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FARMERS' PERCEPTION OF FADAMA SOIL FERTILITY ALONG CHALLAWA RIVER, KANO STATE, NIGERIA

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ABSTRACT

The failure to adequately address farmers' perception in soil studies have been identified as a limiting factor against the prospect of full realization of benefits of some soil related studies. This study was carried out in an area located between latitudes11° 02 ′ 00 ″ N, 11° 3 ′ 43′ N, and longitudes 08° 41′ 35 ″ E, 08° 57 ′ 06 ″ along River Challawa, Kano State, Nigeria. Seven of farmers were first identified and then respondents were selected using simple random sampling technique. Structured questionnaires were collected from sixty Fadama farmers. The data was analysed by the used of tables, percentage and kruskal wallis' test. The result for the socio-economic analysis shows that 25% were aged 36 to 40 (56 as their mean) years. There were 86.7% males against 13.3% females Fadama farmers in the area. The mean income of the farmers was found to be N. On fertility dynamics, 68.4% were of the view that fertility levels were not fixed, rather fertility indicators were variable. Also, 83.3% of the respondents indicated that soil fertility problems could be overcome through the practice of bush fallowing. Similarly, 81% of the farmers suggested that fertility could be best tackled when organic and inorganic fertilizer were applied simultaneously. Late growth and maturity of crops were the major indicators of fertility decrease according to 33.3% of the respondents. Finally, the study recommends creating more avenues for the education of the local farmers, training and retraining and creation of bioorganic fertilizer production plants.

Keywords: Perception, Fadama, Soils, Challawa River, Kano State

INTRODUCTION

The growth and productivity of plants is determined by the soil fertility available in a given area of land (Ogbena *et al,* 2016). The differences in soils are chiefly a function of prevailing climatic condition, vegetation cover and topography. Soil fertility decline is widespread and has been an issue of concern particularly in Sub-Saharan Africa where the problem cuts across many different soils types. Many endogenic (such as soil pH, organic matter, and texture, primary, secondary and micro nutrients) and exogenic (such as land use and farming systems, technological innovations and input management) factors combine to initiate and or exacerbate soil fertility decline. Majority of the factors are beyond the smallholder farmers' capability to handle (Mowo, Janssen, Oenema, German, Mrema and Shemdoe, 2006). Because of their accumulated experience in cultivating lands, it is obvious that farmers ought to play stabilizing role in agricultural land management. Soil scientists and other professionals are somehow biased on the farmers' knowledge of soil fertility. However, small-holder practicing farmers have a well-developed ability to perceive differences in the level fertility between and within varieties of farmlands (Domchang *et al*, 2014). It is part of these and similar assessments that these farmers use soil fertility indicators such as crop yields, soil depth, drainage, moisture, slow growth of plants, leaves coloration and other factors of soil's capacity for sustainable productivity (Nafi'u *et al* 2012). This enables them to link the current and past soil management regimes.

Nigeria has a wide variety of soil under diverse ecological conditions and with different level of fertility. Fadama soil is known to be rich in nutrients content with high fertility level. As far as the country is concerned the need for food sufficiency has brought a corresponding need to harness the fertility of Fadama soil as it shown the potential use for all year round. Fadama is a local (Hausa) name meaning the seasonally flooded or floodable plains, irrigable lands, or low laying plains along major savanna rivers or depressions on the adjacent low terraces (Adeyeye, 2005). This type of soil is under continuous cultivation especially in Northern Nigeria in areas around Kano, Kaduna, Bauchi, Plateau, Niger, Kebbi and Sokoto among others

Several studies have been conducted both in Nigeria and other African countries on soil fertility using scientific soil assessment methods. Researchers conducted includes studies in Ethiopia (Fanuel *et al,* 2017), Ivory Coast (Birmingham, 1998) Bauchi (Shafi'u 2007), Gombe (Umar *et al,* 2011), Ekiti (Adeyeye and Omolaye, 2008), Plateau (Jauro *et al*, 2006), Borgu in Niger state (Ogbena *et al,* 2016) among others. The farmers' ways of classifying soil fertility differs from the scientific methods. Similarly, researches conducted in Nigeria include those carried out by Raji *et al*, (2011) in Kaduna State; Kundiri *et al*, (2007) in Yobe State; Ademola, (2002) in Kwara State; and Idoga (2006) in Makurdi, Benue State. The need to beef-up food production in order to meet up with food needs of our ever increasing population, necessitate the harnessing of Fadama soil for food sufficiency in Nigeria. This brought about initiation of the national Fadamas project (Fadama I, Fadama II, Fadama III projects). The core objective of this paper is to assess farmer's perception of Fadama soil fertility while the specific objectives are (a) to identify farmers' demographic information and (b) identification of farmers' perception of soil types and other fertility attributes of soils in the six farming communities.

STUDY AREA

The study was conducted along the Fadama floodplains of River Challawa in Kumbotso and Madobi Local Government Areas of Kano State, located within Latitudes 11˚ 72′ 00 ″ N, 11˚ 92′ 04′ N, and Longitudes 08˚ 30′ 69 ″ E, 08˚ 63′ 45″ E (Ahmed, 2006). The study area is made up of seven farming communities, namely Magasawa, Kauran Mata, Galinja, Magami, Kaba, Yan Sama and Kuttiyawa. The current climate of the area is largely tropical wet and dry, coded as Aw in Koppens system of climate classification. The mean annual rainfall of Kano is about 900mm and it last for three to five month. The dry season starts from October to May while the rainy season starts from May ending to early October with a peak in August and September. Temperature of the area ranges between 21^{o}C to 37^{o}C (Ahmed, 2006). The soils of the area is divided into four main groups; ferruginous tropical soils or nitrosols, formed on the crystalline acid rocks occupying about 40% of the Kano region to the South, Southwest, South-east; the brown and reddish brown soils and lotosols occur in the southern half, the brown reddish soils are in the North-eastern corner, and the juvenile and hydro-morphic soils occur along the alluvial channel complexes (Falola, 2010). The vegetation of the area consists of open wood land with grasses between 1.5 to 3.0m tall.

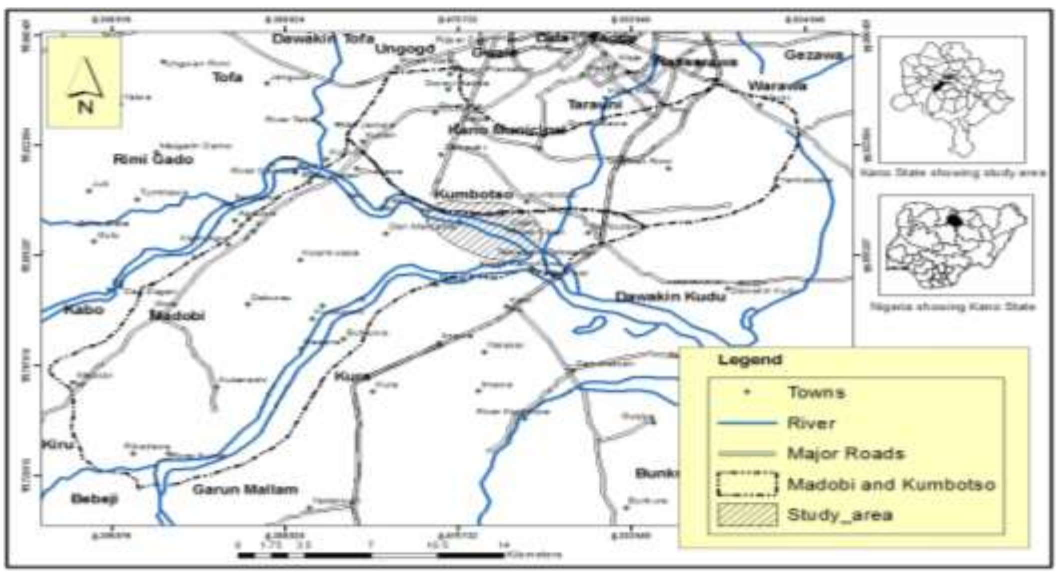

Figure 1: The Study Area
Source: Adopted from Abdulkadir (2016)

MATERIALS AND METHODS

Reconnaissance survey was carried out prior to the field survey to get acquainted with Fadama farmers. The exercise served as a guide in determining the total population and designing the sample sized of the population. Sample size based on Krejcie and Morgan (1970) was used in selecting the sample size from the total population of 72 Fadama farmers. Thus 60 Fadama farmers (representing 83.3%) served as the sample size from the population of 72 farmers. Two stage sampling was adopted; firstly, seven clusters were identified and secondly farmers were identified using simple random sampling (Ahmed, 2009). The data was collected using structured questionnaire and interview methods. The questionnaires were administered to the Fadama farmers on the field. The data analysis was done using descriptive statistics, tables, percentages, bar charts and Kruskal Walli's test. This test is applied because it involved comparing more than three variables the test used the level of significance at 0.05. Therefore the test is mathematically expressed as:

$$\mathrm{H} = \frac{12}{\mathrm{N(N+1)}} \sum_{i=1}^{K} \left(\frac{\mathrm{R_i}^2}{\mathrm{ni}}\right) - 3(\mathrm{N}+1)$$

where capital N = Total sample size, Capital $\mathrm{R_i}$ = Total of the ranks for the height sampled, that is the sum of each sample, small ni = sample size for the height sampled, that is the sample size of each group, K = the number of samples.

RESULTS AND DISCUSSIONS

The result is presented using table and chart, SPSS version 11 and MS Exel.

Socio-Economic Characteristics

The socio-economic characteristics of the respondents including age, gender, level of education and annual income from farming are as presented in Table 1. Farmers in the age-group 41 and above had the highest frequency of 28.3%. This can be attributed to African culture which ascribes of custodianship farms to the most elderly male person in household. By mere seeing 86.7% of the farmers are male is enough to suggest that this African culture is deeply engrained in this area. Years of farming experience increase as the age of the farmer increases. Studies conducted in the humid forest and moist savannah agro-ecological zones of Nigeria showed that productivity was positively associated with more experience in farming (Ajibefun and Abdulkadri 2004; Ogunniyi and Ojedokun, 2012). The older a farmer is, the more experienced he becomes and perhaps the better his gains in farming practices. This is probably the reason why 23.8% of the farmers were found to be more than forty years of age.

Education has known to have influence innovations in agriculture (Abdulazeez *et al,* 2014) and a study by Ashraf and Qasim, (2019) suggests education of farmers have significant and positive association with their earning. The fact that 16.7% of the farmers received at least primary education coupled with fact that every single respondent had one form of education or the other shows the importance these farmers attached to education. It should be stress that farmers at this level need not to acquire higher certificates neither do they require high technical education as prerequisite for successful farming operation. In fact, most of the farming operations can successfully be done with basic education.

Income is an essential variable in agricultural practices, without income farmers cannot easily get access to fertilizers, insecticides, seeds among others. It appears that Fadama farming has been a high paying job for the farmers, because 41.7% of the farmers were earning more than N200, 0000, 00. This increase in income by farmers was a confirmation of findings of Ugwumba and Okechukwu (2014), which found farmers mean income was found to have increase by 204.80%. Although in their study, Ukoje and Yusuf (2013) reported Fadama farmers in Zaria acquired some informal artisanal training which provides off-season, non-farm supplementary/complementary income. However, no such form of income was reported in this study.

A strong correlation of the Hausa indigenous soil classification could be better achieved with the WRB system, both of which have two levels. It was also obvious that the indigenous classification could not differentiate the soils on the bases of subtle differences, especially in the subsoil, unless translated onto the soil surface. However, the farmers' soil map was very similar in outline to the soil map by the scientists. The major difference is in the extent of the mapping units especially the Fadama. For sustainable development in the study areas and to improve communication between the scientists, the extension agents and the farmers, an integration of local soil name into the soil map legend will go a long way in this direction (Raji, Malgwi, Berding and Chude, 2011).

Table 1: Socio-Economic Characteristic of the Farmers

Age group	**Frequency**	**Percentage**
21 – 25	6	10
26 – 30	11	18.3
31 – 31	11	18.3
36 – 40	15	25
41 above	17	28.3
Total	60	100
Gender	**Frequency**	**Percentage**
Male	52	86.7
Female	8	13.3
Total	60	100
Level of Education	**Frequency**	**Percentage**
Primary	10	16.7
Secondary	4	6.7
Post-Secondary	3	5
Adult Education	7	11.7
Qur'anic Education	36	60
Total	60	100
Annual Farming income	**Frequency**	**Percentage**
35,000 - 50,000	7	11.7
51,000 – 100,000	29	48.3
101,000 – 200,000	14	23.3
201,000 – 700,000	10	16.7
Total	60	100

Source: Field Work 2017

Farmers Identification of Soil Types and their Perceived Properties

Table 2 indicates farmers' classifications of predominant perceived properties in their farms. Farmers' identification of soil types and their perceived properties were achieved through oral interviews and administration of questionnaire. In all, four soil types were identified in the area, locally named as *Yumbu/Tabo, Yashi, Jan gar-gari and Jigawa,* corresponding to Hydromorphic soil, grainy sand soil, Lateritic soil and fine grained sandy soil respectively. Integrating such local knowledge allows them to give soil names that have more meaning (Kundiri *et al*, 2007). This indigenous classification had two levels and principally described two landscape types from within Fadama: Fadama Kwari (within the lowest elevated flood plains) and Fadama Tudu (on relatively higher elevation). The farmers identified of the soil texture and soil drainage conditions by feeling and observation.

Table 2: Farmers' classifications of soil types and their perceived properties

Name of Soil type	Colour			Particle Size			Fertility			Manure demand			Erosivity			Moisture		
	Classification	Resp	%	Classification	Resp	%	Classification	Resp	%	Classification	Resp	%	Classification	Resp	%	Classification	Resp	%
Yumbu /Tabo	Blackish	30	50	Very Fine Particle	17	28.3	High	20	33.3	Low	5	8.3	low	10	16.7	High	20	33.3
Yashi	whitish	10	16.7	Sandier	13	4.7	Low	13	21.7	Very high	26	43.4	High	18	30	Low	12	20
Jangar Gari	Red and redish brownish	5	8.3	Finer particles	10	8.7	Low	12	20	High	17	28.3	Moderate	14	23.3	Moderate	14	23.3
Jigawa	Brownish	15	25	Fine perticles	20	33.3	Moderate	15	25	Moderate	12	20	High	18	30	Moderate	14	23.3
Total		60	100		60	100		60	100		60	100		60	100		60	100

Source: Field Work (2018)

The *yumbu/tabo* soils had high fertility, blackish in colour, high moisture retention, low manure demand and low erosional activities (Table 2). They were also characterised by minimal demand for manure. The farmers' perceptions for these soils were: high fertility (33.3%), high moisture retention (33.3%) low manure demand (8.3%) and low erosivity (16.7%). The soil of this nature allows and supports much Fadama crop cultivation. It significantly contrasted with *yashi* soil classified as Whitish colour, low fertility, very high demand for manure high erosivity, and low in water retention. soil which was characterised by low fertility (21.7%), very high manure demand (43.4%), high erosivity (30%) and low in retaining water (20%). There is high demand for manure for a successful plant growth. Jan-gargari soil was classified as red and redish brown soil, with fine particles, high demand for manure, moderate erosivity and moisture retention and low fertility. The farmers described this soil as badland topography with no serious crop cultivation. Soils variations are rather mostly explained in terms of horizontal differences (Kefas, Zata, Philip, Ukabiala and Ezekiel, 2016).

Farmers Assessment of soil fertility over time

Figure 1 below shows farmers' perceptions on assessment of soil fertility trend. Out of the sixty farmers sampled, about 37 % had the view that soil fertility was at increase in their farms. However, some other 32 % had a contrary view. Still, another 32 % were of the view that soil fertility in their farmland remained fixed. Research findings conducted elsewhere on Fadama farms (Jamala, Shehu, Musa and Abraham, 2012; Kefas, Zata, Philip, Ukabiala and Ezekiel, 2016**;** Imadojemu, Osujieke and Obasi, 2017) indicate similar non stability of fertility. And this can be attributed to constant nutrient mining arising from continuous cultivation of the Fadama farm in dry and rainy seasons. What is more, many of them had appreciation (observed during oral interactive) that planting legumes add to the nutrients level in soils.

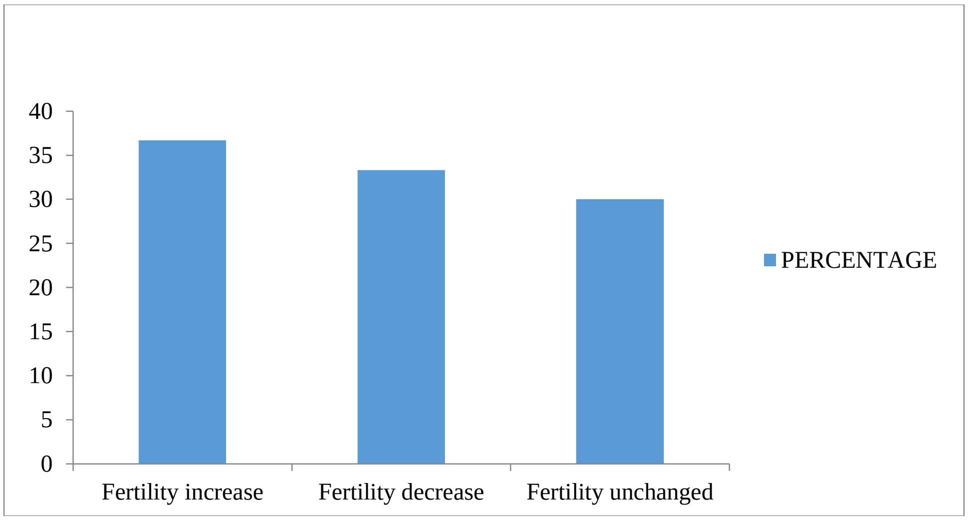

Figure 1: Farmers Assessment of soil fertility over time
Source: Field Work (2018)

Features of Decreasing Soil Fertility

Table 3 shows farmers responses on features of decreasing soil fertility; also N indicates frequency of responses.

Table 3: Features of Decreasing Soil Fertility

	RESPONDENTS	PERCENTAGE
Decrease in crop yield	22	36.7
Stunted crop growth	10	16.7
Change in colour of crops	4	6.6
Late growth and maturity of crops	20	33.4
Growth of weeds	2	3.3
Diseases and vectors	2	3.3
TOTAL	60	100

Source: Field Work 2018

From Table 3, the vast majority of respondents (36.7% and 33.4%) linked sign of soil decrease fertility to decreasing crop yield and late growth and maturity of crops respectively; while others mentioned variety of other factors. Availability of rainfall and indeed moisture is often regarded as the most critical for successful crop production. This suggests that farmer perception of soil fertility is therefore closely related to the soil's water holding capacity. It can also be adverted to other factors like vectors, small stones in the soil, and decrease in soil depth among others. Elsewhere, farmers mentioned variety of factors as indicators of decreasing soil fertility such as decrease in crop yield, stunted growth, late growth and maturity of crops, change in colour of crops, growth of weeds, and presence of small stones in the soil, decrease in depth of soils, and decrease in crop residues (Usman, 2015). It can be observed that the key single indicator mentioned by respondents was reduced crop yield. Harris (1998) noted that to conserve soil nutrients farmers must mobilize the nutrients in such a way that maintains a flow through the farming system. Smallholder farmers in the Kano closed settled zone keep livestock for their value as producers of manure and also for their ability to convert the crop residues into manure (Harris, 2008).

Ways of Tackling Soil Fertility Decrease

Table 4 below indicates farmers' responses on how to solve the problem of soil fertility decrease.

Table 4: Ways of Tackling Soil Fertility

	RESPONDENTS	PERCENTAGE
Application of Fertilizer	12	20.0
Application of Manure	6	10.0
Application manure and fertilizer	34	56.7
Practicing crop rotation	6	10.0
Practicing of fallow farming	2	3.3
TOTAL	60	100

Source: Field Work (2018)

From the sixty responses, only ten percent of the farmers adopted to using manure as a sole way of solving the problem of soil fertility decrease (Table 4). Another 20% were relying solely on chemical fertilizer to overcome the problem of soil fertility. Chemical fertilizer such as NPK, Urea, and super phosphate are generic soil conditioners common in the northern part of Nigeria despite the spatio-temporal variability in soil characteristics (Ukoje and Yusuf, 2013). On the other hand, 34 respondents or 57% of the farmers were combining both organic and inorganic fertilizer as a mean of the problem of soil fertility decrease. Organic material, inorganic fertilizer and pesticide are among the agricultural inputs which are believed to provide material impact on both the soil and importantly to the output. Therefore wherever a piece of farm is put to fallow, such land is expected to regain and increase its fertility. However, Harris (1998) noted that to conserve soil nutrients farmers must mobilize the nutrients in such a way that it maintains a flow through the farming system. Additionally small holder farmers in Kano closed settled zone keep livestock for their value as producers of manure among other use and livestock are able to convert the crop residue into manure (Harris, 2008). Both inorganic and organic manure constitute what is generally termed integrated land management system (Abdulazeez *et al,* 2014).

Test of hypothesis using Walli's test for the features of decreasing soil fertility

Hypothesis test on features of decreasing soil fertility was conducted using the Walli's

Table 5: Test of hypothesis using Walli's test for the features of decreasing soil fertility.

Decrease in crop yield		**Stunted growth**		**Change in the colour of crops**		**Late growth and maturity of crops**		**Growth of weeds**	
Farmers	R1	Farmers	R2	Farmers	R3	Farmers	R4	Farmers	R5
60	79	60	89	60	84	60	87	60	81

Ho: there is no difference in the features of decreasing soil fertility in the seven farming communities

R1= 79 R2= 89 R3= 84 R4= 87 R5= 81

The level of significance used is 0.05

The degree of freedom is 5 – 1 = 4

$$H= \frac{12}{N\,(N+1)} \quad \sum_{I=1}^{K=3} \left[\frac{Ri^2}{ni}\right] - 3\,(N+1)$$

Ni = 6

N = 30

$$H = \frac{12}{30\,(30+1)} \text{ X } \left[\frac{79^2}{6} + \frac{89^2}{6} + \frac{84^2}{6} + \frac{87^2}{6} + \frac{81^2}{6}\right] - 3\,(30 + 1)$$

$$= \frac{12}{30\,(30+1)} \text{ X } [1040.2 + 1320.2 + 1176 + 1261.5 + 1093.5] - 93$$

$$= \frac{12}{930} \text{ X } [1040.2 + 1320.2 + 1176 + 1261.5 + 1093.5] - 93$$

$$= 0.013 \text{ x } 5891.4 - 93 = -16.412$$

The critical value is 9.49; therefore the hypothesis is rejected because there is significant difference in the features of decreasing soil fertility in the six different farming communities, because the value calculated is greater than the critical value.

CONCLUSIONS AND RECOMMENDATIONS

The study wishes to establish that farmers' perception on soil fertility has been all-encompassing, surpassing the traditional survey of nutrient status in farm fields. Broadly, socioeconomic variables such as income level, in addition to physic-chemical were seen as part of the overall available soil fertility. It is also apparent that colour and texture of soils stood out as the most repeatedly mentioned indicators of soil fertility by the farmers. Organic and mineral fertilizer remained the dominant practice source for replenishment of soil fertility with varying amount of supply in case of former or their price in case of latter.

From the foregoing, it imperative that increased cooperation with extension services are further encourage and consolidated with a view to help these small holder Fadama farmers in every aspect of land management practices. There are also the need to adapt to improved varieties and good agricultural practices, including Integrated Soil Fertility Management practices with a view to build the capacity of Fadama farmers to monitor the soil fertility regularly and give quick, site-specific recommendations.

In light of the above findings the following recommendation will be appropriate to be observed.

i. Since the farmer face the problem of soil fertility decrease on their farms, policy makers and those concerned should make all the ways possible to address this problems therefore avenues for providing and subsidizing fertilizers to the smallest holder farmers should be provided.
ii. Since organic fertilizer forms significant supply to Fadama farmers, government should make concerted efforts at providing enabling environment for establishment of bio-fertilizer industries.
iii. Training and retraining programs should be rendered to the farmers on the ways of some farming practices that can contribute to the improvement of soil fertility.

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