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Poultry Waste Management Techniques in Urban Agriculture and its Implications: A Case of Metropolitan Lagos, Nigeria

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Abstract: This study examines the existing poultry waste management and utilization technique in urban vegetable farms. It analyses the implications of the management pattern on yield and revenue and further determines the socio-economic differentials of farmers on management pattern. Socio-economic survey was carried out to determine relationship between socio economic characteristics of farmers and poultry waste management while field experiments and estimations were done to determine poultry waste production input and crop yield. The result revealed that poultry waste is poorly collected, packaged and transported. Proper knowledge on treatment is lacking due to lack of skill, space, time together with paucity of capital. Availability and cost of synthetic fertilizer among other factors determine poultry waste utilization. Exotic vegetable requires more poultry waste than indigenous ones and soil characteristics play strong role in influencing poultry waste input and yield of vegetable crops. At $p>0.05$, there is significant difference between poultry waste utilization, crop yield and revenue in the study area.

Keywords: Management technique, poultry waste, urban agriculture, utilization

INTRODUCTION

With a population growth rate of about 7% and over 65% living below US $1/day poverty level coupled with pressure on urban resources, Lagosians surfer intense food insecurity, poverty and mass unemployment such that urban agriculture has increasingly become a source of livelihood to a number of them. The growing recognition of urban agriculture practicability and usefulness has been easing the burden of food insecurity and also improving the urban economy, because of the incredible utilization and management of poultry waste as alternative to synthetic fertilizer and as ingredient for improving soil and production output (Redwood, 2004). Despite the perceived benefits associated with poultry waste utilization, there has been uncertainty about its quality and suitability for crop production probably due to the complexities of its nature involving the complex interactions among biophysical, social, cultural, economic and political factors (Lebel, 2003; DePlane and Kilelu, 2004).

There is also no conscious effort made to clearly understand the utilization and management technique of poultry waste for urban agriculture, problems associated with its acquisition, handling, seasonal variations, organization and farmer's perception as well as their implications on yield. This concern has brought the need to focus attention on the techniques use for managing and utilizing poultry waste in urban agriculture and how it influence yields and well-being of urban farmers. Understanding the drivers of poultry waste management and utilization techniques especially as its affect crop yield and revenue generation among farmers, could pave ways for improving poultry waste activities for urban agriculture and consequently increase income, urban food security and poverty reduction.

Objectives of the study:
The objectives of the study include:

- Examining poultry waste management and utilization techniques and their determinants in Lagos
- Analyzing the impact of poultry waste utilization on yield and revenue
- Determining the socio-economic differentials of poultry waste users on the management pattern of poultry waste in the study area

Research questions: In order to pursue the objectives of the study, the following research questions were formulated namely:

- What is the pattern of poultry waste management for urban agriculture and what are the determining factors in the study area?
- What are the socio-economic attributes of poultry waste users in urban agriculture and how do these attributes affect their management pattern?

- What are the impacts of poultry waste on crop yield and farmer's revenue?

Research hypotheses was formulated and stated in null form as stated below:

- There are no differences in the quantity of poultry waste utilization and crop yield in the study area.

LITERATURE REVIEW

Animal waste management for agriculture in Nigeria: The utilization of animal waste (Cattle, Sheep, Goat, Poultry) for agriculture in general and in urban agriculture has been a traditional source of manure for food production in Nigeria. In the pre-colonial era, the use of animal waste for food production was highly effective and efficient because there was less reliance on modern agricultural input like hybrid feeds, insecticides and chemicals for animal rearing and production. Introduction and adoption of inorganic manure {brands of NPKs 15:15:15, 20:10:10, 27:13:13, triple super-phosphate and urea} and other agro-chemicals during the period of colonialization created affordable access to the inorganic manure. However, the 1990s recorded restricted access to inorganic manure through hoarding and high price and there was problem in obtaining sufficient quantities of inorganic fertilizer such that farmer especially urban farmers were left with no other alternative than animal waste or traditional fertilizer such as poultry waste for food production.

With the agricultural sector, becoming relatively modern by the 1990s, waste from animal's production has become a mixture of agrochemicals and chemical from cleaning and treating diseases associated with animal production. With this development, it is expected that waste from animals used for food production such as vegetable is treated to increase yield and minimize diseases transfer from animal to human before used as it is done in Havana, Cuba. In Havana, organic manure used for all agricultural activities are collected, treated and distributed by government to all urban farms. Ironically, this is not so in Nigeria, because treatment facilities are unavailable and collection, packaging, transportation and distribution of waste used as manure is not properly coordinated and monitored for food production in Nigeria. For instance a vehicle hired to transport untreated animal waste to farms could also be used to transport food stuff such as Cassava flour (Gari) and dry fish.

Apart from this, most waste management activities in Nigeria are mainly concerned with reduction of public health hazards, dust and obnoxious odours (Taiwo and Osinowo, 2001) Adequate management scheme for efficient collection and treatment of animal waste for food production requires much investment which is not often available and if available, is used for more prioritized sectors like, health care, road construction and education. The decision to integrate waste into urban agriculture specifically and agriculture in general has thus been left as the sole responsibility of the individual farmer who knows little or nothing about the possible health and environmental impact that could be inherited from the use of animal waste.

Animal waste management for urban agriculture: Waste utilization for agriculture including poultry waste is not a new phenomenon in Africa but a traditional method of providing nutrients for plants, enhancing soil quality and creating livelihood for farmers (Onibokun, 1999). The utilization of waste for urban agriculture has recently become an important phenomenon in developmental research due to its role in curbing urban food and unemployment problems for the growing urban population. Recent studies have provided evidences of environmental, social and economic contributions of waste utilization for urban food production. However, a major problem to contend with remains how waste (wastewater, municipal waste, cattle waste, poultry waste etc.) can best be managed for healthy food production with minimal negative health implications (Allison *et al*., 1998).

One of the principles of Agenda 21, adopted in Rio in 1992, is that sound waste management should include safer recovery of any form of waste and the promotion of environmentally sound waste treatment that enhances integration of and changes to a more sustainable pattern (UNEP, 2004). This principle has been accepted by most countries including Nigeria who were signatories to the concept. In Ghana, the concept of Integrated Waste Management (IWM) has evolved and is slowly becoming accepted by decision makers (Cofie *et al*., 2006). IWM relies on a number of approaches to manage waste, including all aspects of waste management, from generation to disposal and all stages in between with proper consideration of technical, cultural, social, economic and environmental factors.

The application of animal manure such as poultry/pig manure and cow dung or human excreta directly to the soil requires an organized composting or co-composting of the animal manure with other forms of solid waste for efficient productivity in urban agriculture (Cofie *et al*., 2005). The process also requires microbial degradation that releases useful nutrients in organic waste for soil improvement and plant growth. The organic composting involves a process of decomposing or breaking down organic waste materials (by micro-organisms such as bacteria, protozoa, fungi, invertebrates) into a valuable resource called compost. Composting is done at different

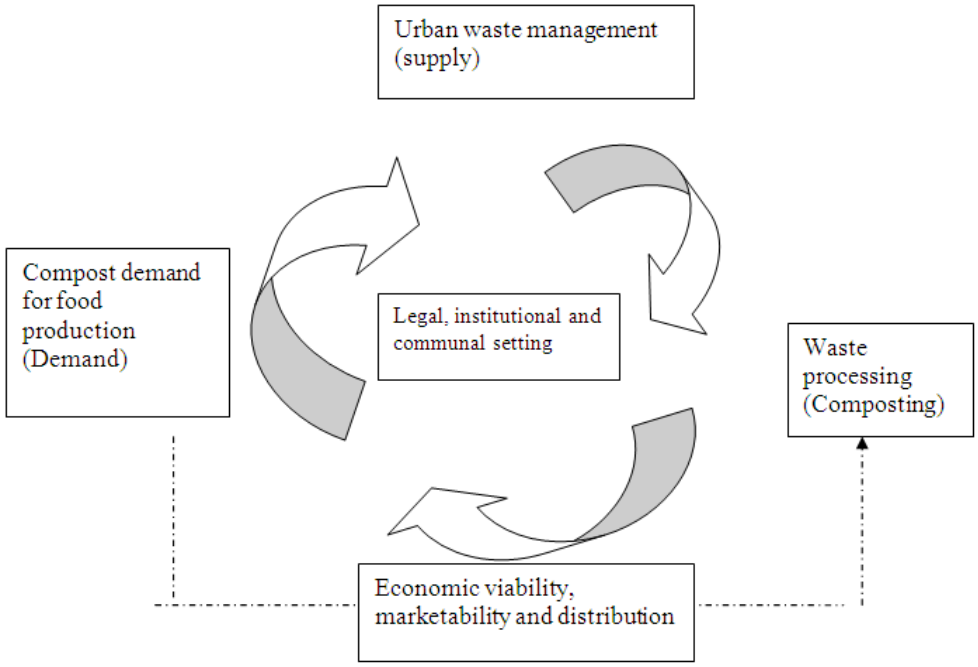

Fig. 1: Concept of nutrient cycle loop and waste management as developed by Drechsel and Kunze (2002)

scales (large, medium and small) by various people (municipalities, NGOs, communities, individuals). The nutrient recycling loop concept developed by Drechsel and Kunze (2002) becomes very helpful explanatory devices in the process of proper waste management (Fig. 1).

The recycling loop is represented by various segments: urban waste generation, waste processing, compost demand for agriculture, along with an economic feedback mechanism and the legal, institutional and communal settings throughout the loop. However, as lucrative as the nutrient loop might appear, issues related to its numerous segments has raised concern. For instance, (Drechsel *et al*., 2002) argued that it might be difficult to achieve an effective management practices considering the many factors that influence waste utilization coupled with its associated constraints. Notwithstanding, the recycling loop gives the required framework and potential best practice for planning composting for urban agriculture (Cofie *et al*., 2001; Danso *et al*., 2006). Studies have demonstrated the usefulness of the framework in some African cities. For example, (Cofie *et al*., 2006) used the framework to produce compost from human excreta in Northern Ghana. In Nigeria particularly Lagos there exists less composting activities and thus waste management activities do not conform to the standard rules and regulations guiding the integration of waste for food production. Safety pre-cautions are absent and procedures for adequate treatment or composting regulations are not adhered to such that poultry waste reuse poses serious threat to human health. The smell and sight of poultry waste are offensive and often become breeding ground for a variety of pests, rodents and also generate polluted runoff into water ways and to the environment (Zeeuw, 2000).

Waste utilization for urban food production can encourage transmission of faecal-oral infections including diarrhoea and dysenteries (Cairncross and Feachem, 1983). It can also promote diseases associated with rats such as plague, endemic typhus and rat bite fever. With the limitations in waste integration into urban agriculture, literature on this has been restricted to investigation of animal waste quality (UNDP, 1996; Drechsel *et al*., 2000) without emphasis on its implications on productivity.

METHODOLOGY

Table of random numbers was employed to determine the total number of questionnaires that were administered in the study locations (75 questionnaires in each). In addition, face to face interview schedule method was used to gather qualitative information from key government officials. The questionnaires consisted of both open and close ended questions that gave respondents chances to express their views about integration of poultry waste into urban agricultural activities. The focus of the researcher was firstly on practicing farmers. The questionnaire was sub-divided into two major parts. Firstly, information was requested on the socio-cultural and economic characteristics of farmers and secondly, questions on

poultry waste management were requested. Twenty farm beds were hired in each farm location (Alapere and Barracks) for on-farm experiment with two beds used as control point. This was done to quantify the amount of poultry waste use for selected vegetable types and output per unit area. Land allocations for vegetables types were also marked out on the farm to enable the researcher estimate the Net Return (NR) of local and exotic vegetable crops. This enhanced the researcher's regular visits to the farms, improved discussion with farmers and engendered observations that are related to farmers' behaviours and life styles. Six poultry farms were visited and poultry waste brokers and marketers were also interviewed. The information obtained provided insight into personal perspectives pertaining to the impact of poultry waste utilization on yield. Non-conventional Focus Group Discussions were held at each farm site on meeting days of farmers' associations. This was to enable farmers to participate actively in the discussions and for deliberations on possible, feasible and practicable solution to farmers' priorities and needs. The meetings gave the farmers avenue to air their views on pertinent issues on poultry waste utilization. Multiple Regression was used to determine the effects of several causal factors that influence poultry waste management and utilization in the study locations. This was done in order to determine the partial and net contributions of the selected factors that influence the distribution of poultry waste utilization in the study area. Chi square (χ^2) test was adopted to examine the influence of farmers' socio-economic attributes on poultry waste management because of the classified nature of the data sets. The socio-cultural data set was classified into age, income, ethnicity, gender, educational level and religion, while the management data set was classified into application, treatment and storage techniques.

RESULTS AND DISCUSSION

Poultry Waste (PW) management technique: The analysis revealed that poultry waste is an important soil ameliorating resources for urban agriculture and it is acquired by searching poultry firms within Lagos localities up to 300 km radius across the immediate environs. Types, contents and quality of PW product are hardly given consideration when sourced for. PW is usually a combination of poultry bird faeces, urine, saw dust and remnants of animal feeds, drugs and pesticides. Conveyance cost is usually high due to its weight and bulkiness and there are no specific vehicles assigned or designed for poultry waste haulage and there are no standard measures for poultry waste collection and packaging although the informal nature of the PW business plays a major role. Storage of PW is mainly by heaping (75%) and covering (25%), while in some cases they are buried (64%) in between farm ridges and covered with leaves.

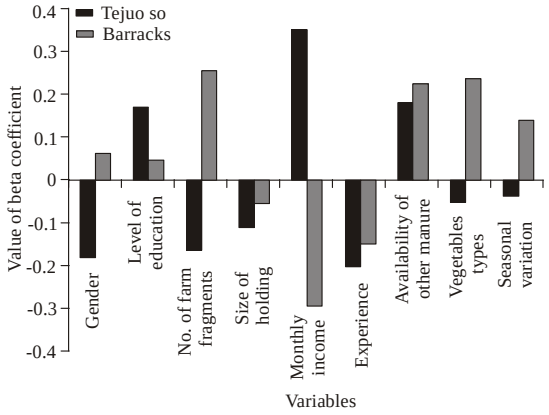

Fig. 2: Factor that influence PW utilization at tejuoso and barracks

Knowledge about treatment techniques builds on sorting, picking and grinding molded particles into fine stuffs for easy application. This mode of treatment is adopted due to lack of skill for proper composting methods (64%), insufficient space and time (15%) and paucity of capital (9%). Other reasons are the burdensomeness of the long processes required for its treatment (8%) and inadequate access to other needed materials such as ash (4%). Application is manual and it is done without protective gadgets like boots and nose mask. Reasons for non-use of protective gadgets relate more on non-economic factors like ease and convenience of application. According to one of the farmers at Barracks, 'I prefer not to wear any protective cloths because my bare hand allows me spread PW evenly and carefully'.

As depicted in Fig. 2, an analysis determining the differences in factors influencing the magnitude of PW utilization in two study location (Tejuoso and Barracks) using Standard Beta coefficient from a regression analysis, reveal that gender, level of education, number of fragment farms, availability of other types of manure, vegetable types and seasonal variation influence PW utility at Barracks. While monthly income, level of education, availability of alternative manure determines PW utility at Tejuoso.

Implication of poultry waste on crop yield and revenue: Estimation of vegetable yields and quantity of poultry waste used per unit area (per plot or 0.06 ha) in two locations (Alapere and Barracks) is as presented in Table 1. The data show spatial differences in the quantity of poultry waste, crop yield and revenue. The outcome depicts a non-correspondence of increase of poultry waste on crop yield and on revenue. For instance, application of

Table 1: Estimation of the quantity of poultry waste, vegetable yields and net revenue per unit area

	Alapere (site A)			Barracks (site B)		
Farm site	Amount of poultry waste (kg)	Yield per unit area (kg)	Net revenue (N)	Amount of poultry waste (kg)	Yield per unit area (kg)	Net revenue (N)
Lettuce	769	3,578	159,000	792	2,700	64,440
Tete	557	2,199.5	92,750	540	1,890	22,950

Unit area: a plot (0.06 ha)

Table 2: Significant value of the variations between quantity of poultry waste and crop yield

	Chi-square value	Table value (PV)	p-stand	Remark
Quantity of PW between alapere and barracks	29.30	3.48	p>0.05	Significant
Quantity of yield between site alapere and barracks	45.84	7.82	p>0.05	Significant

Table 3: Association between farmers' attributes and poultry waste management practice

			Probability value @ 0.05		
Socio- cultural. characteristics	Management indices	Chi-square (χ^2) value	Table value (PV)	p-stand	Remark
Age	Application	2.25	0.523	0.05	PV>p Significant
	Treatment	12.224	0.201	0.05	PV>p Significant
	Storage	9.964	0.126	0.05	Pv>p Significant
Gender	Application	4.26	0.039	0.05	PV<p Not Significant
	Treatment	15.52	0.001	0.05	PV<p Not Significant
	Storage	8.523	0.014	0.05	PV<p Not Significant
Ethnicity	Application	0.527	0.913	0.05	PV>p Significant
	Treatment	10.832	0.287	0.05	PV>p Significant
	Storage	32.634	0.000	0.05	PV<p Not Significant
Educationallevel	Application	10.391	0.065	0.05	PV>p Significant
	Treatment	29.086	0.015	0.05	PV<p Not Significant
	Storage	9.511	0.484	0.05	PV>p Significant
Income	Application	1.696	0.638	0.05	PV>p Significant
	Treatment	8.303	0.504	0.05	PV>p Significant
	Storage	4.920	0.554	0.05	PV>p Significant
Religion	Application	0.946	0.623	0.05	PV>p Significant
	Treatment	8.936	0.177	0.05	PV>p Significant
	Storage	3.467	0.485	0.05	PV>p Significant

If pV≥p: Significant; if PV≤p: Not significant

higher amount of poultry waste in Barracks (792 kg) produced 2,700 kg of lettuce per unit area. By contrast, application of lesser amount of poultry waste (769 kg) gave higher yield (3,578 kg) of Lettuce in Alapere.

The experiment suggests that exotic vegetables require more poultry waste than local vegetables in both Alapere and Barracks. Statistical test on the premise that there is no significant variation in the quantity of poultry waste utilization and yield between the two locations using chi-square (χ^2) model, shows significant variation between poultry waste used in sites Alapere and Barracks (p>0.05) as well between yields (p>0.05) (Table 2). The null Hypothesis (Ho) is hence rejected while the alternative (H_1) is accepted. There is therefore 95% affirmation that there is variation between the quantity of poultry waste used and crop yield in the study area. The disparity in the amount of poultry waste and vegetable yields is not unconnected with spatial differences in the biophysical characteristics of the two locations parts of which are related to nature of soil and extent of biodegradable activities. For instance the texture of soil in Barracks is sandy while that of Alapere is loamy in nature.

Influence of farmers' characteristics on poultry waste management practices: The relationship between farmers' socio-economic characteristics and PW management practices was examined to determine how poultry waste is integrated into vegetable production, using Chi-square technique. The choice of Chi-square (χ^2) technique was informed by the subsets of socio-economic and management variables. The variables and their subsets are as depicted in Table 3. The result depicts that there are significant associations between age, income and religion characteristics of farmers and all poultry waste management indices.

CONCLUSION

The research highlights that poultry waste utilization for urban agriculture is indeed integral part of the urban economy. It is one activity that has multiple means of addressing some core challenges of urbanization in Lagos, i.e., minimizing waste management problems. The use of poultry waste for urban food production reduce government burden to sufficiently provide inorganic for the growing urban farmers and also assist to sustain farmers in the city. It is however, pertinent to note that improved knowledge especially in respect of standard composting procedures, handling and storage needs to be enforced. This requires proper and integrated science and technology for recycling operations that enables safe

utilization of the resource for enhanced production output, increase income, minimize health risk and further encourage sustainable urban agriculture in the growing city.

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