ASSESSMENT OF NUKKAI RIVER BASIN, JALINGO FOR ORGANIC FOOD PRODUCTION
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Abstract
Organic crop production by small scale farmers is a key step towards effective and efficient way in securing the safety of food consumed at the household level as well as developing income generating potential. A survey of Nukkai river basin was carried out in 2010 to ascertain the types of fertilizers, sources of organic manure, level of usage, crops, land area involved and factors that determine the use of organic manure, as well as effect on weed and pest control. A proportional sampling technique and structured questionnaires were used to sample 345 farmers in upper nukkai (112), lower nukkai (27), upper kofai (61) and lower Kofai (145) basins of the river. Descriptive statistics and chi square were used to analyse the data collected. Results showed that about 46.2, 41.4 and 12.3% of the farmers sampled use mineral, organic and both fertilizers, respectively on their farms. Sheep (27.5%), poultry (25.9%), cattle (22.8%) and goat (21.7%) were the major sources of manure. Majority (66.7%) of the small scale farmers (8,25 acre) applied 51-150 kg of manure per season. Higher percentage of farmers cultivating okro (72.7%), onion (69.2%) and sugarcane (37.5%) used organic manure on their farms. Gender, number of years of cultivation, tillage structure, weeding frequency and pest attack did not significantly (P>0.05) influence decision on the usage, sources and quantity of organic manure. However, these parameters were significantly (P<0.05) influenced by age, farm size, location and government aid. The study showed that potential for organic crop production in nukkai river basin is high, especially for vegetables.

Keywords: Nukkai river basin, crop farming, fertilizer use.

Introduction
Risks associated with using synthetic agrochemicals including mineral fertilizers in crop production have led to the desire for safer food. Synthetic fertilizer, especially nitrogen fertilizer has been criticized as an unsustainable source of nitrogen for food production due to its reliance on fossil fuel energy and the environmental impacts associated with its use in agriculture (Jensen and Hauggaard-Nielsen, 2003). Such widespread environmental impacts include nitrogen fertilizer losses into waterways, which can lead to eutrophication (nutrient loading) and ensuing hypoxia (oxygen depletion) of large bodies of water. The trend of the health hazards has led to the formation of the International Federation of Organic Agriculture Movement (IFOAM) in 1972, a movement that creates awareness for safe foods through the adoption of organic methods of production and safe methods of processing that is strictly in accordance with the internationally recognized principles (Wikipedia, 2010).

Organic agriculture is a production system that sustains the health of the soils, ecosystems and people (IFOAM, 2008). Organic crop production has environmental (Kotschi and Mulber-Samann, 2004), economic (Wheeler, 2008) and health (Kluger, 2010) benefits. Organic agriculture is the actual panacea for improving food security and conserving natural resources especially in the risk prone regions of Africa (Dugje et al., 2010). The system aims at satisfying human needs while at the same time conserving the environment. The practices are within the reach of the farmers as use of local resources and indigenous knowledge and minimization of external inputs are encouraged. The system promotes the use of natural fertilizers, botanical pesticides and cultural practices that protect the environments and the health of the consumers. Organic agriculture can also help in mitigating climate change (Kotschi and Mulber-Samann, 2004).

Robertson and Morgan (1996) explained organic farming as the agricultural system that avoids the use of synthetic fertilizer and pesticides. Williams (1999) reported that research indicates that organic manure increases yields of food crops and forages. Promoting long lasting soil fertility by harnessing the resources of the farm itself is a central concern in organic farming (Koepf, 1981). The global area under certified organic agriculture is about 30 million hectares, and additional 33 million ha of land for certified organic wild collection exist (Willer and Lukas, 2009). It is estimated that Africa accounts for 1.3% of global land under certified organic management (Bouagminbeck, 2008). Australasia has the largest total organic
farmland (4.1 million ha) followed by Argentina (3.1 million ha), China (2.3 million ha) and the United States (1.6 million ha) (Wikipedia, 2010).

Nigeria appears to be at the early stage of the development of organic agriculture, with very few farms or projects claiming to be organic and even fewer operating a recognized form of certified organic agriculture (Harris, 2006). Lockhart and Wiseman (1988) reported that there is very little research guidance on how best to carry out organic farming research successfully and there are different views on what fertilizers and herbicides may be used. In Taraba State, Fadama lands have high sustainable food security potentials (Michael and Aliyu, 2012) and farmers use organic materials from various plant and animal sources in crop production. But, there is a dearth of information on the extent, crops of priority and effectiveness of the practice. Thus, the survey was carried out to ascertain the types of fertilizers, sources of organic manure, level of usage, crops, land area involved and factors that determine the use of organic manure, as well as effect on weed control.

Materials and Method

Nukkai River Basin is located at the boundary between Ardocola and Jalingo Local Government Areas of Taraba State. Taraba State lies roughly between Latitude 6°30' - 9°36' North and Longitude 9°10'- 11°50' East in north – eastern Nigeria. Taraba State has about 2.3 million people (2006 population census) inhabiting an estimated land area of about 54,428 km². About 75% of Tarabans are involved in farming.

Structured questionnaires were administered with the assistance of trained Research Assistants to sample 345 farmers in upper Nukkai (112), lower nukkai (27), upper kofai (61) and lower Kofai (145) basins of the river. Farmers were selected randomly within each identified land units proportionally. The four land units are characterized by similar vegetation, annual rainfall, length of growing season and temperature, but with varying degree of utilization e.g. lower nukkai which had boundary with the new Timber shed have fewer number of farmers. Upper kofai have a number of commercial water dealers using water pump to sell water to trucks and water tankers and relatively busy. Information gathered included the types of fertilizers, sources of organic manure, level of usage, crops, land area involved and factors that determine the use of organic manure, as well as effect on weed control. The rate of return was about 96% of administered questionnaire. Descriptive statistics and chi square were used to analyse the data collected and presented as percentages of returned usable questionnaire.

Results and Discussion

Fertilizer types, sources and quantity of organic manure

Table 1 shows the types of fertilizers, sources and quantity of organic manure used by farmers in nukkai river basin. About 46.2%, 41.4% and 12.3% of the farmers sampled used only inorganic, organic or both types of fertilizers, respectively for producing crops. Inorganic fertilizer like NPK 20 -10-10, 15-15-15 and urea are still the most common. This could be attributed to several advantages of chemical fertilizers: high nutrient concentration, low quantity needed, ease of application and its fast release capability when compared with organic manure which most of the time are not in adequate supply. The main problem facing organic farming is how to supply adequate amounts of nutrients and organic material (Lockhart and Wiseman, 1988).

Sheep, poultry, cattle and goat manure were the major sources of manure for crop production in the system as indicated by 27.5%, 25.9%, 22.8% and 21.7% of the farmers, respectively. Household waste and pig manure were only used each by 1.1% each of the farmers. The sources of manure reflected the status of livestock production in the study area. Most families rear animals and local poultry, sheep which are very hardy and can survive with minimal management. The total poultry population in Nigeria has been estimated at between 133-165 million (RIM, 1991). With about 90% of the figure derives from the local poultry stocks, which is next only to ruminants as a source of animal protein in Nigeria, accounts for almost 25% of local meat production (Raji et al., 2010).

The potential of pig is yet to be exploited, despite that it has higher N and P than the rest animals (Dugje et al., 2010) indicated by farmers surveyed. The low usage of pig manure may be due to poor housing, low confinement which makes its manure not be substantial in a given location and low population of pig in the area, as well as unpleasant odour of pig manure. This confirmed Oyesola and Obabire (2012) who reported that in Ekiti State odour of certain organic manure made farmers to be selective in the choice of organic manure they use. The low use of house hold waste could be associated with poverty which make
the quantity of left over to be insignificant. Malangwa (2010) observed that household and crop wastes in a poverty-stricken subsistence economy were relatively scarce.

A higher percent of the farmers (62.4%) used 51-150 kg of organic manure per season. Only 5.2% of the farmers used 1 tonne and above of organic manure per season. This was grossly inadequate, when compared with the manure requirements of most crops of 5 to 20 tonnes of farmyard manure per hectare (Lombin, 1988; Ofori, 1999). This may be because of insufficient organic manure in the area. This contrasted the findings of Ogunbile et al. (1990) that manure quantities used by farmers in Kano, Jigawa and Katsina States averaged 1906.3 kg per household and 573.6 kg per hectare. This also contrasted a survey by Mdintire et al. (1992) in Africa who reported that in on-station research, applied quantities of manure were approximately 2.5 to 20 tonnes per hectare, whereas farmers' actual application levels ranged from 175 to 700 kg per hectare.

Gender, location, family size and age

Table 2 shows the influence of gender, location, family size and age on type of fertilizer used by farmers in Nukkai river basin. Higher percentage of female sampled (47.5%) used organic fertilizer when compared with male counterpart (38.7%). This implied that sustainable organic crop production is likely to be more accepted and adopted by female farmers. The higher percentage of male (50.9%) using chemical fertilizers shows that male farmers have more access to fund and could afford chemical fertilizer. This support the view of Audu et al. (2010) who reported that women in Akpa local government area, kogi state were dominant in the rearing of poultry (82.5%), sheep (68.3%) and goats (70.8%). These animals are reared on free range with or without accommodation in the night. Women provide accommodation for these animals especially fowls in their kitchen-huts which are separate buildings situated beside their own buildings in the compound.

In view of the fact that, chemical fertilizer is one of the costliest farm input and beyond the reach of majority of the women farmers, animal droppings and in some cases cow dung (organic manure) are usually applied manually and incorporated into the soil by the use of a simple hand-hoe. This contradicted Dipeolu et al. (2006) who noted that organic farmers are mostly male.

Higher percentage of farmers from Lower Nukkai (64.0%) and Upper Nukkai (59.3%) used inorganic fertilizer when compared with (44.3%) and (33.8%) farmers in Upper and Lower Kofai, respectively. However, the percentage farmers using organic manure was higher in Kofai (46.0 – 54.1%). Organic crop production prospect is greater in Kofai, Ardo Kola LGA. The number of farmers that used organic manure in Ardo Kola was significantly higher than the number of farmers in Jalingo LGA. Jalingo is more developed with little space for livestock production. Sonaiya (2007) observed that the importance of rural chicken production in the life of rural communities in developing countries is very significant. Additionally, inorganic fertilizers are more readily available in Jalingo, being the state capital, from where distribution starts. The supply of organic resources – manure, crop residues and other plant biomass – is both seasonally and spatially variable (Place et al., 2003).

Family size significantly influenced (P<0.05) the type of fertilizer used by farmers in Nukkai river basin. Generally, the percentage of farmers that used inorganic fertilizer was higher than those who used organic manure for family size of 6 (43.5%), 7-10 (42.9%), 11-15 (48%), > 15 (72.7%) when compared with those that use organic manure. Higher percentage of farmers using organic manure were found in family size <3 (56.1%). Though the percentage of farmers using organic manure (18.2-56.1%) was very significant, the concentration then among small families reflected small farm size. Large family requires big farm which could not be sustained by the quantity of available manure. Organic farming nearly always results in lower yields (18-20%) and increase in labour cost especially on weed control and handling the organic matter (Jakusko, 2010). This explains while large families are less involved in organic crop production as it may not sustain the family demands.

Age showed very highly significantly (P< 0.001) affect on the choice of fertilizer used for crop production in the Nukkai river basin. All the youngest farmers (< 20 years) sampled used only organic manure while all the old farmers (56-60 years) used only inorganic fertilizer. Beyond 36 years of age, the percentage of farmers using organic manure diminishes when compared with inorganic manure. The result showed that young farmers prefer organic farming. This may be due to high cost of chemical fertilizer; high cost of labour for application and being youth, they have the stamina to do it themselves. The prospect for organic crop production is higher among the youth and should be exploited. They are very strong and can withstand stress to some extent and so they have enough agility which enables them to spend enough
time in agricultural production activities. This supports the findings of Ogunbameru (2001) and Gvary et al. (2010) that young and middle aged people are active in agricultural production activities and have increased productivity.

Application of organic manure requires technical-know-how which majority of the older farmers do not have, thus reducing the usage of such manure. This is in support of the findings of Adeoluwa et al. (2006), Oyesola, and Obabire, (2012) that lack of know-how or technologies adjusted to local condition in scale and simplicity can be a factor obstructing the way to reduce utilization. They equally reported that majority (70.6%) of the respondents stated that time consumption was a severe problem in organic farming. Older farmers need time for other ventures. This confirmed the findings of Solomon, (2008) that farmers however disagreed that organic farming saves time. The implication is that farmers spend more time on farm which they could have used for other income generating activities.

Farm size and length of cultivation
The influence of farm size and number of years of cultivation on the type of fertilizer used by farmers in nukkai river basin is presented in Table 3. Farm size significantly (<0.05) influenced the choice of fertilizer. There is no well defined pattern. Small holder farmers (<0.25 acre) have the highest farmers using organic manure (66.7%) followed by 1-2 acre (58.1%). Equal percent of 33.3% for each large scale farmers (>12 acre) used either organic, inorganic or both. This implies that there is prospect for small scale organic farms in Taraba state. The strategy of allowing the cattle to graze after harvest must have been responsible for the high percent (41.9%) of medium [6-8 acres] scale farmers.

The percentage of farmers using organic manure decreased with the number of years of cultivating the land: 1yr (75%) > 2-3 yrs (46.8%) > 4-6 yrs (41.3%), > 7-10 yrs (38.9%), > 10 yrs (32.5%). Conversely, use of inorganic fertilizer increased with years of cultivation from 16.7% at 1 yr to 60.0% at >10 yrs. The natural soil organic matter reduces with cultivation and this will require more quantity of organic material to maintain productivity. Since, this demand cannot be met, a number of them must have dropped the idea using only organic, added inorganic or completely go for inorganic fertilizer.

Crop grown, purpose of farming and seed type
Table 4 shows the influence of crop grown, purpose of farming and seed on types of fertilizer used by farmers in nukkai river basin. Organic manure are mostly used by Kumi (100%), Amaranthus (81.5%) and Okra (72.7%) growers, followed by sugar cane growers (37.5%). Other crops are mostly grown using inorganic fertilizer. The higher use of organic manure among vegetable growers could be due to short gestation period, sustained income generation and the small land area required to cultivate such vegetable crops when compared with the annuals. This contrasted the report of Oyesola and Obabire (2012) who indicated that crops grown by the farmers in Ekiti State were mainly annuals like maize, yam, cassava, sweet potato, plantain/banana because it was male dominated.

The purpose of farming did not significantly affect choice of fertilizer types. However, higher percentage of commercialized farmers (48.5%) used organic manure which was greater than subsistence (45.2%). Semi-commercialized farmers (29.2%) were the least users of organic manure. Most of the vegetables grown were for commercial purpose. Organic crop production is market driven; though its contribution to family food safety is equally high. Vegetables are the most affordable and accessible sources of micronutrient in diets (Egwu et al., 2010) and its production has been recognized as a catalyst for rural development, a means of increasing and generating foreign exchange in Africa (AVRDC, 2004). Organic manure by users of Local seed (46.9%) > Improved seed (41.6%) > Both (23.1%). Irrespective of type of seed, Inorganic fertilizer was still the most common (28.8 – 49.5%).

Effect of government support, season, tillage, weeding frequency and insect pest on the type of fertilizer used in the study area
The effect of government assistant, season, tillage, weeding frequency and insect pest attack on types of fertilizer used by farmers in nukkai river basin is presented in Table 5. Access to government loan seems to reduce the percentage of farmers using organic fertilizer. Those that don't have government loan, go for organic manure (48.0%) compared to those that received government loan (36.1%). With government loan farmers could afford to buy chemical fertilizers.

Dry season farmers (57.4%) used organic fertilizer more than rain fed farmers (34.9%) and all year round farmers 34.0%. Rainfed farmers used more inorganic fertilizer (54.8%) when compared with dry season growers (30.9%) and all season growers (42.6%). This reflected the incorporating of the manure just
before rain. This is the common practice among crop growers. This will help to enhance faster decomposition, such that the nutrient will be readily available in the rainy season. The high cash value is always also associated with dry season farm products. The choice of types of fertilizer as influenced by tillage structure shows that use of organic manure are more common among farmers that used sunken bed (51.2%), followed by those that use raised bed (41.2%). About 34.5% and 24.4% of the farmers that produce crops on flat and ridges, respectively use organic manure. This could be as a result of sunken or raised bed having higher potential to conserve moisture than other tillage structures.

The frequency of weeding per season did not influence the choice of fertilizer type in nukkai sadama system. The percentage of farmers surveyed that weeded 2-3 times or 4-6 times per season had higher percentage (46.3-47.3%) that used inorganic fertilizer when compared with those that used organic fertilizers (40.0 - 41.8%). Those that weeded 1 time per season indicated that they use more organic fertilizer (42.9%) when compared with inorganic fertilizer users (40.8%). This suggests that the interval between production of manure and application is close and could minimize the weed seeds it could contain if left for longer duration. This means use of organic fertilizer is safe and may not significantly increase weeds on the farm.

Among the farmers that experienced pest attack, majority (46.5%) used inorganic while 41.7% used organic fertilizer. There were equal percentages, 41.5% each of the farmers that did not experience insect pest attack. There is no significant impact of fertilizer on insect pest attack. Use of organic manure does not necessarily increase insect pest attack. So the fear of extra-pest attack does not arise in Nukkai river basin. This could be attributed to proper working in of the manure mostly weeks or months before planting.

**Recommendations**

To effectively harness the potential of nukkai river basin for organic crop production the following are recommended:

- Government aid should be redirected to supply organic fertilizer and pesticides
- Organic farmers' network or association should be formed, empowered and trained especially for young farmers in the area.
- Women in Agriculture should channel some resources to encourage the women who formed the majority of organic farmers.
- The university should concentrate research in organic crop production focusing on vegetables.

In conclusion, the potential for organic crop production in Nukkai river basin is high, especially for vegetables.

**References**


