowledge' (Cools *et al*, 2003: Gizaw and Haile, 2021). It is a body of knowledge built up by a group of people through generations of living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a set of self-management that govern resource-use. Local people have significant knowledge of soils and environments, acquired by experiences that have been tested by many generations living close to the land which is crucial for success or failure of any type of agriculturally- based development (WinklerPrins, 1999; WinklerPrins and Sandor, 2003).

Despite the recognized importance of indigenous farming knowledge in promoting sustainable agricultural practices, rural farmers in Mubi North Local Government Area (LGA), Adamawa State, face significant challenges in effectively utilizing these traditional techniques. The growing influence of modern agricultural practices, driven by industrialization and globalization, has led to a decline in the adoption and integration of indigenous knowledge systems. As a result, many farmers are increasingly relying on modern inputs and practices that may not be well-suited to the local environmental conditions, potentially compromising long-term agricultural sustainability and food security (Danjuma *et* *al 2025)*. There has been little or no use of land evaluation information among rural farmers in Nigeria due to lack of access, or technical knowhow to understand the conventional reports. This study was designed to understand the farmers' indigenous knowledge on land evaluation with respect to farming and quantify their perception on the management of soil fertility.

MATERIALS AND METHODS

The study was carried out in Mubi North Local Government Area, Adamawa State, and North-eastern Nigeria. The local government has over 45 villages (Adebayo, 2004), with numerous farms. It has a population of about 175,165 people (National Population Census, 2006) spread over 11 political wards. It lies on the west bank of the river Yedseram (a stream that flow north into Lake Chad) and on the western flank at the foot of the Mandara mountain.

Mubi North Local Government Area covers a land mass of about 752.85km^2 (Adebayo, 2004). It is one of the twenty-one Local Government Area of Adamawa State and lies between latitude $9^0$26”1’ and latitude $10^0$10”1’ N and between longitude $13^0$11”00’ and $13^0$44”01’ E (ministry of land and survey Yola, Adamawa state). The entire town and its environs bordered with Maiha Local Government area on the south, Hong Local Government on the west, Michika Local Government on the north and Cameroon republic to the east (Adebayo, 1997).

Mubi local government area is made of four districts namely: Mubi which is the administrative centre (seat) of the local government area, mayo-bani, Ba'a and mijilu. It is made up of eleven wards which include: Yelwa, Sabon Gari, Kolere, Lokuwa, Vimtim, Digil, Bahuli, Muchalla, Mujilu, Betso, and Mayo-Bani. Mubi north local government area has a number of ethnic groups such as Gude Nzanyi, Fali, Kilba, Marghi, Kamwe(higi), Fulani and Mundang (Godo-godo) (Adebayo, 2004).

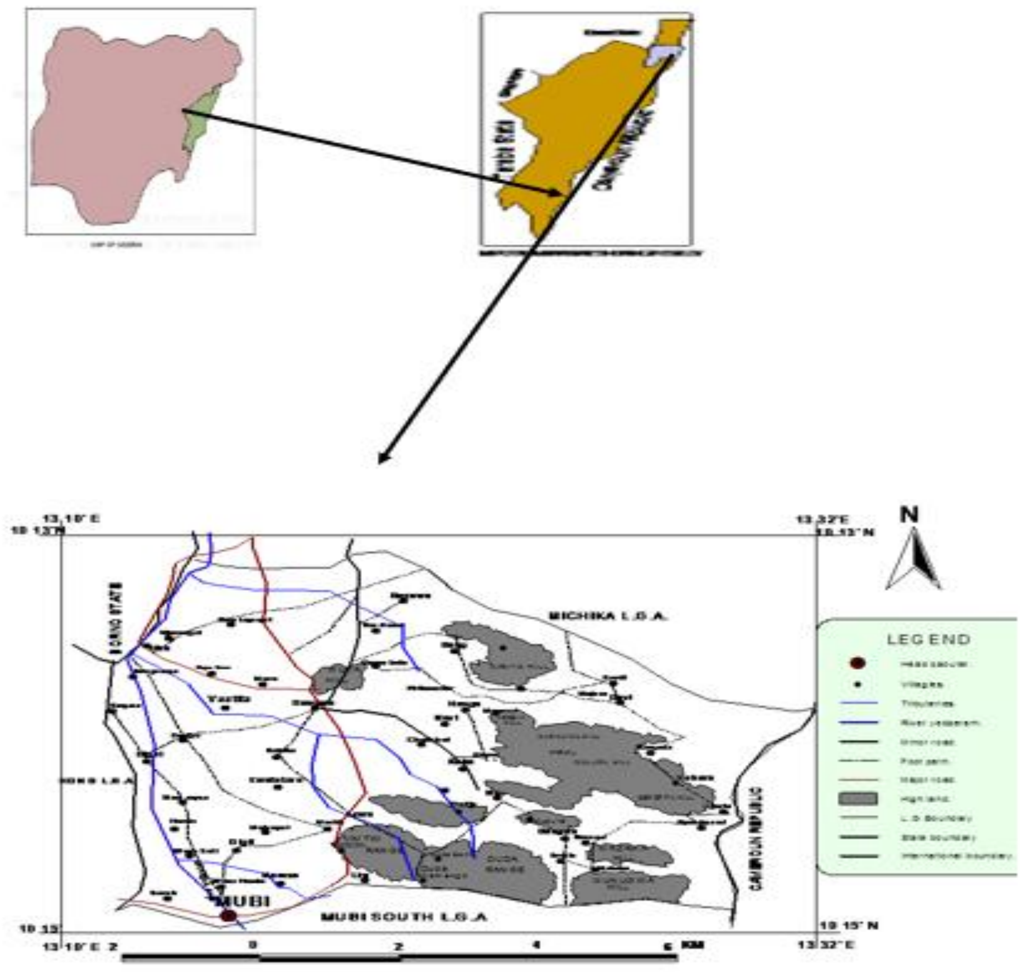

Figure 1: The Study Area
Source: Adebayo, 2004, modified by author

Structured questionnaires were administered to 100 rural farmers in three farm settlements in Mubi North L.G.A, Adamawa State, Nigeria. The farm settlements are located at Bahuli, Mayo Bani and Vimtim (Fig. 1). The questionnaires have 31 questions divided into 5 parts namely: (i) Personal/ general information, (ii.) Land use/land characteristics (iii.) Indigenous land evaluation methods (iv.) Soil fertility management and (v.) Interaction with relevant agencies.

While self-identification was optional, distribution was by personal contact and the questionnaires were collected on the second visit. Answers to structured questions were entered into Microsoft Excel spreadsheet (Microsoft Corporation,

2016) and the proportions of respondents for each answer were summarized with simple statistics and percentages.
Group interviews and transect walks were held at Bahuli and Vimtim farm settlements as a follow up to the questionnaires during which farmers were allowed to allocate the land by their perceived fertility assessment to a scale of 0 to 10- 0 being the poorest and 10 being the most fertile. A transect each cutting across the physiographic landscape were laid at the two farm settlements and bulked composite soil samples from 0-20 cm depths were collected from three locations representing the upper slope, middle slope and lower slope positions along the transect for laboratory analysis. The soils were air dried, sieved through 2mm aperture and were subjected to routine soil analysis using standard procedures. Particle size analysis was by the Hydrometer method described by Day (1965). Soil pH was determined at 1:2.5 soil/water ratio, by a glass electrode digital pH/conductivity meter. Organic carbon was determined by the Chromic Acid Wet oxidation method while total nitrogen was estimated by the micro-Kjedhal procedure of Jackson, 1978. Exchangeable cations (Ca, Mg, K and Na) were extracted with normal ammonium acetate at pH 7. Na and K were determined by flame photometry method while Ca and Mg were determined by atomic absorption spectrophotometer. Exchangeable acidity was extracted with normal KCl and titrated with NaOH. Available P was extracted with Bray 1 solution and P content assayed by the Molybdate blue colour method. Effective Cation Exchange Capacity (ECEC) was computed. Farmers' fertility ranking was correlated with the values three major soil chemical fertility indices namely organic carbon, Total N and Available P.

RESULTS AND DISCUSSION

Demographic Characteristics of Rural Farmers

Table 1 shows the personal characteristics of the rural farmers in the three farm settlements. Farm production in this part of the country is by men and women in Bahuli, Mayo Bani and Vimtim farm settlements. This is probably a cultural issue as in most rural farming producing areas in Nigeria; women are allowed and permitted by tradition to own farm lands.
In terms of age distribution, more than half of the rural farmers in the three farm settlements are well above 50 years with 34.60 % between the ages of 55-65 while 14.30% are above 65 years. More than 60% of the farmers At Mayo Bani, are 55 years and above. This has been observed by Abolagba (2004) who reported that most rural farmers in Nigeria are above 50 years in age. Most of the rural farmers are married. 97.1 % overall. Apart from a farmer who did not respond to the marital status question at Mayo Bani and one respondent who is widowed, at Bahuli, all other respondents from the three farm settlements reported that they are married. The educational level showed that only 2.90 % of responding rural farmers had no formal education signifying that the farmers are mostly literate. Though only 7.2 % overall had post-secondary education (some of which are actually retired civil servants or Teachers) it is commendable that the rural farmers are over 90% literate having one form of training or the other. 80.63 % of the total respondents have farming as their primary occupation; Mayo Bani had about 90% primarily engage in different crops cultivation meaning that many households in the study areas make their likelihood through farm cultivation.

Table 1: Characteristics of the Rural Farmers in Three Farm Settlements in Mubi North

Characteristics	Number of respondents (%)			
	Bahuli	**Mayo Bani**	**Vimtim**	**Combined**
Gender				
Male	55	50	48	100
Female	45	50	52	100
Age				
24-35	9.60	0.00	0.00	2.90
36-45	19.10	3.60	30.00	15.70
46-55	32.90	14.30	30.00	24.40
56-65	33.40	42.90	25.00	34.60
65 and above	4.8	21.4	15.00	14.30
No response	0.0	17.9	0.0	7.20
Marital Status				
Single	0.00	0.00	0.00	0.00
Married	98.60	96.40	100.00	97.10
divorced	0.00	0.00	0.00	0.00
Widowed	4.8	0.00	0.00	1.40
No response	0.00	3.60	0.00	1.40
Education				
No formal education	4.80	3.60	5.00	2.90
Adult Education	0.00	7.10	5.00	4.30
Vocational training	19.00	28.60	15.00	1.40
Primary	71.40	57.10	45.00	58.0
Secondary	19.00	28.60	25.00	24.6
Post-Secondary	4.80	3.60	15.00	7.20
Primary Occupation				
Rubber farming	72.40	90.80	69.50	80.63
Others	27.60	7.20	15.00	

Table 2: Methods of Determining Land Suitability and Perceived Effects of Soil on Farm Yield As Perceived By Rural Farmers in Three Farm Settlements in Mubi North

Methods	Number of respondents (%)			
	Bahuli	Mayo Bani	Vimtim	Combined
Visual appraisal	42.9	57.10	40.00	48.50
Indicator plants	19.00	39.30	20.00	28.40
Vegetation vigour	28.60	50.00	80.00	52.20
Cropping history	9.50	17.90	0.00	10.10
Recommendation from agencies	0.00	3.60	25.00	13.90
Others	6.9	7.10	10.00	6.81
Soil type				
Sandy	9.50	0.00	5.00	4.3
Loamy	76.2	89.30	90.00	85.5
Clayey	14.30	3.60	0.00	5.8
Gravelly	0.00	0.00	0.00	0.00
Swampy	0.00	7.10	0.00	2.90
Others	0.00	0.00	5.00	1.4
Perceived effect of soil on farm yield				
Positive effect	47.60	50.00	55.00	50.70
No effect	47.60	46.40	45.00	46.40
No response	4.80	3.60	0.00	2.90

Indigenous Land Evaluation Methods

Land suitability determination among rural farmers and the perceived effect soil and land systems on their farm yield is presented in Table 2. This classification is not limited to rural farmers as many of the farmers also practice arable farming inside and outside their cultivation area. It should be pointed out here that many of the percentage responses may not add up to 100 because some employed more than two methods to classify the suitability of their lands. About 48.50 % of the farmers rely on visual appraisal to determine the suitability of their lands for crops and other agricultural use. The highest number of respondents (57.10 %) relying on visual appraisal is from Maya Bani while 42.90% and 40 % use this method at Bahuli and Vimtim respectively. Use of indicator plants is also higher at Mayo Bani (39.30%) compared with the 19% and 20 % at Bahuli and Vimtim respectively. The use of indicator plants and visual appraisal require some experience. During the follow-up interview it was discovered that some of the indicator plants that identify a good soil are *Chromolaena odorata*, (Awolowo weed) and *Andropogon gayanus* (which they refer to as elephant grass) while *Imperata cylindrical* (spear grass) is indicative of a poor soil. Majority of the farmers at Vimtim (80 %) estimate the suitability of land for crops through the vigour of the native vegetation. According to one of the farmers, it is logical to believe that where other trees that look like rubber are growing well, the land will be able to support rubber. Very few farmers rely on cropping history (17.9 % at Mayo Bani) and it was only in Vimtim that an appreciable number of farmers obtain advice from some agencies. While many of the farmers categorized their soils (surface soils) as loamy, spot checks on field texture by hand feel method at Bahuli and Vimtim showed that the surface soils range from loamy sand (LS) to sandy loam. However, about half of the farmers believe that crop yield is not related to the nature of the land.

Table 3: Selected Physical and Chemical Properties 0-20cm) Of Some Soils at Bahuli and Vimtim with the Fertility Indication by Farmers

Farm settlement	Catenary position	Farmers description	Fertility * rating	Sand	Silt	clay	Texture **	pH	Org C	Total N	Available P
				g kg^{-1}				(H_20)	g kg^{-1}		mg kg^{-1}
Bahuli	Upper slope	Red soil/ loamy	8	828.40	21.20	150.40	SL	4.70	2.20	0.57	6.20
	Middle slope	Red soil/ loamy	5	836.20	2.20	156.00	SL	4.50	7.90	1.25	5.60
	Lower slope	Brown soil / sandy	3	846.20	2.20	146.00	LS	5.20	1.10	0.44	5.60
Vimtim	Upper slope	Black soil/ loamy	9	810.20	3.40	186.40	SL	4.70	20.40	2.40	18.18
	Middle slope	Black soil/ loamy	6	840.80	40.60	118.60	LS	4.80	7.90	1.25	4.40
	Lower slope	White sand	6	862.40	12.80	124.80	LS	3.87	11.30	1.00	12.51

* Fertility rating as described by farmers **SL = Sandy Loam, LS = Loamy sand

Table 4: Correlation Matrix between Farmers' Fertility Ranking and Laboratory Analysis

	Org C	Total N	Avail. P
Local	.603*	.515ns	.647*
Org C	1.	.824**	.603*
Total N		1.	.221ns
Avail P			1.

*Correlation is significant at the .05 level;
**Correlation is significant at the 0.01 level

The significance value (Sig. = 0.647) confirms that this relationship is statistically significant at the 0.05 level. This implies that the observed correlation is unlikely to have occurred by chance, thereby validating the connection between fertility ranking and laboratory analysis.
The Eta coefficient (0.603) further supports this association, indicating a substantial degree of consistency in the relationship between the two variables. This outcome concurs with the study by Adeoye and Oyekale (2020), who also reported a positive correlation between fertility ranking and laboratory analysis among traditional farming methods in South West Nigeria.

Table 5: Soil Fertility Management among Rural Farmers, Effects on Crop Yield in Three Farm Settlements

	Bahuli	Mayo Bani	Vimtim	Combined
	Number of respondents (%)			
Fertilizer application				
Applied fertilizer	38.1	92.90	80.00	72.50
No Fertilizer	61.9	3.60	20.00	26.10
Fertilizer Type				
NPK	38.1	92.90	80.00	72.5
Rock Phosphate	0.00	0.00	0.00	0.00
Organic Manure	0.00	0.00	0.00	0.00
Urea	0.00	0.00	0.00	0.00
MOP	0.00	0.00	0.00	0.00
SSP	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00
Effect of fertilizer on yield				
Improved	38.10	96.4	80.00	73.90
No improvement	4.80	0.00	0.00	1.40
No response	57.1	3.60	20.00	24.60
Rate of improvement due to fertilizer				
0-5 %	0.00	0.00	0.00	0.00
5-15%	0.00	14.30	5.00	7.2
15-30 %	28.60	25.00	20.00	24.60
30-50%	0.00	10.70	20.00	10.10
Above 50%	0.00	0.00	0.00	0.00
No response	71.40	50.00	55.0	58.00
Other fertility management practises				
Animal dung	0.00	7.10	5.00	4.40
Liming	0.00	0.00	0.00	0.00
Household waste	0.00	7.10	0.00	2.90
Intercropping	33.30	64.30	15.80	41.20
Cover cropping	4.8	17.90	63.20	17.60

Soil Fertility Management

Many local rural farmers rely predominantly on the recycling process of natural fallow to rejuvenate their soil fertility. In the three locations studied 72.5% have applied fertilizers at one stage or the other in their farms (Table 5). This comprised of 38% at Bahuli, 92.9 % at Mayo Bani and 80 % at Vimtim. Almost all respondents that applied fertilizer applied NPK in the three study sites. While the awareness and availability of chemical fertilizers were identified as major constraints to fertilizer practices by many farmers, interview showed that many of them actually applied other forms of manure such as household wastes, wood ash and poultry droppings as soil amendments which they regard as fertilizers at the time of filling the questionnaires. By analyzing what constitutes soil fertility management in practice, the internal differentiation of local soil management and knowledge can be brought to the surface. The impact of farming practice on soil dynamics can be thereby better understood. Interview revealed that those who are educated and seemed to have more access to fertilizer supply, apply too much fertilizer relative to the nutrient demand of the crops and accompanying other subsistence crops. Consequently, some practices in subsistence plots result in excessive macronutrient levels without consideration of the possibility of nitrate and phosphate pollution. In all the farm settlements, 73.90% of rural farmers agreed that there was an improvement on their crop yield as a result of fertilizer application with the highest at Mayo Bani (96.40%). The response on rate of improvement in the yield of crops due to fertilizer application which is somewhat quantitative showed an interesting result. While 58% of the rural farmers showed no response (Consisting mostly of those who have never applied). These findings align with studies like Ajani (2018), and Ndaghu et al. (2023), who reported that Effective soil fertility management among rural farmers directly boosts crop yield, quality, and food security by ensuring soil has a balanced supply of essential nutrients for plant growth. Conversely, poor management leads to soil depletion, which results in reduced crop yields and can be exacerbated by factors like over-cultivation, inadequate use of fertilizers, and a lack of sustainable practices. Successful management often involves combining organic methods with mineral fertilizers to achieve sustainable yield increases.

CONCLUSION

In conclusion, indigenous farming knowledge serves as a vital pathway to soil fertility management and land evaluation. By leveraging the strengths of these traditional methods while addressing their limitations, stakeholders can foster a more resilient agricultural sector. Such a holistic approach will be crucial in promoting sustainable agricultural practices that not only benefit the environment but also enhance food security for local communities in Mubi North LGA and beyond

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