INDIGENEOUS SOIL CONSERVATION PRACTICES AMONG IRRIGATION FARMERS IN ZARIA URBAN AREA, NORTH CENTRAL NIGERIA

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Abstract

The study examines the soil conservation practices used by farmers in Zaria peri urban area to maintain soil fertility. A set of structured questionnaires and interview schedules were employed as sources of information from a total of 165 sampled respondents. Through a purposeful random sampling technique of farmers practicing irrigation on the Gulma–

Kubanni Basin System samples were obtained. By use of simple descriptive statistics bias in percentages results were analysed so as to have a good appreciation of farmers' knowledge on the used of soil fertility maintenance measures. Result of analyses showed that majority of farmers use organic substances on farms to improve soil fertility which they attributed to the availability and cheapness of the product. Further investigation revealed that the high cost of inorganic fertilizer and the difficulty in procurement made it an unpopular method as a soil fertility measure, though most farmers were of the view that it produces better result on soil fertility when compared with organic fertilizer. The farmers therefore were able to establish a link between decline in fertility level of soil and decrease in crop yields. The study recommends that there is the need to evolve an integrated cooperative approach to soil fertility maintenance, raise the capacity of the farmers by provision of loans and training, provision of motivational incentives to encourage farmers to engage in soil conservation activities and raise awareness of the farmers of the benefits of agro forestry as a soil fertility maintenance.

Keywords: *Indigenous, irrigation, conservation, soil fertility and management.*

ITRODUCTION

Despite several efforts by governments in the developing countries to shift from an agrarian economy to industrialization, agriculture still remains the backbone of the economic development of most countries. It is therefore not surprising that in Nigeria where petroleum has dominated most revenue source subsequent governments have seen the need for the diversification of the country's economy of which agriculture holds a promising option due to its reliability, dependability, renewability and sustainability. Agriculture also offers the largest employment opportunity for most of the able labour force in the rural setup and if meaningful economic development is to be pursuit then agriculture should be accorded its rightful place (Osuande, 1996). In most peri urban Nigeria, the increased demand for garden crops has led to the utilization of water in streams, drains, canals and ponds for irrigation. Irrigation as practiced augments rain–fed agriculture thus raising food production. Though irrigation is practiced along these water courses to meet the demand of the bourgeoning urban population it is however accompanied by serious soil nutrient depletion and the built up of hazardous substances thus reducing the potentials of the soil for crop development (Abubakar & Mashi, 2008). Though several efforts have been directed towards improving soil fertility by agricultural specialized interventions on soil fertility maintenance however in the developing countries it has not achieved the desired outcome. As observed by Warren (1996) since the early colonial era to the present attempts have been made to introduce soil and water conservation measures in a wide range of settings yet many have failed as a result combating land degradation is a major challenge facing many countries indicating that soil and water conservation issues should be accorded very high priority in land development programs. Farmers in many countries have been advised or forced to adopt new soil and water conservation measures and practices, these efforts have however been undermined by many problems.

One area of problem is the lack of appreciation of indigenous practices by soil conservation experts and policy makers resulting in lack in record in soil and water conservation efforts in many countries. If soil and water conservation practices have to succeed then there is the need to recognize farmers as potential solution rather than being a problem (Steiner, 1998). Indigenous soil and water conservation measures should be integrated to modern conservation techniques. Farmers should be active and functional participants in determining and planning of conservation policies. Projects and programs must find ways of building on the skills, enthusiasm and knowledge of farmers which Brokensha *et al.* (1980) observed that to ignore farmers knowledge is almost to ensure failure in development because local

people's knowledge respects the expertise of the indigenous people and is regarded as a major contributor to development thinking. Osuande (1996) was of the view that the bane of agricultural development in Nigeria is poor soil management practices, which include the application of wrong solution by agricultural experts, introduction of structures alien to the farming communities and their non adoption, prescription of capital intensive programs which are presumed to bring about rapid transformation of agriculture and many more. The direct results of these errors are the decline in crop yield and the subsequent falling standard of living of the rural people.

Farmers in many areas have in the cause of experimentation devised various techniques of conserving soil fertility through sustainable approaches. This involves the introduction of sound farming methods which not only prevent erosion but also keep the soil in a stable state. As expressed by Getis *et al.* (1981) the introduction of soil erosion measures such as contour plowing, terracing, grass waterways, check dams and other soil retention practices by the US Soil Conservation Services in the 1930s and 1940s helped greatly to repair past and prevent future erosion problems. In Africa the introduction and imbibement of measures that are alien do not go well with many areas and therefore disturbed the natural pattern of drainage and where dams are constructed permitted storm water to break through at vulnerable points due to poor construction (Petty, 1995). Soil conservation types were also identified by Reij *et al.* (1998) to include contour plouphing whereby the furrows in which crops are planted follow the contours, if furrows are done slopewise they are likely to be accompanied by gulling, terracing commonly practiced on rocky sloppy terrains in parts of Asia where rice is grown and among the Angas rocky communities of Jos Plateau where shallow rooted crops such as hungry millet, finger millet and millet are raised, planting of shelter belts on flat and undulating topography vulnerable to wind erosion, strip cultivation and crop rotation which involve cultivation of alternative strips at right angle to the prevailing winds to ensure the continued presence of vegetal cover on adjacent strips. In addition to these is the application of agronomic inputs such as organic and inorganic components to improve soil fertility and the return to the soil plant residues to raise the soil nutrients status. If soil conservation policies are to effectively achieve success foundation must be laid on indigenous knowledge, though ideas and skills might be borrowed from others since the world is viewed as a global village but if we are in possession of our minds, what is borrowed will enrich and embellish what already we have and not to supplant it. Diala (1994) observed that in Burkina Faso farmers trust practices that they have used for years and are more likely to adopt techniques which are perceived to be risky than new ones that require an investment of resources and time which may not worth it. Okoba & De Graff (2005) argued that a lack of appreciation of Kenyan farmer's knowledge and their perceptions of soil erosion and conservation measures were responsible for low adoption of recommended technologies by farmers. While Morges & Holden (2007) opined that a better understanding is required about farmers' knowledge of indicators of soil erosion than can currently be derived from available literature. Tabor & Hutchison (1994) concluded by saying that development policy that undermines or contradicts viable indigenous resources management strategies is likely to be unsustainable and further argued that indigenous knowledge assures that effort is concentrated on the most valuable resources types.

Indigenous farm management practices that have endured over the years are now faced with modern challenges. Despite the introduction of modern conservation practices, rural system sustainability has not been impressive requiring therefore re–appraisal in favour of indigenous system. The search for a solution to environmental problems such as soil fertility exhaustion might be served by building on a foundation of what people already know and what they have been practicing over the years. It is therefore pertinent to undertake this study in Zaria urban area, where indigenous soil conservation practices have been in place time immemorial and with positive outcomes. It is hoped that revert to indigenous practices will greatly improve soil fertility and as such boost agricultural production.

The study aims at examining knowledge and use of soil fertility maintenance measures among urban agricultural farmers in Zaria, Kaduna State. To achieve this aim the following objectives will be used. To asses farmers knowledge of soil fertility maintenance measures among urban agricultural farmers. To asses the major types of measures adopted by the farmers. To determine the factors militating against the adoption of the measures. To identify the strategies required in effectively promoting sustainable soil management in the area.

MATERIALS AND METHODS

Zaria urban area is located approximately at latitude 11^0 11" minutes north and longitude 7 degrees 38 minutes east in Kaduna state, Nigeria. The people are predominantly Muslims though it has large pagans and Christians settlements. The area is situated on the Central High Plains of Hausaland in Northern Nigeria. The land area is about 54.25 sq km and the Kubani–Gulma basin is one of the major basins within the region. The basin is located wholly within the Guinea Savannah Climatic Belt with a climatic regime characterized by seasonality of tropical wet and dry climate. The Kubani–Galma basin witnesses

on the average 6–7 rainy months and 5–6 dry months. Onset of rainfall is in April, reaches a peak in August and with cessation months at late September or early October. The basin has an annual mean rainfall of 1107 mm and an absolute rainfall range of 665 mm. The mean annual evaporation was computed to be 2070 mm (Kowale, 2002), representing an average annual net loss of moisture, a negative water balance. Zaria region is underlain by the ancient basement complex rocks with about 60 percent of the basin underlain by porphyroblastic biotite granite and the remaining comprise of biotite gneiss (granite).

The soils are of two types:

i. those of upland, upslope and valley–side slopes and

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Those in the former group are the ferruginous soils over which are deposited a thin layer of aeolian drift. The latter category are the fadama hydromorphic soils of the vertisols type, which are usually grey to dark grey in colour made up of clays with very poor drainage. Except for the aeolian deposits and the fadama soils, the soils are mainly derived from the basement complex and quaternary deposits. On the divides occur thick lateritic formation and a few others scattered elsewhere within basin. The soils have supported the growth of a variety types of crops both cereals and root. In the fadama the dark grey clay soils (vertisols) have become highly valued and rally points for intensive agriculture especially in the dry season when soil moisture deficiency is the major limiting factor to crop production. Large areas of such fadama lands are being used for economically valuable market gardening for growing tomatoes, sweet pepper, okra, onion, Irish potato and sugarcane employing the traditional shadoof irrigation method. This traditional irrigation scheme is laborious and to small to cope with the rate of expansion and development of the fadama lands. It however supplements urban employment through provision of job opportunity to a section of the urban population especially the seasonal migrant laborers.

Zaria urban area was purposively selected for this study because of its documented history of urban agricultural practices and the availability of extension and advisory services being offered by several governmental and non–governmental bodies in the area of soil fertility maintenance.

The methodology adopted for this study was modeled in accordance to those of Okoba & De Graff (2005) and Moges & Hodden (2007). A set of structured and unstructured interview schedules, were developed, validated, pre–test and used for the study. This method was considered preferable because of the generally low level literacy of most of the famers in the area and also to allow more flexible probing and dialogue. A multi stage sampling technique was employed in sampling farmers' opinions. Purposeful sampling technique was used to select farmers actively practicing farming in the study area. A total of one hundred and sixty five (165) farming households across two locations (86 at Jushi and 79 at Dakace) on the Kubani–Gulma Basin System where active urban farming exists were covered. Interview schedules were conducted between December (2007) and January (2008), which coincided with the period when land preparation and planting were actively being done. Data obtained from interview schedules were summarized using simple descriptive statistics bias in means and percentages so as to have a good appreciation of the farmers' knowledge and use of soil fertility maintenance measures in the area.

Results were presented and discussed in three sections i.e. major characteristics of farmers, knowledge of soil fertility measures and crop yield changes among farmers.

Socio–economic profile of respondents

A close look of the socio–economic profile of farmers in the study area revealed that about 83 % lies between the ages of 21–50 years an age range considered as that during which someone is in his\her prime age. As argued by Kolawale (2002), farmers who belong to this age bracket are those in the active farming age. Information also revealed that about 43 % of farmers interviewed were married a situation which Samaila & Avre (2006) observed that more family responsibilities and financial obligations must be provided as stipulated by gender roles and farming is the major viable option to this peri urban folks. All respondents indicated that whether married or single, widowed or divorced, are faced with the challenges of having to find a means of income to feed their households. All respondents had some form of education ranging from western to Islamic indicating that there is in general, fairly high literacy level among the farmers which will likely enhance their knowledge and use of soil fertility measures.

Data on nationality of farmers showed that about 94 % are Nigerians of which about 92 % belong to the Hausa and Fulani ethnic groups the main tribes that dominate Hausaland in Nigeria. Of the non–Nigerians majority are from neighboring Niger Republic that seasonally enter Nigeria to engage in urban farming activities in town. Though main occupation of most respondents was farming but most admitted of engaging in other non farming occupations to supplement their earnings. The income level of the farmers clearly indicates that contrary to the widely held view that farmers in Sub–Sahara Africa are generally resource poor (Rueben & Pender, 2004) only about 26 % earn less than #50000 per annum a probable reason being that urban farmers do

have off–farm jobs that urban areas typically avail its residents.

Knowledge of soil fertility and crop yield changes

Table 1: Knowledge of soil fertility and crop yield changes

Variable	Option	Number of respondents	% of total
Whether owning land	Yes	154	93.33
	No	11	6.66
Noticing soil fertility changes on the farm	Yes	156	94.54
	No	9	5.46
Nature of change in soil fertility	Increasing	151	91.51
	Decreasing	14	8.48
Noticing crop yield changes on the farm	Yes	144	87.27
	No	21	12.72
Nature of changes in crop yields	Increasing	134	81.21
	Declining	21	18.98
Not cultivating some crops now due to decline in soil fertility	Yes	30	18.18
	No	135	81.81

Source: Field survey (2008)

Table 1 shows knowledge of soil fertility and crop yield changes. A close look at the table shows that about 93.33 % farmlands are owned by the farmers indicating that they most have cultivated the land for long to be able to tell if changes have taken place in soil fertility and crop yields. About 94.54 % of the respondents notice soil fertility changes on the farms and that there is increasing changes in the nature of soil fertility. The implication of this to the soil is that its prolong use will result to soil fertility deficiency which can only be ameliorated through fertility improvement measures by investing in soil fertility maintenance aimed at promoting increase in soil fertility and crop yields. About 81.21 % were of the view that there is increase in crop yields with few observing declining crop yields on their farmlands. Despite the changes in soil fertility observed by most farmers only but few expressed that there is declining changes in crop yield (12.72 %) a probable reason why few farmers (18.18 %) indicated not cultivating some crops due to decline in soil fertility.

Fertility measures used to improve soil fertility

Table 2: Kinds of fertility measures used in improving soil fertility

Variable	Option	Number of respondents	% of total
Whether using some fertility maintenance practices	Yes	165	100
	No	0	0
Kinds of fertility maintenance practices	Inorganic fertilizer	146	88.48
	Animal manure	132	80.00
	Mulch/compost	56	33.93
	Intercropping	98	59.39
	Agro–forestry	10	6.06
	Urban waste ash	136	82.42
	Un–burnt urban wastes	154	93.33
	Others	3	1.81
Changes in use of fertilizer	Increasing	13	7.87
	Decreasing	113	68.48
	Remained the same	39	23.63
Whether investment in fertilizer is beneficial	Yes	154	93.33
	No	11	6.66
Whether fertilizer is readily available	Yes	43	26.06
	No	122	73.93

Source: Field survey (2008)

The kinds of fertility maintenance measures are presented in Table 2. All the respondents exhibited

some level of use of fertility maintenance practices of which inorganic fertilizer (88.48 %), animal manure (80 %), urban waste ash (82.42), intercropping (59.39) and un–burnt urban solid wastes (93.33 %) were most popular. The generally high level use of both inorganic and organic fertilizer among the farmers was based on the perception that they promote rapid growth and high yield of crops. On the other hand there was the low level usage of some measures such as mulching\composting (33.93 %) and agro–forestry (6.06). The high level usage of organic manure by most farmers was due to its being inexpensive to purchase when compared to inorganic fertilizer. Most farmers however complained of the bulkiness of the product which attracts high transportation cost and requires sorting before use, inspite of this about 87 % admitted that these problems notwithstanding the investments in use of the commodity on farmlands are quite beneficial and that the commodity is readily available and renewable. Though inorganic fertilizer seems to be costly and difficult to procure as indicated by majority of farmers yet it's a popular commodity for soil fertility maintenance in the area. There were however the decrease in the use of inorganic fertilizer (65 %) due to increase in prices and difficulty in procurement reasons why only 23 % of farmers admitted having maintained the same level of the inorganic fertilizer they were using on their farms. Farmers therefore have to revert to indigenous fertility maintenance measures to improve soil fertility and the yield of crops as a result the utilization of organic manure has received wide spread application by most farmers.

Table 3: Soil conservation practices among farmers in Zaria urban area

Variable	Option	Number of respondents	% of Total
Types of indigenous Soil conservation practices	Crop rotation	56	33.33
	Using crop mixtures	112	67.87
	On–farm residue retention	67	40.60
	On–farm residue burning	123	74.54
	Use of legumes	24	14.54
	Use of animal manures	97	58.78
	Use of urban wastes	127	76.96
	Others	3	1.81

Source: Field survey (2008)

To improve soil fertility and crops yield indigenous soil conservation practices were highly used by most farmers. Popular of these practices were crop rotation, using crop mixtures, on– farm residue retention, on–farm residue burning, use of legumes, increasing use of animal manures and the increasing use of urban wastes, measures which Hudson (1991) observed as being very effective. Though these methods are being used in the study area but the level of adoption defer among farmers, most common practices used by majority of farmers as shown in Table 3 included increasing use of urban wastes (76.96 %), on–farm residue burning (74.54 %), using crop mixtures (67.87 %) and increasing use of animal manure (58.78 %). Further investigations revealed that the farmers perceive these practices as being highly beneficial to the crops and that they are measures which have been in used even by their forefathers over the years that have proved to be very effective in soil fertility maintenance. This supports the view of Diala (1994) that farmers trust practices that they have used for years and that they are likely to keep away from new techniques that require investment of resources and time. Other practices such as crop rotation (33.3 %) and use of legumes (14.54) are used by a few farmers the reasons being that these methods are not commonly used in dry season farming. The use of these practices requires little investment in–term of capital as such they are cheap and accessible to farmers. These practices have been observed to be effective in maintaining soil fertility over a considerable length of time thus increasing crop yields when compared to the use of inorganic fertilizer, which is short term effective, costly and scarce. The direct use of organic residues in agriculture has resulted in an emerging business whereby people collect in polythene bags manure from houses, night soil from dug–out toilets and urban waste from waste dumps and sell to interested farmers at relatively cheap prices, most farmers therefore see this commodity as being inexpensive to purchase when compared to inorganic fertilizer. Another reason for low adoption of inorganic fertilizer is the absence of government program, extension services or media campaign to promote the use of inorganic fertilizer in fertility maintenance, which Hudson (1991) and Tenge, *et al.* (2004) identified as some of the most important factors influencing the adoption of soil and water conservation measures in the tropics.

Problems of organic fertilizer use as soil conservation measure

Table 4: Problems in use of organic fertilizer

Variable	Option	Number of respondents	% of total
Problems in use of organic fertilizer	Too heavy to be carried by self	122	73.93
	High transportation cost	148	89.69
	Smelly/filthy	45	27.27
	Requires sorting	98	59.39
	Requires treatment	7	4.24
	Requires to be burnt	34	20.60

Source: Field survey (2008)

Table 4 gives some of the problems that affect the use of soil conservation practices in the study area. Indigenous conservation practices are those aimed at improving soil fertility of which organic residues forms the major measures used by most farmers. Some of the problems observed include organic matter as being too heavy to be carried by self (73.93 %), about 89.69 % expressed that it requires high transportation cost, 59.3 % posited that it requires sorting before being used, others include, 4.24 % requiring treatment, 20.60 % requires to be burnt and 27.27 % they are smelly and filthy. Though the use of organic related fertilizer seems to be a more common practice for soil fertility maintenance in the study area its use is however likely to be accompanied by serious health problems to the farmers. Further investigation revealed that majority of the farmers view inorganic fertilizer as being a better option to organic manure especially when abundantly available and inexpensive. Its however requires steady short term replenishment for effective soil fertility management. Organic fertilizer is however a natural way of which fertility is returned to the soil through a gradual process.

Measures to improve soil fertility maintenance

Table 5: Suggestions on ways to improve soil fertility

Variable	Option	Number of respondents	% of total
Whether inorganic fertilizer is readily available	Yes	43	26.06
	No	122	73.93
Whether receiving assistance in procurement of inorganic fertilizer	Yes	14	8.48
	No	151	91.51
Suggestions on type of subsidy to encourage the use of inorganic fertilizer	Price subsidy	85	51.52
	Free supply of fertilizer	165	100
	Loans to purchase fertilizer	58	35.15

Source: Field survey (2008)

A major improved method to manage soil fertility as suggested by most respondents in Table 5 is the investment in inorganic fertilizer with over 87 % seeing it as being beneficial. About 73.93 % expressed that inorganic fertilizer is not readily available for purchase and 91.51 % indicated that they do not receive assistance in procurement reasons why most farmers find it difficult to use inorganic fertilizer in the area as a fertility maintenance measure. All those interviewed however agreed that assistance in inorganic fertilizer procurement will highly improve soil fertility maintenance and crop yields. The respondents suggested that assistance in different forms such as price subsidy (50 %) free supply of fertilizer (100 %) and loans to purchase fertilizer (35 %) are all measures that are likely to raise the adoption in the use of inorganic fertilizer. This therefore indicates that should government, NGOs and commercial institutions assist the farmers by making the price of inorganic fertilizer affordable there is likely to be a shift from the use of organic fertilizer. On further investigation most farmers were of the opinion that inorganic fertilizer produce immediate positive effects in the soil resulting in high crop yields. They also express the belief that the product is much healthier to use than organic fertilizer and may reduce the health hazards associated to the use of organic fertilizer.

CONCLUSION

In Nigeria, soil fertility maintenance has widely been recognized as a major problem that affects agricultural development. Due to the serious degradation trends resulting from soil fertility management problems, successive governments have made efforts to conserve and rehabilitate degraded lands in many parts of the country. In recent times, new thinking has emerged that consider that for sustainable soil and water conservation to be achieved farmers should be viewed as the potential solution rather than being the problem. The search for solution to environmental problems such as soil fertility decline might better be solved by building on the foundation of what people know and have been practicing since time immemorial.

In Zaria urban area irrigation has for long been practiced along the river courses. Irrigation in the area is practiced to augment rain–fed agriculture and to meet the increasing demand in garden crops by the rapidly expanding population. Methods used for irrigation include the traditional shadoof method, siphoning tubes and pumping machines. These methods are not very effective and as such can only be used for small scaled irrigation on small tracts of land holdings.

The study revealed that indigenous methods of soil fertility conservation that have been used for time immemorial are still popular with these urban folks, such methods include the use of animal manure, crop mixtures, crop rotation, on–farm residue retention, on–farm burnt residue, use of legumes and use of urban wastes. To raise farmers' interest in the use of inorganic fertilizer, the following suggestions should be taken into consideration, which include subsidy in prices, provision of loans and free distribution of the commodity to the farmers. There is therefore the need for governments, NGOs and commercial institutions to invest in the procurement of inorganic fertilizer so as to make it available and cheap to the farmers. Although the use of organic fertilizer is easy, available and inexpensive it is however associated to low productivity, if agriculture is to keep pace with the increasing urban demand in food crops then a more effective soil fertility maintenance measure has to be provided of which the use of inorganic fertilizer may provide a better option.

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