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Reusing organic solid waste in urban farming in African cities: A challenge for urban planners

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Résumé

Les collectivités urbaines et rurales d'Afrique ont une longue tradition de conservation des ressources grâce à la réutilisation des déchets et à l'utilisation des déchets organiques compostés pour l'agriculture. Dans ce document on étudie le concept de la réutilisation des déchets en agriculture urbaine comme solution locale unique pour faire face aux problèmes des déchets solides dans les villes africaines. On analyse la justification de cette agriculture urbaine qui réutilise les déchets, son histoire, la nature et la situation de l'agriculture urbaine traditionnelle, les contraintes et les conséquences de ce type d'agriculture pour la planification urbaine et les problèmes de mise en œuvre. Enfin, on y propose des solutions pour résoudre ces problèmes.

Abstract

Urban and rural communities in Africa have a long history of resource conservation through waste reuse and the application of composted organic waste for farming. This paper examines the concept of waste reuse urban farming (WRUF) as a unique local solution to address municipal solid waste problems in African cities. It analyzes the rationale for WRUF; the history, nature and status of traditional urban farming; the constraints and implications of WRUF for urban planning; and implementation problems. Finally, we suggest solutions to overcoming these problems.

Introduction

The management of urban solid waste constitutes one of the most immediate and serious environmental problems facing governments in African cities. The conventional municipal solid waste management approach — based on collection and disposal — has failed to provide efficient and effective services to all urban residents. The urban environment steadily degrades due to waste which is not managed efficiently. For example, Adedibu and Okekunle (1989) characterize Lagos, Nigeria as the "dirtiest" capital in the world:

... in most parts of the city, streets are partially or wholly blocked by solid waste. Similarly open spaces, marketplaces are littered with solid

waste. In most cases drains are clogged or totally blocked and many compounds are hemmed in by solid waste.

This deplorable situation is not unique to Lagos, but exists in most African cities. In Accra, Ghana, only 11% of the 1.4 million residents benefit from home collection (Songsore 1992), while the remaining 89% dispose of their waste at community dumps, in open spaces, in water bodies, and in storm drainage channels. The situation in other African cities is not much different. Kulaba (1989) observes that on average, city authorities in Tanzania collect only 24% of the refuse; in Kinshasa, Zaire, Mbuyi (1989) points out that household waste collection and street cleaning are restricted to wealthy neighbourhoods, while in the remaining areas household wastes are dumped along roads, in illegal dumps and in storm water drains — or is buried. In Nigeria, Onibokun (1989) indicates that 35% of Ibadan's households, 33% of Kaduna's, and 44% of Enugu's do not have access to waste collection. When waste is not collected, unsanitary conditions develop and pose environmental and human health risks. The prevalence of parasites, tetanus, malaria, hookworm, cholera and diarrhea in most African cities is attributed to the unsanitary conditions in these cities (Stephens and Harpham 1992). Songsore and McGranahan (1993) reveal that malaria, diarrhea, intestinal worms and upper respiratory tract infections were among the most common health problems reported at out-patient facilities in the Greater Accra Region of Ghana. In the city of Accra, the major health problem is disease attributed to poor environmental sanitation, which is exacerbated by ignorance and poverty (Ababio 1992). In Tanzania, Yhdego and Majura (1988) have reported that poor sanitation and improper waste disposal practices result in the spread of infectious diseases, which are the most frequent causes of morbidity and mortality.

Waste dumped into storm drainage channels, creeks, lagoons and other water impoundment points create serious environmental problems which can escalate into disastrous situations. The devastation of lives and property which occurred due to the 1982 floods in Ibadan, Lagos, Port Harcourt and Aba in Nigeria (Kinako 1979; Filani and Abumere 1992) and Accra, Ghana in 1995 (Daily Graphic, July 5, 1995) were attributed partly to an accumulation of refuse which blocked these cities' drainage channels. The ineffectiveness of contemporary municipal solid waste management practices, which culminates in a number of health and environmental problems, has prompted the need to find effective and pragmatic solutions to waste management problems in African cities.

This paper argues that there is a need to unite waste reuse and urban cultivation in African cities, because opportunities to integrate the two sectors exist in Africa's urban areas. Within this context, certain pertinent questions have to be

addressed. Why emphasize organic solid waste recycling? Is urban farming a permanent enough activity in African cities to be able to sustain organic solid waste recycling? What are the constraints and implementation challenges of waste reuse urban cultivation to urban planning in African cities?

This paper considers these issues in three parts. The first examines the basis and role of re-using organic solid waste in African countries; the second reviews the history and status of urban cultivation; the third considers the constraints and implementation issues surrounding waste reuse urban farming (WRUF) for urban planning.

1. Basis and rationale of WRUF

Solid waste management experts, consultants and researchers on Africa are increasingly recognizing the great potential of WRUF into urban farming to help reduce solid waste collection and disposal problems (Chimbowu and Gumbo 1993; Egziabher 1994; Lee-Smith and Menon 1994; Abutiate 1995). This shift in solid waste management away from an emphasis on disposal toward one of waste prevention and reuse is grounded in what can be called "resource recognition" (Furedy 1992). In this context, organic solid waste is not perceived as something which is repulsive, useless, and dangerous, but rather as an under-used resource. It is a valuable material which can be recycled and used in urban food cultivation, thereby reducing the volume of undisposed waste.

Organic material forms 50–90% of urban refuse in African cities. The organic fraction includes raw kitchen waste generated in the preparation and consumption of food: food leftovers, rotten fruit, vegetables, leaves, crop residues and animal excreta and bones. The bulk of organic waste is generated by households, restaurants and markets. In the Accra-Tema metropolitan area in Ghana, 75% of urban solid waste comes from domestic sources, 15% from commercial and industrial sources, and the rest from institutional sources (Asafo-Boakye and Partners 1992). Fantola and Oluwande (1983) estimate that the Dugbe market in Ibadan, Nigeria generates 827 802 kg of organic solid waste per year. In Accra, Ghana, restaurants and markets combined generate 60 000 m³ of organic solid waste yearly (Lardinos and Klundert 1993).

Table 1 (based on Edmundson 1981; Sridhar et al. 1985; ILO/UNDP 1991; Bertolini 1992; Kramer et al. 1994) shows the composition of municipal solid waste in some selected African cities. It is apparent that the biodegradable organic content is very high, due to the fact that reusable materials such as glass, hard plastics, metal scraps, paper and cardboard are retrieved and reused or recycled into valuable items such as lamps and sandals (Enfo News 1990; Asomani-Boateng 1994). The waste is

Table 1. Municipal solid waste (MSW) composition in selected African cities

| Composition (% by weight) | Cities | | | | |
|------------------------------|--------|-------|--------|---------|--------|
| | Kumasi | Accra | Ibadan | Kampala | Kigali |
| Organic | 84.0 | 85.1 | 55.8 | 75.0 | 94.0 |
| Plastic | — | 3.4 | 6.3 | — | — |
| Glass | — | 1.9 | 1.8 | — | — |
| Metal | — | 2.6 | — | — | — |
| Paper | — | 4.9 | 12.9 | — | — |
| Inert | — | — | — | — | — |
| Cloth | — | 3.0 | — | — | — |

of high density and has a moisture content ranging between 30–50%. Because the solid waste has an abundant organic content, much of it can be recovered for reuse as fertilizer. In these cities, there are many urban cultivators who are in need of such organic matter for soil conditioning. This provides an impetus for organic waste recovery. The ever-growing quantities of urban organic wastes in African cities — which at present amount to 0.5 to 0.6 kg per inhabitant, per day (Cointreau 1982) — as well as the low organic matter content of soils in most parts of Africa caused by severe drought, the cost of mineral fertilizers, and their relative scarcity, have increased the need to recycle organic waste materials as a source of crop nutrients. There is an inexhaustible and readily-available supply of organic matter: left alone, it constitutes a major health and environmental hazard. Used as an organic fertilizer, however, it ceases to be the environment's principal contaminant.

Promoting the use of organic waste in food cultivation will not only benefit urban cultivators but also it will minimize the need for expensive imported chemical fertilizers, which in Ghana averaged 46 684 tonnes from 1987–1990 (Ministry of Agriculture 1991). The question remains: is urban agriculture a permanent-enough activity in African cities to be able to sustain organic solid waste recycling? This question is examined in the discussion which follows.

2. History and status of urban farming

Today, urban farming in African cities is complex and diverse. It involves the cultivation of food and non-food crops as well as animal husbandry (including livestock, fowl and fish) within (intra) and on the fringes (peri) of built-up areas of cities (Ganapathy 1983).

Historically, urban farming has been a major activity in African cities since pre-colonial days. According to Winters (1983), in hot, often humid regions such as tropical Africa, the problem of storing food compounded the problem of transporting

it. The fact that urbanization was so independent of trade was one more reason for cities to be self-sufficient in food.

Agricultural activities have influenced and determined urban land use and the morphology of cities in Africa. Cities such as Kumasi, Ghana and the Yoruba towns of western Nigeria were surrounded by a zone of intensive farming in which the majority of residents worked each day (Bowditch 1819; as quoted in Winters 1983). The fact that urban farming constituted an activity in which a significant proportion of the population in pre-colonial African cities participated, is one of the reasons why these cities were classified as non-urban (Bascom 1955), and hence referred to as a "group of villages" (Winters 1983). Urban cultivation played a more important role in eastern and central African cities. The quarters of these cities were separated and the spaces between them used for farming (Winters 1983). As one observer said of Kampala, "it was less of a city than an immense garden" (Gutkind 1963). The capital of Loango in the Congo was so green that an eighteenth-century missionary remarked that "a missionary who was a bit nearsighted could have traversed the whole town without seeing a single house" (Balandier, as quoted in Winters 1983).

Colonial administrators' response to urban cultivation in African cities could be described as negative and hostile. This was reflected in their colonial urban planning, which modernized African cities by removing any vestiges of "backward" and "filthy" activities. Urban cultivation was seen as a manifestation of rural habits or "a remnant of bush life," as Naipul (1981) described it. The colonizers who controlled African cities had "concepts of grandeur, percepts of cleanliness and a firm intent to distinguish themselves from the bush" (UNDP 1996). Consequently, urban cultivation and the rearing of animals were not permitted. Colonial administrators thought urban farming would compromise town and city health, and distract the so-called "natives" from working in the emerging formal economy. In addition, it was assumed that since rural agriculture could provide the food needs of towns and cities, cultivation in cities was not necessary. The only plants that urban residents were permitted to grow were ornamental plants, plants that could beautify African cities and towns.

Urban farming in contemporary African cities is largely unrecognized, unassisted, and in some cases, outlawed because of the supposed hazards associated with it. Furthermore, urban farming is seen as not conforming to zoning regulations because in planning African cities colonial administrators ignored urban cultivation. Therefore, "there has been a remarkable continuity from colonial practice in this sphere across the continent" (Simons 1979). Contemporary urban planners and city managers associate development and modernization with industrialization, and ignore farming in urban areas, viewing food production as being "external to cities"

(Guyer 1987) and "real agriculture" as taking place in rural areas (Dr scher 1994). Subsequently, hostility and repression have confronted the activities of urban farmers in a host of African cities. In Bamako, Mali, the authorities banned the cultivation of cereals in 1989 on the grounds that the tall stalks provide hiding places for bandits (Diallo 1993). Kenyan authorities view urban cultivation as a blight on the urban landscape. In Zambia, the harsh repression of urban cultivation in the 70s and 80s was justified on the grounds that urban farming facilitated the breeding of malaria-carrying mosquitoes (Rakodi 1988).

Despite the official neglect from the colonial period to the present day, it is clearly apparent across contemporary Africa that urban farming is widespread and is becoming a permanent feature of the landscape of many cities. Proof of its persistence and stability is reflected in the acreage of land farmed within and around the built-up space of African cities and by the number of urban residents engaged in urban agriculture.

A significant proportion of urban land in African cities is being cultivated (Mosha 1991). In Dar-es-Salaam, Tanzania, satellite imagery has revealed that 23% of the metropolitan area is used for agricultural production; nearly 34 000 ha are devoted to crop production, with vegetables accounting for 500 ha (DSM/ARDHI 1992). In Harare, Zimbabwe, land under cultivation increased from 5 000 ha in 1990 to 9 000 ha in 1993, representing between 15% and 20% of the city's total area (Mbiba 1995). In Daloa, Ivory Coast, land under urban cultivation increased from 52 ha in 1954 to 624 ha in 1988 (Mougeot 1994). An increasing number of urban residents are engaged in urban agriculture: two thirds of urban Kenyans are farmers (Lee-Smith et al. 1987; Freeman 1991); in Accra, Ghana, Amuzu and Leitmann (1991) estimate that 3% of the city's labour force is engaged in urban farming (including fishing) and 90% of the city's vegetable supplies (including radishes, cabbage, and cauliflower) are supplied by urban farmers. The words of the Accra Metropolitan Assembly (Tetteh and Botchwey 1989) reveal the importance of urban agriculture in the city:

Subsistence farming manifests itself in nearly every home and any unused space in the city. Vegetables and food crops which are commonly planted combine effectively with poultry, piggery and fish farming to supplement the income of the metropolitan dweller.

In Dar-es-Salaam, urban farming is the largest employer in the city, engaging 11% of the total urban population (Bureau of Statistics 1988). In Lusaka, Zambia, urban farming is so extensive that the city has been described as "the world capital of urban cultivation" (Sanyal 1984).

The foregoing discussion establishes the fact that urban farming is an age-old activity which continues to expand. Current conditions prevailing in African countries, including rapid urbanization, ineffective agricultural policies, crippled domestic food distribution, constrained government spending, removal of subsidies, wage cuts, soaring inflation, rising unemployment, natural disasters, and civil strife, will likely accelerate the growth of urban farming (Mougeot 1994). A growing number of African countries have recognized the importance of urban farming and have taken steps to incorporate urban agriculture in their city plans. The new national capitals of Ivory Coast, Malawi and Tanzania have been planned to accommodate urban agriculture (DGIP/UNDP 1992) and local governments in Maseru, Lesotho (Greenhow 1994), Kampala, Uganda (NEIC 1994) and Dar-es-Salaam, Tanzania (DSM/ARDHI 1992) have commissioned special sectoral studies on urban agriculture as part of their master planning process.

It is against this background that promoting WRUF is seen as a practical opportunity for organic solid waste to be part of a "closed loop" within African cities. Is the concept of WRUF in African countries new?

Waste reuse urban farming

The practice of reusing waste in food cultivation in Africa is not new. Most African countries have traditionally utilized various types of organic materials to maintain and improve the productivity, tilth and fertility of agricultural soils. The indigenous kitchen gardens, compounds and community gardening systems of West Africa have made extensive use of organic materials.

Kitchen garden

Kitchen gardening involves cultivating a small parcel of land within the home or living compound immediately outside the dwelling unit (Figure 1). The kitchen gardens, which are operated as backyard gardens because of their proximity to the home, benefit from household organic refuse, manure and other organic waste materials to ensure continuous cultivation. Crops grown are those frequently required by the kitchen or household of the operator and usually consist of vegetables.

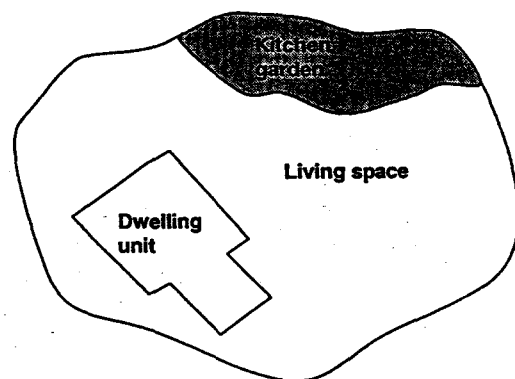


Figure 1. Kitchen garden (not to scale)

Compound gardening

The compound farming system (Figure 2) also centres on the household compound. The land immediately surrounding the compound is intensively cropped with vegetables and staples using organic soil regeneration techniques which involve the use of household refuse and manure from live-stock. Among the Kwahus

of southern Ghana, a portion of the land surrounding the compound is allocated for dumping organic solid waste from the household, which mainly consists of food and kitchen waste, and manure from chicken and livestock raised by the household. Dumping continues for at least two years and the pile is left for a year to undergo anaerobic decomposition. This piece of land, usually referred to as "sumina," is used for the cultivation of okra, tomatoes, peppers, maize, cocoyams and plantains.

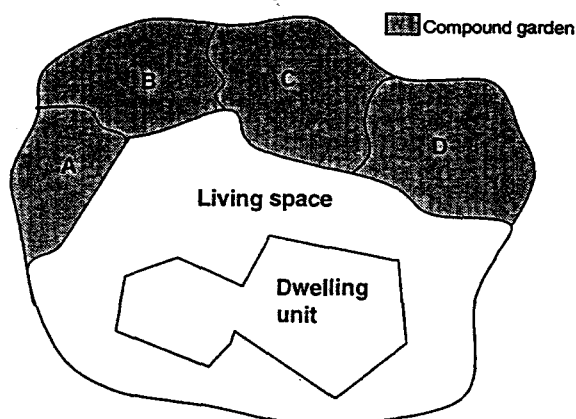


Figure 2. Compound garden (not to scale)

Community gardening

Community gardening (Figure 3) is widely practiced in Ghana and requires the extensive use of organic solid waste in crop cultivation. In rural and small urban communities, waste management is undertaken on the basis of each neighbourhood looking after its own sector. And in each neighbourhood, locations are selected for residents to dump their household waste. Dumping continues until the space is used up, then a new site is selected. The old dump is left idle to decompose and the site is allocated for gardening after two-to-three years.

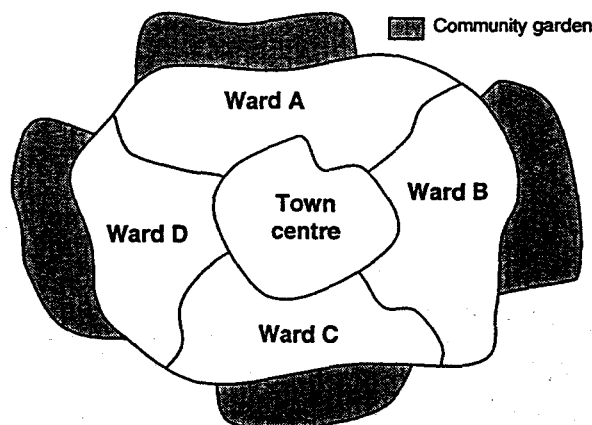


Figure 3. Community garden (not to scale)

In Kano, Nigeria, the practice of using taki (compost from manure, household waste, street sweepings and ash) as fertilizing material by the city's peri-urban farmers has gone on for centuries (Lewcock 1995). Mortimore (1972) revealed that in 1969 and 1972, 1 137 and 1 447 donkeys respectively carried "taki" out of the old walled city of Kano. This represented between 140 and 1180 tonnes of compost per day for peri-urban farms. It is estimated that in a 7.5 km radius, 25% of farmers' fertilizer needs were met by waste from Kano at an average application of between 3.25 and 5.0 tonnes per hectare per annum (Mortimore 1972).

Emphasis on recycling waste in food cultivation shifted in the 1960s to the use of artificial fertilizers. With their newly gained independence, African countries vowed to modernize their economies based on the model of western, industrialized countries. Ultimately, indigenous practices were discouraged — including agriculture which involved reusing organic waste. Emphasis was placed on modern agricultural practices, including the use of chemical fertilizers. The indigenous form of agriculture was viewed as being out-of-touch with modernity. Hence, the reuse of waste in an urban area — which was actually a symbol and show-piece of modernity — was considered taboo.

Lately, there has been a resurgence in WRUF. Urban cultivators "mine" abandoned waste dumps for compost to be applied on farms, while garbage farming — involving cultivation on abandoned waste dumps — is now common in African cities. Food waste generated by restaurants and canteens is used extensively to feed pigs, goats, sheep and cattle.

3. Constraints to WRUF

Health

Promoting the reuse of waste in urban cultivation on a large scale in urban areas with high population concentrations raises the issue of health. This fundamental issue was brought up by the Ad Hoc Panel of the Advisory Committee on Technology Innovation for the Board on Science and Technology for International Development of the National Research Council (USA) in 1981:

The strongest negative factor in the use of human and animal wastes for the production of food, feed or fertilizer is the possibility of disease transmission, which would negate the gains derived from the use of the waste. (p. 134).

The issue of health is critical. Urban solid waste in African cities contains large quantities of pathogens due to the presence of human excreta, and the application in farming of such untreated waste can pose significant health risks both to those who have direct contact with it, and also the general public, who are affected through food chain links (Furedy et al. 1997).

Economic

Production costs of and the market for compost (compared to the price of artificial fertilizers) determine the long-term sustainability of WRUF. Production costs are affected by such factors as the technique of compost production (mechanized or labour intensive), labour costs, and the generation of wastes in sufficient quantities. The quality of the compost, its transportation, and labour costs arising from its distribution from the production site to the place of use, as well as the price of substitutes, are factors which determine the market for compost. Composting of organic wastes using centralized and highly mechanized approaches in African cities failed. This was because of constant mechanical failure; equipment which is expensive to procure, operate, and maintain; lack of technical knowledge to operate sophisticated equipment and processes; and the production of low quality, expensive compost.

Official attitude and behaviour

City authorities' negative perception of WRUF is a major constraint to the promotion of this concept. As discussed above, authorities in African cities find it hard to accommodate urban farming in their cities because they view it as a detriment to modern urbanity and a health hazard. Hence the enactment of policies to curtail urban farming.

4. Implications and challenges of WRUF for urban planning

The reuse of organic solid waste in urban cultivation calls for changes in the institutional and organizational planning of municipal solid waste management — and in the spatial planning of African cities.

Institutional and organizational planning

The institutional and organizational aspects of the planning process refers to "who does what" to prepare and implement the plan. To facilitate the WRUF concept, the current centralized approach to waste management planning must be reconsidered.

The current approach is based on the rational planning paradigm, which excludes important actors and stakeholders in the waste management planning process. Rather, the best approach would be to incorporate other integrative and participatory modes involving citizens and other stakeholders. Within this framework, various actors — including the waste management department, the city council, the agriculture department, community-based and neighbourhood organizations, the planning department, urban farmers, households, and generators of

organic solid waste — would be involved in the planning for reusing organic solid waste in urban cultivation. Decentralizing certain aspects of waste management planning to the community level, whereby certain functions (like source separation and the composting of waste) could be undertaken locally, is of paramount importance. Africa is a continent that is rich in traditions of self-help and community participation in providing shelter and other services. Every country south of the Sahara has its own variety of mutual aid organizations, many of them based on traditions of shelter construction and environmental clean-up. The presence of several neighbourhood and self-help groups like the Mbatia women's group and Undugu society in Kenya, Nima 441 and La Mansaamo Kpee (LMK) in Ghana and Copricol in Burkina Faso — all of which are actively involved in environmental clean up exercises in their communities — should be exploited. These groups could be given the responsibility of organizing household source separation and composting source-separated waste in their neighbourhoods. These activities are fundamental to the concept of reusing organic solid waste in food cultivation in African cities.

Source separation

Source separation, which involves the systematic division of waste into designated categories, is critical to recycling organic solid waste in urban farming. It reduces the incidence of contamination resulting from the co-mingling of different kinds of waste. It is important that any source separation exercise should be undertaken at the household level because once the waste gets to the community bin or collection point, it is likely to be contaminated by hazardous wastes generated by primary health care, dental centres, veterinary clinics, private clinics and laboratories spread throughout African cities. These institutions lack appropriate collection and disposal services and, consequently, pathogenic waste products generated by them often enter the municipal solid waste stream and pose serious health risks to the public.

Composting

Composting is the biological decomposition or breakdown of organic waste materials by a mixed population of micro-organisms in a warm, moist, aerated environment. This process eliminates or reduces any potential health risks to farmers and consumers that arises from the presence of pathogenic macro-organisms associated with reusing raw organic waste in urban cultivation. The high temperatures of between 55°C to 70°C normally reached within the compost heap effectively kill most of the pathogens. Any composting technique selected should be small-scale, community based, labour intensive, and simple. It should also depend on

low-mechanized processes such as windrows, because studies show that small-scale, labour intensive composting projects tend to be viable (Cointreau 1982; Woolveridge 1994; Asomani-Boateng et al. 1996). A comparison of the cost effectiveness of different composting methods done in India by Lardinos and Klundert (1994) revealed that the unit production costs of manual composting method vary from US \$1–5 per tonne of organic material, as compared to about US\$11 per tonne for mechanical treatment. There are many combinations of factors involved: negative factors include inadequate financial resources (both local and foreign) and a lack of technical personnel. More conducive factors include the year-round warm and humid climate, and the availability of cheap labour in African cities. Given such a combination of factors, simple and labour intensive composting techniques are the most appropriate methods for composting in African cities.

It must also be emphasized, however, that community-based composting in African cities as revealed by Asomani-Boateng et al. (1996) is beset with problems. These include: the difficulty of convincing households to source-separate their waste; negative attitudes of waste management officials to the idea of community composting; the lack of space for composting household waste, especially in poor and high-density residential neighbourhoods; and residents' lack of knowledge about the art of composting. Hence, the essential requirements for successful community composting, among other things, depends on strong community support, cooperation between municipal waste management and cleansing authorities, the availability of space for composting, a market for compost, and a continuous supply of household organic solid waste as feedstock for composting.

Land-use planning

Recognizing that composting and urban cultivation have spatial implications for African cities calls for fundamental changes in land-use planning. These activities require space, and should thus be seen as important components of urban land use when promoting the reuse of waste in urban cultivation. Designating areas in the city for organic solid waste recycling and urban cultivation is necessary. Locating these activities within the same site is crucial: compost is bulky and is, therefore, difficult to transport. Studies have shown that transport costs contribute to the high cost of compost, thereby making it unattractive to farmers. Where in the city should land be set aside for composting and urban crop cultivation? Locating these activities where most of the city's organic solid waste is generated is logical. Setting aside land in close proximity to residential areas in African cities — where about 75% of the municipal solid waste is produced — is easily accomplished in proposed residential subdivisions. As for already built-up areas of the city, open spaces within and

bordering these areas could be designated for urban cultivation and composting of organic solid waste. At the household level, future residential plots should be large enough to provide land for cultivation and for the composting of household waste, where the compost produced could be used in household cultivation. Promoting household cultivation and composting in high-density residential neighbourhoods of African cities where space is scarce will not be possible. But it can be accomplished in cities which have areas designated for dumping community household waste. In low-density, high-class residential areas, where there is enough space within homes, promoting waste reuse in home cultivation is viable.

Conclusion

WRUF in urban cultivation in African cities is a potentially powerful, locally responsive approach to addressing waste disposal problems in these cities. Promoting the concept is beset with problems of health as well as institutional and official attitudes. These can be addressed through pursuing best practices, initiating institutional changes and educating all actors involved. The concept is not new to Africa, but to promote it on a large scale requires fundamental changes in planning Africa's urban areas, as well as a change in attitude of city governments, decision makers, and urban planners. Change demands a commitment by them to include urban cultivation and organic, waste recycling as an integral part of the built environment. The present centralized approach to solid waste management planning needs to be replaced by one that allows for a decentralized, integrative and participatory approach to solid waste management planning and urban cultivation.

Acknowledgments

The authors wish to acknowledge the valuable contributions, comments and suggestions of Dr. Seth Asare at the University of Guelph School of Engineering; Professors Larry Martin and Pierre Fillion at the School of Urban and Regional Planning, University of Waterloo; and Ronald Pushchak of the School of Environmental Health, Ryerson Polytechnic University (Canada). Financial support for this research is provided by International Development Research Centre (IDRC), Ottawa, Canada.

References

- Ababio, B.M. 1992. Urban Primary Health Care: Accra Healthy Cities Project. Accra Planning and Development Programme, (draft). Accra, Ghana.
- Adedibu, A.A.; Okenkule, A.A. 1989. Issues on the Environmental Sanitation of Lagos Mainland Nigeria. *The Environmentalist*, 9(2), 91-100.
- Amuzu, A.T.; Leitmann, J. 1991. Environmental Profile of Accra. Case Study. Prepared for the Urban management and Environmental Component of the UNDP/World Bank/UNCHS Urban Management Programme.
- Asafo-Boakye. 1992. Product-market-technology Combination of Waste Materials Recycling in Accra, Ghana. Waren-project. Waste Consultants, The Netherlands, 1992.
- Asomani-Boateng, R. 1994. Planning for Domestic Solid Waste in Developing Countries: A Pilot Project of Community Composting in Accra, Ghana. MA Thesis, School of Urban and Regional Planning, University of Waterloo, Waterloo, ON, Canada.
- Asomani-Boateng, R.; Haight, M.; Furedy, C. 1996. From Dump to Heap: Community Composting in West Africa Biocycle, January. 70-71 pp.
- Bascom, W. 1955. Urbanization among the Yoruba. *American Journal of Sociology*, 60,446-454.
- Bertolini, G. 1992. Waste Recycling Management in Kigali. ILO/UNDP inter-regional research workshop on Employment Generation in Urban Waste Program through the efficient use of local resources. Nairobi, Kenya, 6-10 April 1992.
- Bureau of Statistics. 1988. Population Census: Preliminary Report, Ministry of Finance, Economics Affairs and Planning. Dar-es-Salaam, Tanzania.
- Chimbowu, A. and Gumbo, D. 1993. Urban Agriculture Research in East and Southern Africa IP Record Capacities and Opportunities. International Development Research Centre, Ottawa, ON, Canada.
- Chpamuriwo, W. 1990. More Wastes More Jobs. *Focus on Africa*, January-March, 1991, 17(1).
- Cointreau, S.J. 1982. Environmental Disposal of Urban Solid Waste in Developing Countries. Urban Development Technical Paper No. 5, The World Bank, Washington, DC, USA.
- Daily Graphic 1995. No. 5, July 1985.
- DGIP/UNDP. 1992. Urban Agriculture in Latin America, Africa and Asia. DGIP/UNDP, New York, NY, USA.
- Diallo, S. 1993. Urban Agriculture in West Africa Research Review and Perspectives. International Development Research Centre, Ottawa, ON, Canada.

Drescher, A.W. 1994. Management strategies in African homegardens — and the need for new extension approaches. Section on Applied Physiogeography of the Tropics and Subtropics, University of Freiburg, Freiburg, Germany.

DSM/ARDHL. 1992. Environmental Profile of the Metropolitan Area. DSM, Dar-es-Salaam, Tanzania.

Edmundson, A.R. 1981. Refuse Management in Kumasi, Ghana. Land Research Centre, UST. Kumasi, Ghana.

Egziabher, A.G. 1994. Urban Farming, Cooperatives and the Urban poor in Addis Ababa. Cities Feeding People: An Examination of Urban Agriculture in East Africa. International Development Research Centre, Ottawa, ON, Canada.

Enfo News. 1990. Tyres and Tins — Recycling in the Third World. October 1990, 12(2).

Fantola, A.; Oluwande, P.A. 1983. Administrative and Technical Aspects of Solid Waste Management in Ibadan, Nigeria. African Journal of Science and Technology, 2, 35-46.

Filani, M. O. and Abumere, S. I. 1992. Forecasting Solid Waste Magnitudes for Nigerian Cities. Paper presented at the National Conference on Development and the Environment, NISEPZ, June 1982, Ibadan, Nigeria.

Freeman, D.B. 1991. A City of Farmers: Informal Urban Agriculture in the Open Spaces of Nairobi, Kenya. McGill-Queen's University Press, Montreal, PQ, and Kingston, ON, Canada. 64-70 pp.

Furedy, C. 1992. Garbage: exploring non-conventional options in Asian cities. Environment and Urbanization, October 1992, 4(2).

Furedy, C.; Maclaren, V.; Wiutney, J. 1997. Food from Waste: Urban Pressures and Opportunities for Food Production in Asian Cities. Paper presented at the International Conference on Sustainable Urban Food Systems, May 22-25, 1997, Ryerson Polytechnic University, Toronto, ON, Canada.

Ganapathy, R. S. 1983. Development of Urban Agriculture in India: Public Policy Options. Paper presented at the Urban Agriculture Seminar, July 1983, Singapore. International Development Research Centre, Ottawa, ON, Canada.

Greenhow, T. 1994. Urban Agriculture: Can Planners Make a Difference, for IDRC Panel on Cities Feeding People, Habitat 94 (IFHP-CIP) 20 September 1994, Edmonton, AB, Canada.

Gutkind, C.W. 1963. The Royal Capital of Buganda. The Hague, The Netherlands.

Guyer, J.I., ed. 1987. An outline history of African food supply. In Guyer, J.I., ed., Feeding African Cities: Studies in Regional Social History. Manchester University Press. Manchester, UK.

ILO/UNDP. 1991. Recycling solid waste in Kampala. A Feasibility Study. UNDP/ILO INT/89/021 Project.

Kinako, P.D.S. 1979. City Refuse Dumps: A Multi-dimensional Environmental Problem of Nigerian Urban Areas. Journal of Environmental Management, 9, 205-212.

Kramer, H.; Jechimer, K.; Lengsfeld, S.; Nartey-Tokoll, I.B. 1994. Determination of major planning data for solid waste management in Accra Metropolis. Accra Metropolitan Assembly, Waste Management Department, Accra, Ghana.

Kulaba, S. 1989. Local Government and Management of Urban Services in Tanzania. *In* Stren, R.E.; White, R.R.; ed., African Cities in Crisis: Managing Rapid Urban Growth. Westview Press, Boulder, CO, USA. pp. 205-245.

Lardinois, I.; van de Klundert, A. 1993. Organic Waste: Options for Small Scale Resource Recovery. Waste Consultants, Gouda, The Netherlands.

Lardinois, I.; van de Klundert, A. 1994. Recovery of Organic Waste in Cities. ILEIA, October 1994.

Lee-Smith, D.; Manundu, M.; Lambda, D.; Gathuru Kuria, P. 1987. Urban Food Production and Cooking Fuel Situation in Urban Kenya. National Report, Results of a 1985 National Survey. Mazingira Institute, Nairobi, Kenya.

Lee-Smith, D.; Menon, P.A. 1994. Urban Agriculture in Kenya Cities Feeding People: An Examination of Urban Agriculture in East Africa. 67-84 pp.

Lewcock, C.P. 1995. Farmers Use of Urban Waste in Kano. *Habitat International*, 19(2), 225-234.

Mbiba, B. 1995. Urban Agriculture in Zimbabwe: Implications for urban management and poverty. Avebury, Aldershot, UK.

Mbuyi, K. 1989. Kinshasa: Problems of Land Management, Infrastructure and Food Supply. *In* Stren, R.E.; White, R.R.; ed., African Cities in Crisis: Managing Rapid Urban Growth. Westview Press, Boulder, CO, USA. 149-175 pp.

Ministry of Agriculture. 1991. Agriculture in Ghana: Facts and Figures. Presbyterian Press. Accra, Ghana.

Mortimore, M. J. 1972. Some Aspects of Rural-Urban Relations in Kano, Nigeria. *In* Vennetier P., ed., La croissance urbaine en Afrique noire et à Madagascar, Colloques Internationaux du CNRS, Paris, France.

Mosha, A. C. 1991. Urban Farming Practices in Tanzania. Review of Rural and Urban Planning in South and East Africa, 1, 83-92.

Mougeot, Luc J.A. 1994. Urban Food Production: Evolution, Official Support and Significance. Feeding People Series, Report No. 8, International Development Research Centre, Ottawa, ON, Canada.

Naipul, V. S. 1981. A New King for the Congo: Mobutu and the Nihilism of Africa. *In* The Return of Eva Peron. Vintage Press, New York, NY, USA.

National Research Council, Board on Science and Technology for International Development. 1981. Food, Fuel and Fertilizer from Organic Wastes. National Academy Press, Washington, DC, USA.

NEIC (National Environmental Information Centre). 1994. District Environmental Profile: Kampala Draft NEIC, Kampala, Uganda.

Onibokun, A.G. 1989. Urban Growth and Management in Nigeria. *In* Stren, R.E.; White, R.R.; ed., *African Cities in Crisis: Managing Rapid Urban Growth*. Westview Press, Boulder, CO, USA. pp. 69-111.

Rakodi, C. 1988. Urban Agriculture: Research Questions and Zambian Evidence. *Journal of Modern African Studies*, 16(3), 495-515.

Sanyal, B. 1984. Urban Agriculture: A Strategy of Survival in Zambia. Unpublished Ph.D. Thesis. School of Planning, University of California, Los Angeles, CA, USA.

Simons, H.J. 1979. Zambia's Urban situation. *In* Turok, B., ed., *Development in Zambia*, Zed Press. London, UK.

Songsore, J. and McGranahan, G. 1993. Environment, Wealth and Health: Towards an Analysis of Intra-Urban Differentials within the Greater Accra Metropolitan Area. Accra, Ghana, Stockholm Environmental Institute (SEI), Sweden.

Songsore, J. 1992. Review of Household Environmental Problems in Accra Metropolitan Area, Ghana. Stockholm Environmental Institute (SEI), Sweden.

Sridhar, M.K.C.; Bammekke, A.O.; Omishakin, M.A. 1985. A Study on the Characteristics of Refuse in Ibadan, Nigeria. *Waste Management and Research*, 3, 191-201.

Stephens, C. and Harpham, T. 1992. Health and Environment in Urban Areas in Developing Countries. *Third World Planning Review*, 14(3).

Tetteh, J.J. and Botchwey, C.S. 1989. Accra Capital of Ghana. Accra Catholic Press, Accra, Ghana.

UNDP. 1996. Urban Agriculture: Food, Jobs and Sustainable Cities. United Nations Development Programme, New York, NY, USA.

Winters, C. 1983. The Classification of Traditional African Cities. *Journal of Urban History*, 10(1).

Woolveridge, C. 1994. An Analysis of the Critical Factors affecting the success of Neighbourhood Composting Projects in Jakarta and Bandung, Indonesia. MA Thesis, Environmental Studies, University of Toronto, Toronto, ON, Canada.

Yhdego, M. and Majura, P. 1988. Malaria Control in Tanzania. *Environmental International*, 14, 479-483.

