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Full Length Research Paper

Reuse of wastewater in urban farming and urban planning implications in Katsina metropolis, Nigeria

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Studies on urban farming in Sub-Saharan African cities reveal the existence of literatures in Eastern, Southern and Central African cities. A few have focused on West Africa. In Nigeria, there is a paucity of information on reuse of waste water in urban farming. The purpose of this paper is to examine the status of wastewater reuse in urban farming in Katsina, an important urban area in the semi arid region of Nigeria. A total of 120 households were selected and interviewed out of the total number of 250 that officially registered with the Katsina Urban Planning Authority. It was found out that the reuse of wastewater in urban farming in the area is an occupation that is not only practiced as a fulltime and sole income earner for many households, but an activity that the town cannot do without. Being a city located within a semi-arid setting, relying on rainfed for successful promotion of urban farming is certainly a risky enterprise and hence the practice virtually has no substitute. Unfortunately urban planning process has not officially recognised and given attention to this important activity in the town. Appropriate recommendation on how to promote the activity and get it integrated into planning processes in the area have been given.

Key word: Urban, peri-urban, agriculture, farming, semi-arid, Nigeria.

INTRODUCTION

The use of urban wastewater in urban farming is a century-old practice that is receiving more attention with the increasing scarcity of fresh water resources in many arid and semi-arid areas. A primary exposure route for urban population in general is the consumption of raw vegetable that have been irrigated with urban waste-water (Scott et al., 2004). In many developing areas however, non-built up urban lands, especially those lying along the courses of urban drainage systems, are sometimes seen as locations for the production of some agricultural products that are in high demand by urban dwellers (such as vegetables). Several researchers have shown that a significant proportion of a city's food requirements in developing countries are supplied from within the urban boundaries, because within those areas substantial amount of wastewater (mainly from homes and industries) is available in urban drains for irrigating lands along the urban drainage courses. Since the early 1990s, in particular, there has been increasing recognition amongst the scientific and development community of the rising importance of wastewater-based food production in city areas, particularly in those parts of the world that have been characterised by economic collapse (Mbiba and Van Veenhuizen, 2001). In cities of many arid and semi- arid areas, this is sometimes the only major source of irrigating urban lands being used for food production and fortunately for such areas, there are no prohibitions of disposal of wastewater in urban rivers.

The growing demand of water for irrigation has produced a marked increase in the reuse of treated and/or untreated wastewater worldwide. The use of industrial or municipal wastewater in agriculture is a common practice in many parts of the world (Blumenthal et al., 2000; Ensink et al., 2002; WHO, 2006; Sharma et al., 2007). Rough estimates indicate that at least twenty million hectares in 50 countries are irrigated with raw or partially treated wastewater (Scott et al., 2004; Hussain et al., 2001). The major objectives of wastewater irrigation are that it provides a reliable source of water supply to farmers and has the beneficial aspects of adding valuable plant nutrients and organic matter to soil (Liu et al., 2005; Horswell et al., 2003). With careful

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planning and management, the positive aspects of wastewater irrigation can be achieved (WHO 2006).

Urban and peri- urban agriculture (UPA) can offer wide-ranging benefits (Pasquini, 2006). It can contribute substantial amounts to the proportion of food consumed in the city. Sweet (1999), for example, has estimated that 15 - 20% of the world's supply of vegetables and meat is produced in urban areas, and FAO (1999) estimates that 800 million urban dwellers are actively engaged in UPA, 200 million providing food for markets (FAO, 1999). UPA is practiced for a variety of reasons, for crisis management when markets are not working (e.g. in Cuba), as a strategy to overcome cash shortages or even for commercial purposes. As well as improving food security and nutrition, and creating employment for the jobless (Lynch et al., 2001).

The objective of this paper is to examining the nature, determinants and problems of wastewater reuse in urban farming in Katsina, a very important urban area in semi-arid region of Nigeria. The focus of this paper is on urban irrigation farming.

STUDY AREA

Located at the extreme northern margin of Nigeria, Katsina urban area, covers a total land area of about 3,370 km^2 and lies between latitudes 11°08'N and 13°22'N (13°00'N- 13°25'N) and longitude 6°52'E and 9°20'E.(7°37'E and 8°00E).

The climate is hot and dry for most of the year. Maximum day temperature of about 38°C in the months of March, April and May are common and the minimum temperature is about 22°C in the month of December and January. Annual rainfall average is about 780 mm.

The area lies within the Sudan Savanna zone but its vegetation has been to a large extent modified as a result of several centuries of bush clearing for construction activities, bush burning, cultivation, animal grazing as well as fuel wood exploitation. In the closely settled area especially around Katsina town, natural vegetation is almost absent but several trees have been planted such as *Azadiracta indica* and *Acacia albida*. A considerable growth of natural vegetation occurs in areas that are marginal and not cultivated.

The soil is predominant ferruginous tropical red and brown soil common in the areas underlain by the Basement Complex rocks. Over large areas, the vegetation does not provide adequate cover for the soils especially at the beginning of the rains, hence the soil are generally susceptible to erosion.

The vast majority of Migrants to Katsina Metropolis originate from rural areas where they have traditionally supported themselves through agriculture. Given their ability in this field, it would be surprising if they did not attempt to continue with such activities once they arrived at the city.

METHODOLOGY

From a reconnaissance survey conducted across the entire Katsina metropolis (Figure 1), UPA practices were identified to be comprising of three main farming systems: household or home gardening (mainly irrigated) taking place within and around homes, open or vacant-space cultivation (mainly rainfed) done in open spaces, undeveloped private, community and residential plots, peri-urban cultivation (both rainfed and irrigated) taking place on lands just outside the built area of the city. Of these systems, only the peri-urban irrigated involves the use of wastewater that flows freely along the courses of Rivers Ginzo (6.4 km^2 total drainage area with a length of 48 km) and Talle (12.2 km^2 with a length of about 26 km), the two main ones that nearly encircle the walled, Katsina urban area (Figure 1) . The two rivers collect water from several drains that run from the hearth of Katsina Township towards the per-urban locations. Consequently, this study was deliberately focussed on the peri-urban locations where waste-water is reused in farming. It was also found out that the cultivated plots are owned on household basis, with members of a household performing various roles in the farming cycle (adult males till the land, male children assist the adult males in planting, weeding and watering while adult female and female children perform the roles of crops' conveyance from the farms and subsequent marketing of the produce.

A total of 120 households were selected and interviewed out of the total number of 250 that officially registered with the Katsina Urban Planning Authority. This number was covered because the interviewing process was made voluntary and as such the researchers interviewed only the willing participants encountered on their farms (Table 1).

Supplementing the interview efforts, the researchers also observed, conversed with, and conducted focus-group interviews with the farmers. These discussions provided the opportunity for participants to share their feelings, insights and experiences about their needs and problems. The type of data sought from the interviews included the socio-economic and demographic characteristics of cultivators, farming practices, land ownership, motives for cultivation, problems they face as farmers in the metropolis, source of water in their farming, reason for using it, consequences of using it, and awareness of those consequences. The responses received were summarized using simple descriptive statistics (percentage).

RESULTS AND DISCUSSION

Gender identity of the cultivators

Heads of all the studied households are males and they act as the custodians of the lands on behalf of the households. In other cities of Africa, males were found to dominate but not the sole owners of urban cultivated lands (Asomani-Boateng, 2002). In some other cities, women were found to predominate the urban farming population (Tripp, 1990 and Mvena et al., 1991, in Tanzania); as well as in Kenya, Uganda, and Zambia (Sanyal, 1984). Informal discussions with some male farmers and female traders revealed that religious and cultural considerations which discourage the visibility of women in active business activities that requires one to physically work in public (like in farming) were the main reasons for the male dominance of urban farming in the area. However, there are certain businesses in Katsina markets that are dominated by women and these include sales of farm produce and agro-based processed food items. Hence, the male farmers deliberately exclude the females from the farming activities and confine them instead to petty business of produce marketing.

The reality is that throughout much of northern Nigeria where Islamic religion has a very strong influence, women do not farm by themselves but assist their

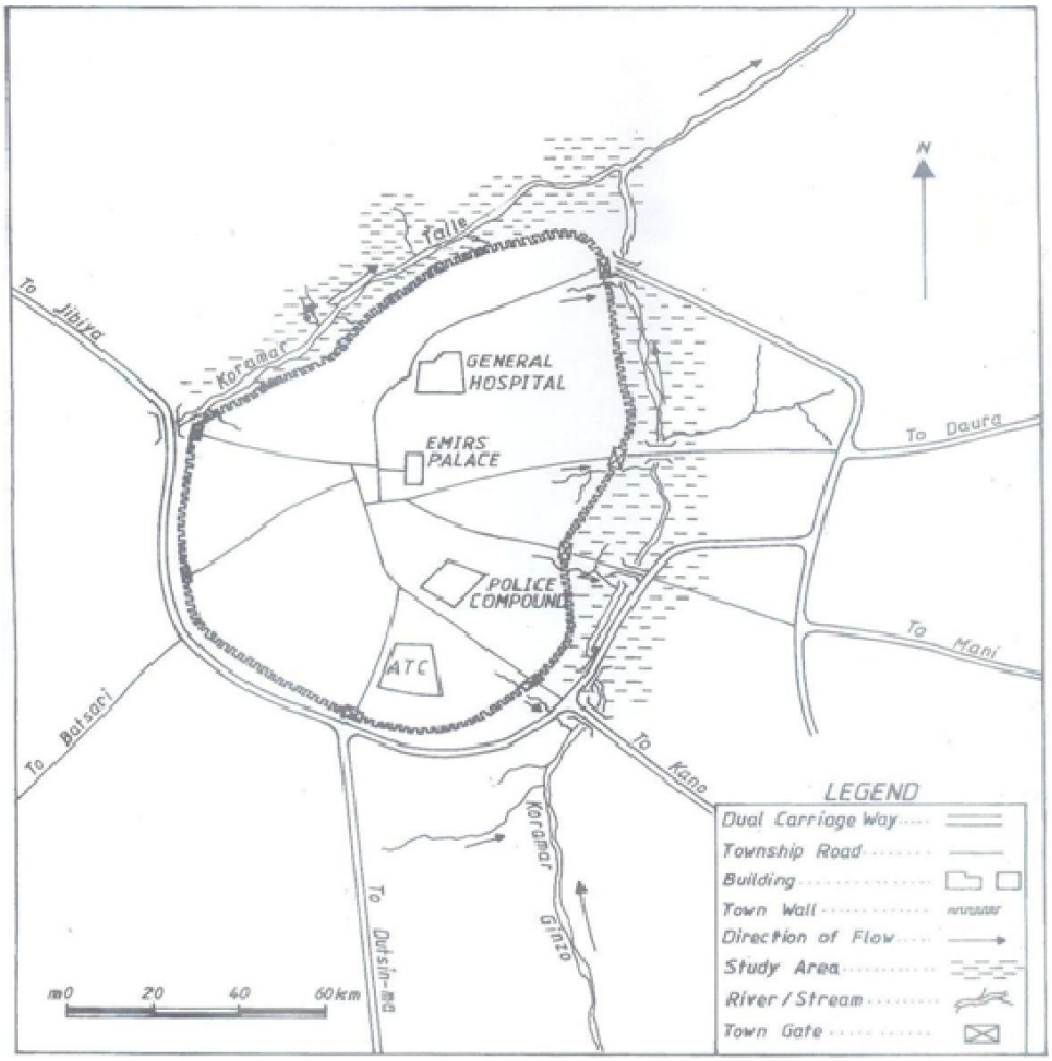

Figure 1. Location of the study area. Source: Ministry of Land Survey, Katsina (2009).

Table 1. Age of the farmers Interviewed.

Age	No. of farmers	Percentage %
20 - 30	8	6.67
31 - 40	72	60.00
41 above	40	33.33
Total	120	100.00

Source: Field work (March, 2009).

husbands; therefore, it is quite uncommon for a woman to farm by herself.

Socio-cultural background of the farmers

All the studied farmers are Hausas (the main tribe in Katsina) and are Muslims (the main religion). Only about 25% of them are immigrants who moved from other towns and villages within the Katsina state to reside in Katsina urban area. But none of these migrants claimed to have moved to the town with the sole objectives of partaking in urban farming. Instead, they claimed to have migrated to the town in search of typical opportunities a city offers (especially employment in formal and service sectors) but ventured into urban farming either due to hardships or as last resorts.

Only about 17% of the interviewed famers had any form of formal education and four out of them were found to be clerical staff of some government establishments who moved to the town to work as civil servants but ended up venturing into urban farming to supplement the meagre earning from their clerical jobs.

More than half (60%) of the farmers have been cultivating between 5 and 10 years. 30% of them have been in cultivation for between 11 and 20 years and another 10% have been cultivating more than 20 years.

To determine whether farmers intend to abandon urban cultivation, farmers were asked: Do you intend to quit urban cultivation? None of them stated no, and reasons given included the fact that because the job market in the formal sector has deteriorated they do not contemplate quitting, and even if the job market is good they will not quit entirely but will cultivate on part-time basis. Others stated that because food cultivation supplements their income and household food purchases, they do not intend to quit now or in the near future.

Most of the farmers (88%) declared urban cultivation to be their full time job and their main source of a livelihood. The remaining 12% indicated that they partake in other activities like trading, service activities (mechanics, electricians etc) and civil service are supplemental occupational activities.

Land access, ownership and site selection

Most (92%) of the farmers own the land on which they cultivated and the land belongs to their entire household. Upon death, the ownership is transferred to the most senior of the male children who farms it on behalf of all the remaining members of the household. When crops are produced they are sold and the proceeds used to maintain the entire household. The average land ownership is 0.76ha per household. When asked about what factors they consider for choosing a particular piece of land to cultivate, 4% of the cultivators indicated proximity to residence, 89% indicated proximity to water, and 7% of them indicated fertility and the suitability of the land for cultivation. During the rainy season, all the farmers cultivate their plots for upland crops under rainfed condition and for lowland crops where the farm experiences periodic flooding.

Availability of water is the most important determining factor on whether the farmer cultivates seasonally or year round. This explains why vegetable growers, who need a lot of water for their operations, are mostly located near streams and drainage channels. Cultivating near streams and drainage channels makes it easier for the farmer to obtain much needed water for irrigation. None of the farmers indicated suffering from crop losses as a result of floods destroying his crops during the rainy season.

Crops cultivated

Nearly all the farmers (97% of them) in the area cultivate mainly vegetables and only 3% cultivate cereals like maize and guinea corn. Vegetables grown were mainly exotics such as lettuce, onion, potato, sweet potato, cabbage, carrots, sweet peppers and peppers. Indigenous vegetables grown included okra, peppers, tomatoes, spinach and garden egg. These are not grown purposely for sale but rather are staples for the gardeners, and cultivated for personal consumption, although any surplus is sold. Fruits like pineapples, banana, guava, cashew, mangoes, paw paw, orange, are grown only on few locations mostly for personal consumption. None of the farmers engage in mechanised farming activities (use of tractors, harvesters etc).

Two types of cultivation were identified, determined by the availability of water: seasonal and year -round. Farmers who farm throughout the year cultivated mainly vegetables, which can be grown even in the absence of rain, provided there is water. However, farmers scheduled production to coincide with periods of high demand, although they nevertheless cultivate vegetables as many times of the year as they can, depending on the period of maturity of the vegetable crop, the ability to replenish the soil and, above all, the farmers' energy.

Returns on cultivation

None of the household cultivators indicated that he cultivate crops purposely for home consumption. Though none could give precise figure of how much is earners per year on crop sales as they produce are never sold at once, figures ranging between 40,000 Nigerian Naira and 85,000 Nigerian Naira were speculated. When one considers that Nigeria is categorised as among the low income countries (per capita GDP of less than 1000 per annum) one could say that the farmers are not in essence resource poor at least by Nigerian standard.

This observation is considered as not so surprising here. This is because, urban farming with urban wastewater though contributing only a small proportion of national food supplier (Ellis and Sumbery, 1998), but is important within urban area, particularly for the poor as it serves as a major source of income for the urban poor; source of vegetables crops for urban dwellers; and creator and user (for fertilizer) of city organic waste, both plant and animals.

Problems of urban cultivators

Like urban farmers everywhere in Africa, cultivators in the study area encounter a number of problems in their farming operations. Finding land was the most common problem mentioned by farmers as they all rely on narrow stretches of land along the Talle and Ginzo rivers with very little or even no chance of expansion. Farmers complained that it is very expensive to farm in the city due to the high cost of farm inputs. Agrochemicals like fertilizers, pesticides, and insecticides are expensive. Consequently, some farmers have resorted to using cheap and banned alternatives like DDT. Some farmers,

especially vegetable cultivators as alternative to chemical fertilizers because they are cheaper, are using cow and chicken manure and compost.

Farmers also complain of theft of their produce before harvest. To guard against theft, farmers have formed watch groups made up largely of their male children that take turns to guard their farms against theft, especially during harvesting periods. Some farmers have constructed sheds in which they stay to guard their farms at night.

In the area of support services, farmers complained about their inability to obtain loans from the banks for farming purposes. Farmers had negative opinions about extension personnel and of the services provided by them. Extension officers were seen as very unreliable are not available when needed, and when available concentrate on only a few farmers. They are also known to be very unfriendly and rude towards farmers. Those who are unable to access the services of extension officers and tap their expertise, particularly in the application of agro-chemicals, are forced to use their own instincts. Ultimately, farmers are applying these chemicals without any technical advice, with its negative consequence for the environment and for the health of farmers and consumers of farm produce. Since most of these farms are located near streams and creeks, the likelihood of pollution of these water bodies from these chemicals is very high.

The marketing of farm produce was reported as a major problem facing farmers, especially vegetable cultivators in the city. There are profound fluctuations in prices resulting from supply and demand inequalities and the farmers have to sell their drops through middlemen and women. Usually, the middlemen who buy the majority of the produce offer ridiculously low farm gate prices, which are not commensurate with the effort of the farmers and, since they have no alternative, must reluctantly accept the low prices. Furthermore, by insisting on buying whole beds of vegetables, the middlemen and women deny the farmers use of the beds until the crops are harvested.

Institutional arrangements for urban farming have not yet been put in place in the study area and as such the farmers did not complain of any official harassment. Many other research workers have shown that the use of urban space for agriculture has received little attention from policy makers, who often see it in rather negative light. But the UPA is greater in many countries than is formally acknowledge and is increasing, for example urban farming in Zimbabwean Capital, Harare (Africa) doubled between 1990 and 1994 (Mbiba, 1995). Even in the USA the extent of urban farming is greater than often thought.

Challenges for urban land use planning

Urban agriculture in Katsina and other cities in Nigeria is an untapped and wasted opportunity, which needs to be exploited in the quest to achieve sustainable urban development in the country and other African cities. To promote the concept, it is imperative to examine the major issues facing urban agriculture.

The Katsina state government is currently making efforts to review the Katsina Urban Master Plan. Thus, a critical issues here to what extent will urban land use planning and urban agriculture be mainstreamed in the new plan? Urban land use planning and urban agriculture seem to be in conflict. The first master plan of the city (produced in the 1980s has generally failed to accommodate urban farming. Katsina is a metropolis in crisis when it comes to land use planning, primarily due to the flouting of planning regulations. Residential developments are taking place in environmentally sensitive areas (wetlands, floodplains, etc.), on proposed roads, and in waste dumps. In peri-urban areas of the city the situation is alarming. The rate at which agricultural land within this zone is being converted to residential use is high.

The mere presence of urban gardens in traditional African cities disqualified them from being classified as urban by colonial administrators. Morgan's remarks about pre-colonial Igbo cities in Nigeria attest to this belief: the dispersed gardens and settlements of primitive cultivators are not concomitant with the rise of cities or the establishment of a stable administration over a large area... the arts and crafts associated with towns are simply not there in Ibo society (Morgan, 1954). There is no doubt that definitions of urban and urban activities have most of the time excluded agricultural land use and agricultural activities. Having said this, why have contemporary urban planners in Africa, who know quite well that urban agriculture was recognized as a major land use by pre-colonial indigenous planners, and accommodated in their urban land use plans, failed to come to terms with such a stark reality? If planning is designed to better the lot of humankind, and if it is a dynamic activity which responds to the needs of society, and desirous of enhancing the liveability of human settlements, then within the context of the urban planning, one can safely conclude that African planners have failed in pursuing these objectives by not accommodating, adopting, adapting and integrating what a significant number of urban residents in African cities have relied upon and continue to rely on, into the urban spatial system.

The need to revolutionalize urban land use planning in African cities, to accommodate urban agriculture is paramount. Urban agriculture has urban planning implications in that land use planning decisions are about the type, amount, and location of land. Simply put it is about ''what'', ''how much'' and ''where''. It is a question of site and size. Questions urban planners always have to deal with in designating urban land uses are ''is this use appropriate on this site'', ''where is this use most suitably located'', ''Are the uses located on the same site or adjacent sites compatible with one another'', and ''how

much land is needed for a particular use''. In promoting urban agricultural activities whether livestock, poultry, fish farming or cultivation of crops, one has to deal with above planning issues of ''what'' ''how much'' and ''where''.

Conclusion

Reuse of wastewater in urban farming in Katsina urban area is a practice that is not only practiced as a fulltime and sole income earner for many households, but an activity that the town cannot do without. Being a city located within a semi-arid setting, relying on rainfed for successful promotion of urban farming is certainly a risky enterprise. Thus, resort to the reuse of wastewater that freely flow in drains within the urban and peri urban setting of the town is one of the readily available options. Unfortunately urban planning process has not officially recognised and given attention to this important activity. The neglect of urban agriculture in Nigeria and most African countries means that its full potential has not been realized. Urban farming should not be viewed as a subsidiary and blighted activity on the urban landscape but rather as an important strategy for developing more productive, viable and sustainable urban habitats. Emphasis should move from mere tolerance on the part of city administrators to one of officially sanctioned and promoted urban agriculture. This will require promoting urban agriculture within the framework of the country's agricultural and urban development policies, in which emphasis will be placed on incorporating urban agriculture into city plans. Planners should recognize the fact that agriculture is as valuable as the use of urban land as industry, housing and commerce, and should, therefore, prepare land use plans and regulations, which accommodate agriculture. It will also require, among other things, addressing the issue of credit, marketing, inputs like seedlings and inadequate extension services which are major problems facing urban farmers in Katsina and in most African cities.

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