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USAGE AND EFFECTIVENESS OF FERTILITY ENHANCEMENT TECHNIQUES AMONG SMALL-HOLDER FARMERS IN THE KANO CLOSE SETTLED ZONE, KANO STATE

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ABSTRACT
This study examines the usage and effectiveness of diverse soil fertility enhancement technique (SFET) among smallholder farmers in the Kano close-settled zone. Four study villages were selected from different parts of the Kano Close-Settled Zone, Kano state. A multi- stage sampling technique was used in selecting a total of 112 farmers for the study. Data were collected by means of structured questionnaires and analyzed using descriptive statistics. The result shows that 88.4% of the respondents are in the range of 21 to 50 years, which is active age group. The mean age of the respondents was 40 years.The result reveals that small ruminants manure with a total of 94% was ranked first in term of popularity in usage and effectiveness in fertility enhancement, ashes manure ranked second. Cattle dung manure and Grasses and compound sweeping manure became the third popular and effective techniques among the respondents. However, inorganic fertilizer is largely utilized by most of the farmers more especially NPK (93%) and Urea (93%) which shows that majority of the respondents combined the use of both organic manure and inorganic fertilizers. In terms of agronomic practices, majority of the respondents practice mixed cropping and intercropping (88%) and crop rotation (86%). It is therefore recommended that farmers should always be encouraged in the appropriate adoption of both the modern and indigenous soil fertility enhancement techniques.

Keywords: Soil, fertility, enhancement technique, small scale farmers

INTRODUCTION

The management of soil fertility is the first condition for sustainable crop production which creates certain challenges to farmers in Nigeria. Food security production for man and feeds for animals depend solely on a fertile soil and it is the reason why its management is necessary for a sustainable agricultural development to hold. The combination of factors has resulted in serious and growing problems of food insecurity in the country. Adverse climatic changes (drought), human population pressure and environmental degradation such as decline in the soil fertility were few among the factors responsible for food insecurity. As such sustainable soil fertility enhancement technique that would improve the livelihoods of rural households through the identification, evaluation, and promotion of technological options to enhance productivity and create an enabling environment for the farmers to improve their level of production is highly required. According to FAO (2008), sustainable agriculture was identified as a holistic approach to the problems of resources conservation, environmental degradation. But in recent decades, the unsustainable soil management practices such as inadequate replacement of soil nutrients taken up by crops, indiscriminate vegetation removal and overgrazing have resulted to decreased in soil fertility and increase in the occurrence of acidified soil (Essiet, 2003; Key, Whitfield, Dicks, Sutherland, and Bardgett, 2013). Decreasing fertility of soils because of soil nutrient mining is regarded as a major cause of decrease in crop yields and per capita food production in Africa (Sanchez, 2002). Soil fertility depletion can be reduced and the fertility can be enhanced through proper adoption of Soil Fertility Enhancement Techniques (SFETs) as some of these techniques reduce the impact of rainwater runoff, soil erosion, and increased water infiltration (movement of water into the soil). In addition, SFET were found to increase soil organic matter content and increase the activities and diversity of soil microbes through biomass production which consequently increase high crop yields (Key *et al.*, 2013). SFET are all the techniques employed by farmers to conserve and improve the fertility of their farmland (Yusuf, 2001). Some of the SFET practiced in Nigeria include application of organic manure, inorganic fertilizers, integration of both organic and inorganic fertilizers, crop rotation, mixed/intercropping, kraaling, mixed farming

agro-forestry and bush fallowing among others. Several soil fertility enhancement techniques are being provided by Agricultural Research Institutions such as International Institute of Tropical Agriculture (IITA), Alliance for Green Revolution in Africa (AGRA), Institute of Agricultural Research, Zaria (IAR), and Kano State Agricultural and Rural Development Authority (KNARDA) and are been adopted by farmers to improve agricultural sustainability in the country.

The adoption of these techniques, however, varies with the environments (soil and land forms) and other resources (Yusuf, 2001). For instance, modern agro-forestry such as Alley cropping and improved fallow are highly practiced in the forest regions of Nigeria. Whereas mixed farming, kraaling animals manure method (cattle's dung, sheep and goats) are more practiced in the savannah regions of Nigeria. This study will therefore identify the variety of soil fertility enhancement techniques (SFETs) practices by the smallholder farmers in Kano Close -Settled Zone of Kano state.

The Study Area

The study area is located within what Mortimore, (1993) called Kano close-settled zone, where the rural population density is considered to be very high by Tropical African standard. The Kano Close-Settled Zone (CSZ) lies within the Sudan savannah of northern Nigeria and is the zone experiencing ever increase in population that has the highest rural population density by African standard, reaching over 500 persons per square kilometres since 1995 (Mortimore and Adams, 1999). Hill (1977) cited in Yusuf (2014) described Kano CSZ as the zone with irregular shape and ellipse, extending some 100km from Kano city to the south east and only 50 km in other directions. However, it is important to note that the current population density of Kano Close-Settled Zone reach about 1000 persons per square kilometres due to the rapid changes over the years (Olofin *et al.*, 2008).

In this research, the study area falls within 50 km radius of Kano Close-Settled Zone as shown in figure 1.

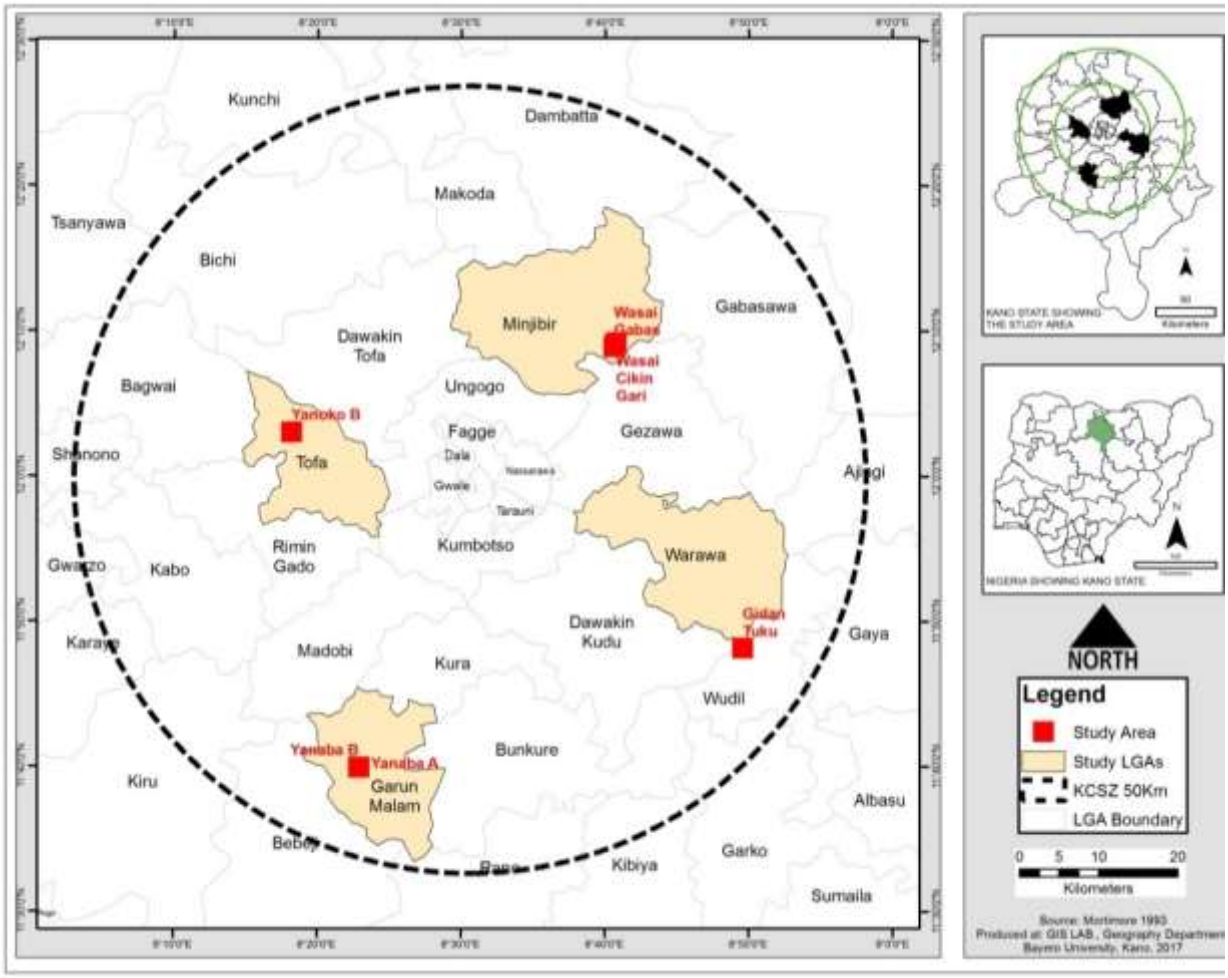

Fig. 1: Kano close-settled zone showing the four study villages

The study area comprises of Wasai, GidanTuku, Yanaba, and Yanoko farming communities. Wasai is in the Southern part of Minjibir Local Government Area, which is situated in the northern part of Kano state and is located between latitude 12.15^0 north of the equator and longitude 8.69^0 east of the Greenwich meridian. The presence of Wasai dam from Jakara River in this area led to the rise of water table in the area which also favours the smallholder farmers to dig wells for irrigation activities. Yanaba is located in the south western part of Garun Malam Local Government Area and is positioned between latitude 11.65^0N of the equator and longitude 8.36^0 east of the Greenwich meridian. This village is blessed with the presence of river Fayan which favour development of extensive agricultural lands for both rain fed and irrigation system. Yanoko is situated in the eastern part of Tofa Local Government Area found in the western part of Kano state and is located between latitude of about 12.08^0N of the equator and longitude 8.31^0 east of the Greenwich meridian. The presence of Watari River favours the growth of irrigation activities in the area. Gidan Tuku is found in southern part of Warawa Local Government Area, east of Kano city and is located between latitude of about 11.08^0N of the equator and longitude $8{\cdot}85^0$ east of the Greenwich meridian. Gidan Tuku was a settlement before (15-20 years ago) which was demolished by frequent flooding of river Wudil and turned it to be an extensive agricultural land for both rainfed and irrigation activities

Research Method

A multi-stage sampling technique was used for the selection of the study villages in the Kano close-settled zone and the smallholder farmers. Stage one involves a purposive selection of four Local Government Area in each direction (North, East, South and West) of the Kano close- settle zone, that resulted in the picking of Minjibir, Warawa, Tofa and Garun Malam. These Local Governments were selected due to the facts that are closed to the city and potential sites of rain fed and irrigation farming (figure 1). Stage two includes the random selection of four farming villages one from each selected Local Government Area (figure 1). In stage three purposive sampling was adopted in the selection of small-holder farmers from each of the selected village resulting to the selection of twenty eight (28) small-holders farmers that who engaged in both rain fed and irrigation farming. This gives a total of 112 smallholder farmers that were selected for the survey. Data was collected through questionnaire administration to the farmers met at the field. The population for the study consists of smallholder's farmers who have been practicing farming for more than (15) fifteen years. Face-to-face contact in the farm field was used to administered the questionnaire as adopted by Ogbonna, Idiong and Ndifon (2007),Martins, Gideon and Beatrice (2010), Akinola(2010), Yusuf (2010), Muhammad-Lawal, *et al.* (2014)andOyewole and Ojeleye (2015).

RESULTS AND DISCUSSION

Table1 indicates the socio-economic characteristics of the farmers. All the sampled farmers were male and married and divided into six age groups for convenience. This indicates that males are more involved in farming activities in the study area. This might be due to female reliance on their husbands in taking farming decisions (FAO, 2005) and most likely women are too occupied in home activities a condition that possibly made them less available for the interview. This result is consistence with the work done in Zaria, Kaduna state by Damisa, and Yohanna (2007) who found out that the level of participation of rural women in the decision-making in different areas of agriculture was quite minimal. But is inconsistence with the study done in Malawi by Kabuli, Phiri and Abdi Khalil (2005), which reveals that majority of the farmers were female. The result also agreed with the findings of Onasanya (2007) that most crop farmers are married and Soyebo*et al.* (2005) that agriculture is very much practiced by married people to enable meet and cater for their family needs. This may probably be due to the fact that the younger generations have migrated to the city. The results presented in Table 1 show that 88.4% of the respondents are in the range of <20 to 60 years which is the active age group. The mean age of the respondents was 40 years. This group is more physically active and highly energetic to participate in farming. They are also able to perform farming activities effectively throughout the year. About 11.6% of the respondents are within the age of below 20 years and above 50 years.

Table 1: Socio-economic characteristics

	LOCATIONS									
Age Group	**Yanaba**		**Wasai**		**G/Tuku**		**Yanoko**		**Total**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
≤20	0	0	2	7	1	4	0	0	3	**2.7**
21-30	3	11	5	18	3	11	3	11	14	**12.5**
31-40	13	46	10	36	15	54	13	46	51	**45.5**
41-50	9	32	7	25	8	29	10	36	34	**30.4**
51-60	3	11	3	11	1	4	2	7	9	**8.0**
Above 60	0	0	1	4	0	0	0	0	1	**0.9**
Total	**28**	**100**	**28**	**100**	**28**	**100**	**28**	**100**	**112**	**100**
Educational Status of the respondents										
Adult Education	2	33	2	33	1	17	1	17	6	**5**
Primary Education	13	33	7	18	10	25	10	25	40	**36**
Secondary Education	6	21	6	21	8	28	9	31	29	**26**
Tertiary Education	4	22	7	39	3	17	4	22	18	**16**
Qur'anic Education only	3	16	6	32	6	32	4	21	19	**17**
Total	**28**	**100**	**28**	**100**	**28**	**100**	**28**	**100**	**112**	**100**
Occupational status										
Farming only	11	39	5	18	12	43	6	21	34	**30**
Civil Servants	8	29	12	43	2	7	6	21	28	**25**
Trading	3	11	5	18	5	18	8	29	21	**19**
Hand Crafts	3	11	4	14	7	25	6	21	20	**18**
Others	3	11	2	7	2	7	2	7	9	**8**
Total	**28**	**100**	**28**	**100**	**28**	**100**	**28**	**100**	**112**	**100**

Source: Author's field work, 2017

It was found that 5% had adult education while 17% had Qur'anic education. About 36%, 26% and 16% had primary, secondary and post secondary education, respectively. Education propels farmers to adopt innovations and technical skills that are vital for enhancing productivity.The result shows that there are five major categories of respondents that involved in farming practice in the four villages. These include full time farmers, civil servants, trading, hand-crafts and others (Table 1). The study reveals that significant numbers of the respondents are fulltime farmers in both rainfed and irrigation farming more especially in Gidan Tuku (43%) and Yanaba (39%) compared to Yanoko (21%) and Wasai (18%) (Table1). This signifies that their livelihood solely depend on farming activities. However, 25% of the respondents are civil servants as observed in Wasai (43%) and Yanaba (29%) villages but very few were observed in Gidan Tuku (7%) considering farming being the secondary occupation. These respondents use the privilege of their salary income to invest in farming operation. Also, 19% of the respondents engaged in hand craft works such as carpentry, building, mechanic, tailoring among others. But the least number of the respondents (8%) are engaged in other occupation such as sugar cane selling, vegetable selling among others.

Soil Fertility Enhancement Techniques Diversity in the Study Area

The use and adoption of soil fertility enhancement techniques available in the four study villages are not evenly practiced by the smallholder farmers. The results shown in Table 2 reveals that most of the farmers (94%)asserted that small ruminants manure happens to be the first enhancement techniques in term of accessibility, availability and affordability. This is because most of the household heads raise livestock and poultry mainly for trading. Therefore, this gives them privilege to cheaply source livestock and poultry manure. Furthermore, ashes manure became the second most adopted enhancement techniques (73%) because of the frequent use of fire woods and crop residues such as stocks as fuel. Cattle dung manure and Grasses and compound sweeping manure accounting for 62% were equally considered important after the adoption of ashes manure. Moreover, significant numbers of the respondents (43%) adopted the use of poultry pit latrines had (28%) while donkey (15%) and horse (13%) manure are use at micro scale. This study is in agreement with previous works done by Yusuf (2001; 2010) and Maconachie (2012) who lamented that manure generation in the Kano closed settled zone was found to be the backbone of intensive as well as sustainable farming system. It

was also revealed that inorganic fertilizer is largely utilized by most of the farmers more especially NPK and Urea, while very few farmers adopted the use of liquid fertilizers (4%) and Super phosphate (SSP) (1%).Integration of organic manure and inorganic fertilizers are use by majority of the respondents (90). The study has shown that farmers in the area adopted the use of inorganic fertilizers despite the cost and short supply.

In terms of agronomic practices, the results in Table 2 reveals that majority of the respondents practice mixed cropping and intercropping (88%) and crop rotation (86%) because of their simplicity and benefits while significant number of the respondents adopted the use of bush burning (14%) and kraaling (21%). The use of mixed farming (5%), crop residues (5%), fallowing (4%) and agro forestry (3%) had minimal adoption among the farmers. This signifies that not all the SFETs were adopted by the farmers in the area.

Table 2: Diversity of soil fertility enhancement techniques

SFETs	LOCATIONS									
	YANABA		WASAI		G/TUKU		YANOKO		TOTAL	
ORGANIC MANURE	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Small Ruminants	27	96	26	93	25	89	27	96	105	**94**
Cattle Dung	14	50	24	86	11	39	20	71	69	**62**
Poultry	10	36	13	46	5	18	20	71	48	**43**
Grasses and Compound Sweeping	15	54	15	54	18	64	22	79	70	**63**
Pit Latrines	10	36	8	29	2	7	11	39	31	**28**
Ashe	21	75	20	71	20	71	21	75	82	**73**
Horse waste	2	7	4	14	2	7	6	21	14	**13**
Donkey waste	7	25	2	7	1	4	7	25	17	**15**
INORGANIC FERTILIZER										
N.P.K.	26	93	26	93	27	96	25	89	104	**93**
UREA	26	93	26	93	27	96	25	89	104	**93**
Super phosphate (SSP)	0	0	1	4	0	0	0	0	1	**1**
Liquid Fertilizer (TakinaRuwa)	0	0	2	7	0	0	2	7	4	**4**
Organic manure +Inorganic Fertilizer	25	89	25	89	26	93	25	89	101	**90**
AGRONOMIC PRACTICES										
Mix Cropping and Intercropping	27	96	21	75	25	89	26	93	99	**88**
Crop Rotation	25	89	24	86	24	86	23	82	96	**86**
Crop Residues	0	0	3	11	1	4	1	4	5	**4**
Bush Burning	7	25	4	14	1	4	4	14	16	**14**
Fallowing	2	7	2	7	0	0	0	0	4	**4**
Kraaling	15	54	4	14	0	0	4	14	23	**21**
Mixed Farming	2	7	2	7	0	0	2	7	6	**5**
Agroforestry	2	7	1	4	0	0	0	0	3	**3**

Author's field work, 2017

CONCLUSION AND RECOMMENDATION

The study concludes that Majority of the small holder farmers in the Kano close settled zone are male in their productive age that had attended one level of education or another, married and had farming experience for more than fifteen years. This study clearly shows that the most adopted soil fertility enhancement techniques were small ruminants manure, ashes manure, cattle dung manure, and grasses and compound sweeping Inorganic fertilizer is largely utilized by most of the farmers especially NPK and Urea. Organic manure is incorporated with inorganic fertilizers which are use by majority of the respondents. In terms of agronomic practices, majority of the respondents practice mixed cropping, intercropping and crop rotation.

It is therefore recommended that farmers should try to adopt other techniques such as mixed farming, improved fallow, kraaling manure method and modern agro forestry as these no doubt would improve the fertility and condition of the farm land. It is also recommended that farmers should always be

encouraged in the appropriate adoption of soil fertility enhancement techniques via suggestions or/and advice by extension services and public enlightenment.

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