Urban and peri-urban agriculture in West Africa — Characteristics, challenges, and need for action

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Résumé

Dans la zone de forêt humide d'Afrique de l'Ouest, la population urbaine est plus importante que la population rurale. D'ici environ 20 ans, deux Africains de l'Ouest sur trois vivront dans des centres urbains. Cela constitue un énorme défi pour la sécurité des approvisionnements alimentaires, pour l'hygiène, pour la lutte contre la pauvreté, en particulier quand on sait que les approvisionnements alimentaires par personne diminuent encore et que la proportion de personnes sous-alimentées vivant dans les villes augmente. Cette augmentation de la population urbaine explique à priori les systèmes d'agriculture intensive périurbaine et urbaine — qui ont tous deux leurs caractéristiques et leurs interactions propres — qu'on a vu apparaître et qui devraient jouer un rôle plus grand au cours des années à venir. Les productions les plus répandues sont celles des produits périssables à valeur élevée comme les fruits et les légumes, ainsi que le petit bétail, la volaille, le poisson et les « amuse-gueule ».

Il faut considérer les régions urbaines comme de vastes réservoirs de nutriments et seules d'énormes importations d'engrais ou un recyclage élevé des nutriments permettront d'assurer la production alimentaire de ces régions urbaines. En plus des sous-produits de l'agro-industrie (fumier de volaille, sciure des scieries, résidus des brasseries) il faut aussi valoriser les déchets des ménages et les matières des vidanges en les considérant comme des sources d'éléments nutritifs de remplacement ou des sources additionnelles. Toutefois, il faut faire attention aux risques de contamination des déchets par les produits chimiques agricoles et par les agents pathogènes.

La production de légumes en milieu périurbain et urbain jouera des rôles multiples pour l'atteinte des objectifs de politique de développement (sécurité alimentaire et malnutrition, possibilités d'emploi et lutte contre la pauvreté, aide aux femmes). À l'avenir, lors de la formulation des plans de développement, il sera important de bien comprendre les liens entre les éléments urbains et ruraux en ne traitant aucun d'eux de façon isolée. Étant donné les lacunes importantes dans les données sur l'alimentation et sur les flux connexes d'éléments nutritifs entre les zones rurales, périurbaines et urbaines, il faut faire des études destinées à

réduire au minimum la perte d'éléments nutritifs en milieu périurbain et à maximiser une gestion des terres respectueuse de l'environnement. De telles études pourraient aboutir à l'élaboration de systèmes d'aide à la décision pour les urbanistes. Il conviendrait d'utiliser une approche de réseau regroupant tous les intervenants du développement urbain et de l'agriculture périurbaine. Ce serait également une bonne idée que de procéder à des comparaisons entre plusieurs villes d'Afrique faisant partie du réseau, et d'étudier la situation d'autres villes, par exemple en Asie, pour profiter de leurs expériences.

Abstract

In the West African humid forest zone more people live in cities than rural areas. In approximately 20 years, two out of three West Africans will live in urban centres. This represents an immense challenge for food security, sanitation, and poverty alleviation, especially as the per capita food supply is still decreasing and the proportion of undernourished people living in cities is on the rise. In apparent reaction to the increasing urban population, intensive peri-urban and urban farming systems — both with their distinct characteristics and interactions — have emerged and are expected to assume great importance in the years ahead. The most commonly produced goods are high-value perishable products like vegetables and fruits, as well as small livestock, poultry, fish, and snack food.

Urban areas have to be considered as vast nutrient sinks and only immense fertilizer imports and/or nutrient recycling will sustain the food supply from the urban production areas. Therefore, in addition to agro-industrial byproducts (poultry manure, sawmill dust, brewery refuse), household refuse and night soil also need to be valorized and considered either as alternative or additional nutrient sources. However, care has to be taken because of waste contamination by agro-chemicals and pathogens.

Peri-urban and urban vegetable production will play a multiple role in achieving development policy goals (food security and malnutrition, job opportunities and poverty alleviation, support of women). When formulating future development plans, it is important that urban-rural linkages are fully understood; neither urban nor rural development should be treated in isolation. In view of the large gap in data on food and related nutrient-flows between rural, peri-urban and urban areas, studies must be conducted to minimize peri-urban nutrient depletion and to maximize environmentally sound land management. Decision support systems for city planners could be designed as one result. A network approach involving all stakeholders of urban development and peri-urban agriculture would be appropriate. As well, it would be a good idea to compare several African cities within the network, and to link to cities — for instance, in Asia — in order to benefit from their experiences.

Introduction

Population growth and urbanization

The world's population is increasing by around 85 million every year — the equivalent of another Egypt or Mexico. According to United Nation's projections, the world's population will grow from roughly six billion today to more than nine billion by 2050. In the same period, Africa's population will almost triple, even under a "medium fertility scenario." This rate is much higher than in India, China, or the rest of Asia. The projected growth rates are especially high in west Africa. Since 1960, the West African population has more than doubled from 85 million to 215 million people in 1993 (Mokwunye et al. 1996; The Economist 1998a, b).

These figures are closely related to the rapid growth of the world's cities. The United Nations (UN) expects that between 1995 and 2025 the number of people living in urban areas will nearly double from 2.8 to 5.3 billion, and that 90% of that growth will be in developing countries. Africa's 1985 urban population will have doubled by the year 2000. West Africa's urban population growth rate of 6.3% (1960–1990) is more than twice the rate of the total population growth (Snrech 1994). In fact, although 40 million people lived in West Africa with 4% in cities in 1930, in 1990 there were about 190 million with 40% being in cities. Projected figures for 2020 indicate that 63% of the estimated population of 430 million will be found in urban centres. This implies that more people will live in towns and cities than in rural areas. This trend is alarming in a region with limited resources for providing the necessary urban services. Currently, about 55% of the population in the West African humid forest zone already lives in cities, although this is only 22% in the Sahel zone (Snrech 1994). This indicates that in the non-coastal countries, the urbanization process will develop less rapidly. Cities like Kinshasa are the typical exception.

Population growth and food security

Population pressure not only directly increases the demand for food, but also indirectly reduces its supply through building development, environmental degradation and marginalization of food production. Two questions arise: can Africa feed its current population? Will it be able to produce enough food for the megacities of tomorrow?

The fact that this urban growth is recent is shown by an examination of the situation in 1960, the eve of independence for most African countries. In that year, tropical Africa had only three cities (Ibadan, Lagos, Kinshasa) with over 500 000 inhabitants. In 1980, there were 28 cities in tropical Africa with 500 000 or more people. And in 2020, Lagos is expected to be home to 14 million people; Abidjan 7 million; whereas Douala, Yaoundé, Cotonou, Accra, Conakry, Kano, Dakar, Ibadan, and Lomé will have between 2 and 4 million (Binns 1994). The main factors causing this rapid urban growth have been the general high average population growth rate of 3% between 1980 and 1989 for tropical Africa, the incorporation of surrounding villages into growing towns, and the growing rural to urban migration created by a quest for better employment opportunities. It has been estimated, for example, that between 1953 and 1963, 644 000 people migrated to Lagos in Nigeria, accounting for 75% of the city's total population growth (Binns 1994).

While world per-capita cereal production increased between 1970 and 1990 from 303 to 327 kg, production in sub-Saharan Africa (SSA) fell from 135 to 112 kg. Consequently, the average cereal consumption in 1990 was more than 100 kg less than the average of all developing countries — although net cereal imports to SSA increased from 3 to 9 million tonnes (De Haen and Lindland 1997; Singer 1997).

It is interesting to note that about 30 years ago, India and sub-Saharan Africa each produced something like 65 to 70 million tonnes of cereals. Today, in a normal year, India produces approximately 225 million tonnes, while SSA produces a bit more than its original 65 to 70 million tonnes for a much larger population (Singer 1997).

Related to the decreasing per-capita food supply, the number of absolute poor in SSA rose from 105 million in 1985 to 216 million in 1992, and the number of chronically undernourished (hungry) people has more than doubled between 1970 and 1991 (Brandt 1997; Singer 1997). In SSA, the share of the population that falls below the poverty line is estimated to be as high as 50% (Badiane and Delgado 1995). While poverty and food shortages remain predominantly rural problems, the proportion of undernourished people living in cities is on the rise due to rural-urban migration (Von Braun 1997). In apparent reaction to the increasing urban population, peri-urban and urban farming systems have emerged and are expected to assume greater importance and intensification in the years ahead.

Characteristics of urban and peri-urban agriculture

Although there is an increasing amount of literature on this topic, studies of urban and peri-urban farming systems in West Africa are scattered and scanty. A wide spectrum of production systems can be found ranging from household subsistence to large-scale commercial farming. In general, there is a tendency toward more intensive production systems that better satisfy the increasing urban demand in peri-urban than in rural areas. Often, larger urban centres have conspicuous inner and outer zones where cultivation of food crops and market gardening are being pursued vigorously (Swindell 1988; Binns 1994; Sarfo-Mensah and Adam 1998). In general,

this confirms the model described by Von Thünen in 1826. He concluded that farm products would be grown in a series of concentric zones outward from a central market city. Perishable crops, or those which are high-yielding, would be grown nearest to the city because readily accessible farmland would be in great demand and, therefore, quite expensive. Livestock production, potatoes and cereals would be raised farther away. Since transport costs to the city increase with distance, there comes a point beyond which it is uneconomical to grow food for the urban centre.

Urban agriculture

Urban agriculture is neither a new nor declining activity in towns; in fact, agricultural goods produced in cities can be the cornerstones of many urban economies. Urban agriculture is practiced by an estimated 800 million people who raise crops and livestock, or who net fish in towns and cities. This takes place in all regions of the world, but until now was most prevalent in Asia (Smit et al. 1996). Usually, vegetables and fruits are grown on land unsuited for building purposes and on undeveloped public and private lands (IDRC 1993). In addition, intensive livestock production systems for milk, meat, and poultry or egg production are operational around and within city limits, with a trend to zero-grazing. At a DSE/ATSAF workshop in 1994, three major types of urban vegetable production systems were identified and described, all of which play distinctly different roles with regard to urban market or urban subsistence food supply (Richter et al. 1995; Gura 1996):

Urban shifting cultivators farm wherever they can find empty spaces in the cities. They grow vegetables mainly for the informal market in order to meet their more basic needs, but also for better-off households. However, their rights to use the land are very limited. They do not appear to be the most recent migrants to town, but rather belong to the group which has been residing there for some time, who have turned to farming as a source of income. Traditional leafy vegetables which grow fast and absorb few inputs are one of their most important products, because they contribute to the inexpensive vegetable supply of the urban lower classes.

Household gardeners reside in town and farm around their homes or elsewhere in (or near) the city. Their land rights are more secure and their investments seem accordingly higher and of a longer-term nature. They raise small livestock and grow trees, aiming at both subsistence and market production. Women in particular grow crops to supplement household food supply, while men concentrate on cash-crop production or off-farm activities.

Peri-urban market producers are often specialized farmers on usually secure land around cities who tend to produce vegetables of higher value (tomatoes, onions, cabbages, eggplants, peppers). They might also grow leafy vegetables if facilities

allow their marketing before spoilage. Their external inputs can be high, and they usually supply the more affluent parts of urban populations with vegetables through formal channels.

Peri-urban agriculture

Urban and peri-urban agriculture can be a continuum in space and time when the cities grow. In fact, these terms are sometimes used interchangeably when considering the agricultural production for urban food consumption. However, the concept of a peri-urban zone is complex because it does not equate simply to one type of production system or a fixed geographical area around a city. It contains both rural and urban elements, but the resulting peri-urban systems may have distinctive characteristics of their own, rather than just a mixture of urban and rural features.

> "The peri-urban area is characterized by strong urban influences and demand, easy access to markets, services and other inputs, but relative shortage of land and risks from pollution and urban growth." (NRI/UST 1997; modified)

A multidisciplinary systems approach is needed, as it is the interaction of urban economic and social processes with surrounding production areas that drive the resulting system. Too often in the past, rural and urban areas have been seen as quite separate. But in reality there are many complex interrelationships between them, which have their "hot spot" in the peri-urban interface. Depending on the culture of the population and their habits, the preferred crops grown in peri-urban areas can vary. With the exception of vegetables, the most commonly produced goods include small livestock, poultry, fish, and fruits, as well as snack food (maize, cassava). As in Asia, it is expected that urban and peri-urban agriculture will increasingly develop into highly intensive production of high-value perishable products such as vegetables, whereas staple food production will be concentrated in the high-potential rural areas. The intensive vegetable farming system is characteristic, though not exclusive, to the peri-urban area.

However, even if we focus only on vegetable farmers as a potential peri-urban target group, we will find that this group is not homogenous, even around the same town. There may be:

- normal subsistence farmers; for example, women who are trying to keep the household going with increased vegetable farming in a situation of reduced plot sizes and decreasing soil fertility;
- young men or young couples, who are able to react flexibly to changing demands and who can form an ideal target group for innovative, participatory research;

- poor young men with short tenure agreements, who try to get as much as they can out of the land. These "hit and run" farmers can pose serious implications for soil mining;
- smallholders, who have a genuine long-term commercial plan; or
- capitalist farmers relying mainly on hired labour, who are buying land in peri-urban areas, usually along major roads, to supply urban food markets.

Looking at the results from different peri-urban studies, certain general characteristics of peri-urban systems emerge (Gould 1988; NRI/UST 1997).

The rapid process of urbanization has provoked some specific changes in agricultural production systems in West Africa and elsewhere. A corresponding study by NRI around Kumasi, Ghana, has provided a picture of contrasting change, lack of change, and adaptation to change in the peri-urban villages (Sarfo-Mensah and Adam 1998).

There have been and continue to be changes in land use, which are of two kinds[1]:

- land used for agriculture at the expense of fallow and forest land; and
- land used for building development, especially housing, at the expense of agricultural land.

But the lack of change in land use is most apparent in the continuation of the traditional bush-fallow system despite the shrinking fallow area.

Peri-urban system characteristics
- dynamic in space and time, moving from rural to urban characteristics;
- areas within the zone are heterogeneous in their degree of urbanization;
- intensification (fertilizer, biocides, water requirements) in vegetable and other cropping systems as well as livestock, especially poultry farming;
- increasing food, firewood and related nutrient-flow from rural and peri-urban production areas into urban centres;
- increased competition for land and water between agricultural and non-agricultural uses, and rural and urban dwellers;
- increased opportunities and competition for farm and off-farm jobs;
- changing social and economic balance between indigenous and immigrant inhabitants;
- increasing dependence on the urban centre (market, jobs);
- increasing number of female-headed households when males assume urban jobs;
- increased facilities (electricity, piped water, schools) which may speed up development;
- reduced fallow periods and increased nutrient mining (despite higher use of inputs); and
- increased (water) pollution and waste disposal problems.

[1] The average fallow period in peri-urban Kumasi declined from 6.2 years in 1983 to 2.8 years in 1997, and is shortest (zero) in many of the villages closest to the city.

Adaptation to change has occurred due to the:

- increased opportunity for the sale of convenience foods such as cooked green maize and sugar cane;
- increased number of intensive poultry enterprises;
- increased demand for land, labour, and accommodation resulting in higher monetary values on these commodities; and
- increased demand (and raised rental value) for valley-bottom land which has water near the surface that allows irrigated vegetable production for the urban market throughout the year.

Land is the key natural resource in the peri-urban areas. Under pressure from demands for residential expansion and industrial use, land sales are increasing and prices are rising. The nature of land tenure systems is vital for the resulting patterns of land use. If land tenure systems are not well understood, strategies for sustainable land management are likely to fail. As access to land becomes restricted, land tenure systems for agriculture may tend to move away from traditional family and sharecropping arrangements towards cash and shorter-term rents (NRI/UST 1997). This tendency towards a reduced security of tenure can discourage long-term investment and encourages shorter-term (and nutrient-mining) cropping systems.

Challenges

Challenges resulting from rapid urban growth concern the organization of sufficient food on a sustainable base, starting with the need for inputs (nutrients, water, chemicals) and ending with the need for adequate waste management.

Food for the cities

Urban farming can be highly productive; in fact, as much as one-seventh of the world's food supply comes from cities. In the United States, for instance, 70% of fruit, vegetables and ornamental plants are grown on urban land (Rabinovitch and Schmetzer 1997). Without urban and peri-urban agriculture, the challenge to feed the megacities would be enormous. For a city of 3 to 4 million inhabitants, the food requirement averages about 3 000 t/day, or the equivalent of 1 000 trucks/day each loaded with 3 tonnes. This implies two trucks entering the city every 3 minutes; something difficult to imagine in view of the daily traffic jams we see in and around the West African capitals. Staples, vegetables, fruits, meat and fish that compose the supply originate from different areas, making food security a logistical challenge in view of transport, cooling, storage, and city traffic. Therefore, urban agriculture as well as the contribution of peri-urban agriculture should be supported through informal channels. However, information on the portion of vegetables supplied by peri-urban agriculture, for example, is rather sketchy and studies are rare. Midmore (1996) estimates that from the Asian experience, between 25% and 85% of the

vegetable demand can be satisfied by peri-urban and urban production. The estimates give a wide range, depending on the definition of the peri-urban area.

Vegetable production is limited to valley bottoms and other sites that have access to already-scarce water supplies. Therefore, it is only through such agricultural intensification techniques as irrigation and fertilizers that the food supply can meet the demand. In fact, studies reveal that fertilizer use is higher in peri-urban than rural areas. This is undoubtedly related to the occurrence of the intensified and commercial vegetable farming systems in the peri-urban area (Harris 1997).

Need for inputs

The intensification of agriculture in and around the cities requires inputs such as fertilizer, biocides, labour, and water. The most expensive inputs in terms of direct costs and possible environmental impact are fertilizers and pesticides. This makes it worthwhile to look for alternatives (waste recycling, integrated pest management), although water can become a key factor. The speed and unplanned nature of urban growth will generate water and closely related sanitary problems, and most cities have an irregular water supply. As in peri-urban areas, irrigation is often proposed as an efficient and lasting way of using land. For example, in vegetable production, competition for water can become a key factor influencing the viability of agriculture near cities (Livingston 1987).

The nutrient gap

Most soil fertility specialists agree that in West Africa, nutrient mining takes place at such a large scale that the soils degrade and lose their production potential. Nutrient mining is particularly severe in areas where increasing population pressure causes higher production, reduction of fallow cycles, and opening up of marginal lands (Stoorvogel and Smaling 1990).

Together with the flow of food, a corresponding amount of nutrients comes to the cities. But unlike rural areas, the urban household and market refuse is usually lost, contributes to urban pollution, or is used as landfill. That is, there is no or little return of biomass or nutrients to the production areas (Figure 1). On the other hand, the continuous nutrient flow is combined with problems at both ends of the chain: mining in rural areas and pollution where nutrients accumulate (Figure 2). However, estimations of rural–peri-urban–urban nutrient flows and budgets are difficult: there is no definition of peri-urban areas in official statistics (the common focus is on districts or provinces); only a little data exists on peri-urban and urban production; nearly no data is available on vegetable production in national African statistics; and only a few data exist on food consumption and the amounts of municipal waste.

However, some national statistics allow rough assumptions of the ratio between nutrient outputs and inputs. For instance, in the Greater Accra Region (which may match approximately the peri-urban area of Accra), okra, tomatoes, peppers, and garden-eggs are intensively cultivated on 13% of the area, and it can be assumed that they are mostly for city consumption. The production of vegetables increased between 1992 and 1996 from 66 500 to 211 000 metric tonnes while the cultivated vegetable area increased by 40% (MOFA 1993, 1996). Assuming 9 kg of nitrogen (N) per tonne of harvested vegetables (Stoorvogel and Smaling 1990), the annual N flow to Accra amounts to about 2 000 tonnes through these vegetables alone. On the other hand, the entire Greater Accra Region annually receives less than 10% of this amount as mineral N fertilizer.

Positive nutrient budgets are largely restricted to home gardens or some privileged peri-urban areas with high-input rice or vegetable cultivation. But, in general, limited external inputs are used in urban and peri-urban agriculture.

This situation will change. The diversification to high-value, marketable crops due to increasing demand as well as income-generating activities outside agriculture will lead to financial returns allowing investments in inputs and soil conservation measures. The ingredients required to establish a process of sustainable intensification of production are potentially present in and around most cities. These range from industrial fertilizer over sawmill and municipal compost, to poultry manure and other agro-industrial by-products (Gerner et al. 1995). Many examples are available which prove that nutritional demand can be best met by a combined application of organic and mineral fertilizers. However, several organic sources are largely underexploited and often only receive attention through NGO activities, despite the fact that they can significantly contribute to a nutrient recycling and two-way flow of nutrients (Lardinois and Van de Klundert 1994). Moreover, it is likely that the demand for "natural" organically produced food will increase.

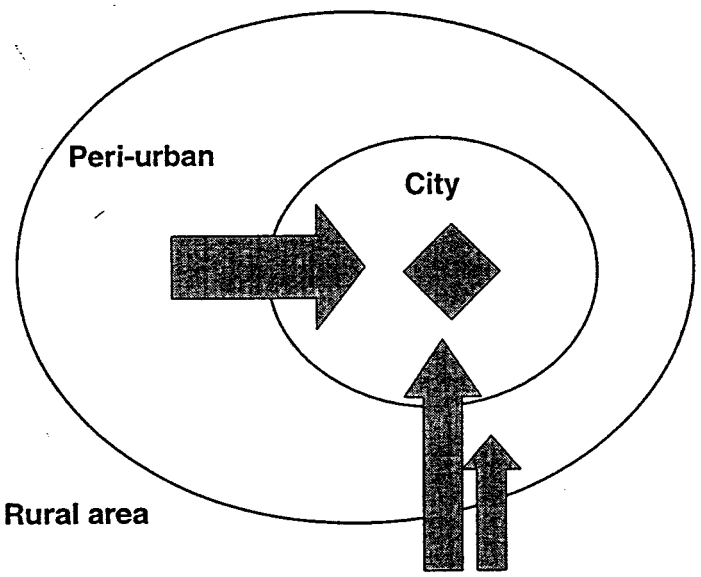


Figure 1. One-way flow of food (biomass, nutrients) towards the city

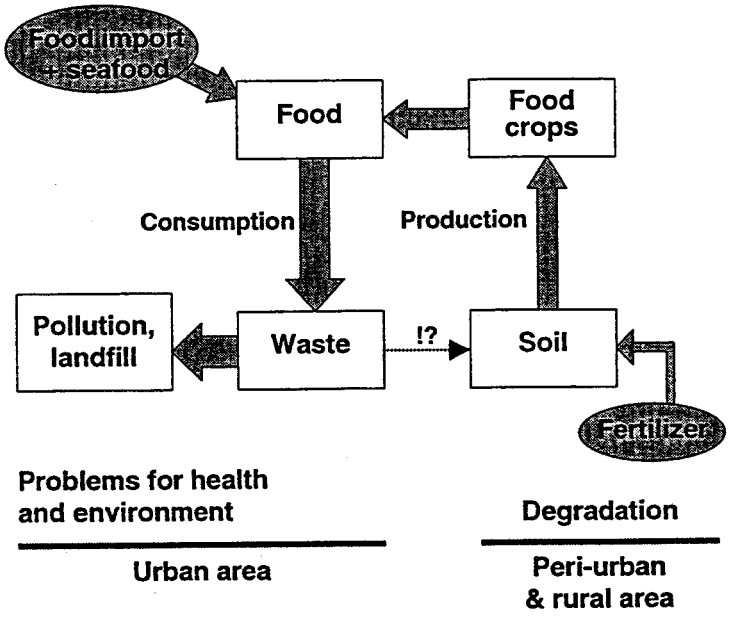


Figure 2. Urban centres: vast nutrient sinks with soil mining in production areas and pollution problems where garbage accumulates. Options for organic waste recycling for soil nutrient replenishment have not been explored much until now.

Waste management and nutrient recycling

The amount of waste generated per person ranges from 0.4 to 0.6 kg/day in low-income countries. Only about 10% is unsuitable for composting (plastic, metal). In middle-income countries, the amounts range from 0.5 to 0.9 kg/day (Cointreau et al. 1984). Composting can turn this waste into a resource, reducing the public cost of waste management, soil and water pollution, and thus providing a better living environment. Municipal solid-waste compost production is becoming an integral part of solid-waste management schemes throughout the USA and other parts of the world. In the USA, the number of landfills has declined by more than 50% from 1988 to 1995, whereas composting facilities for yard trimmings increased by the factor 4 and the number of solid municipal waste composting facilities from 2 in 1984, to 18 in 1994 (Steuteville 1996). These "new" organic manures do not only reduce the continuous nutrient export from production areas, but will contribute as well to the maintenance of the soil's organic matter, its moisture retention, and the reduction of soil compaction. Therefore, their economic value is higher than their mere nutrient content.

But compost is only economical on high-value products as it requires a high labour (cost) input. This is where peri-urban agriculture comes in, with vegetables, flowers, fruits, chicken, ducks, fish, and other high-value agricultural products. The value of urban waste to peri-urban agriculture is, in principle, well known. For centuries the Chinese and other East Asian societies have recycled urban wastes — both refuse and nightsoil — to intensify agricultural production systems. As well, in Khartoum for example, about one-fourth of the city's garbage is consumed by farm animals (Yeung 1986; Rabinovitch and Schmetzer 1997).

However, most success stories require that the systems for collection, sorting, composting and distribution be streamlined by governments of cities and municipalities. In Africa, we see far fewer systems of waste recycling — often without government participation. As public officials become aware that recycling compostable wastes can reduce the volume of refuse, pilot projects to collect and compost materials for recycling have been designed and supported in several countries.

Successful examples of urban-waste composting (mostly household refuse) are also reported, among others, from Cameroon (Ngnikam et al. 1993), Nigeria (Lewcock 1995), Morocco (Bennani 1988), and Ghana (Owusu-Bennoah and Visker 1994). However, waste utilization requires at least a functional collection and, if possible, a sewerage system. This is often not available. For instance in Khartoum, the municipal sewerage system serves only about 5% of the urban area, whereas Kinshasa has no sewerage system and the collection of household waste is only undertaken in a few residential areas of the city (Binns 1994).

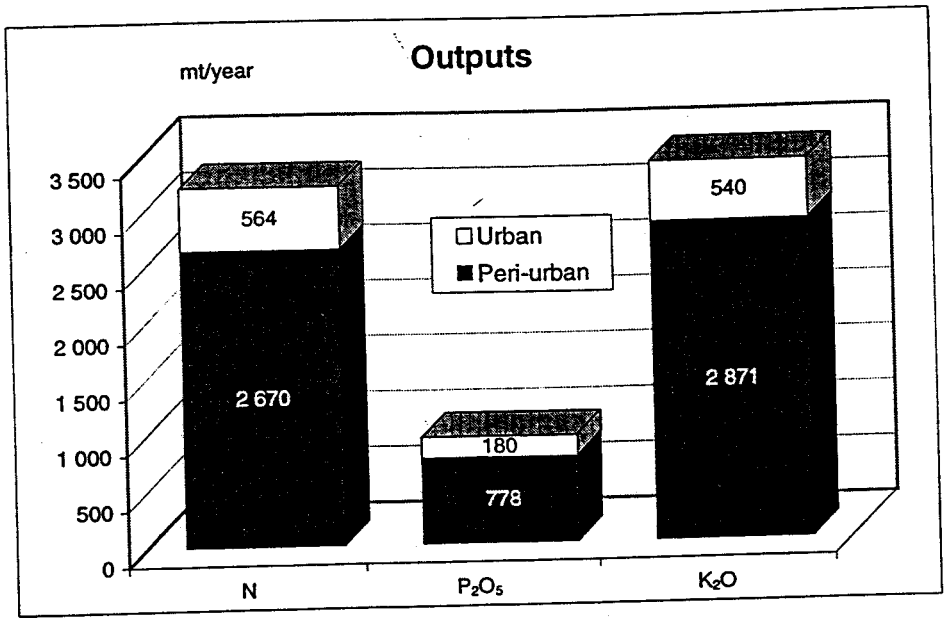
In urban and peri-urban Kumasi, annual nutrient export related to its maize, cassava, yam, cocoyam, and plantain production is about 3 200 mt N, 960 mt P_2O_5, and 3 400 mt K_2O (Figure 3). Annual nutrient input via fertilizer amounts only to 50 mt N, 40 mt P_2O_5, and 30 mt K_2O. Nutrient input/return can be significantly increased through the use of poultry manure, which is abundant and still free of costs around Kumasi (Drechsel and Quansah 1998), as well as through urban-waste composting (Figure 3), as is exemplified by the Teshie Compost Plant of Accra. The amount of nutrients available in poultry manure can exceed the amount of nutrients applied via industrial fertilizer in the whole Ashanti region by the factor of 2–3. This figure is conservative since it only considers large poultry farms. The compost figure is also conservative as it considers only the market refuse collected daily in Kumasi (150 mt), not solid household refuse (450 mt) or night soil. The Kumasi Metropolitan Area authorities assumes that the solid waste they collect is roughly half of the real volume produced. These figures do not include industrial waste, such as from the timber industry. However, at the moment all waste is used for landfill.

Besides household refuse and nightsoil, urbanization and prosperity have brought with them an abundance of livestock wastes. There is a well-developed market for manure around Nairobi (Harris, cited in NRI/UST 1997), while around Kumasi, poultry manure is still dumped and burnt along streets (Drechsel 1996).

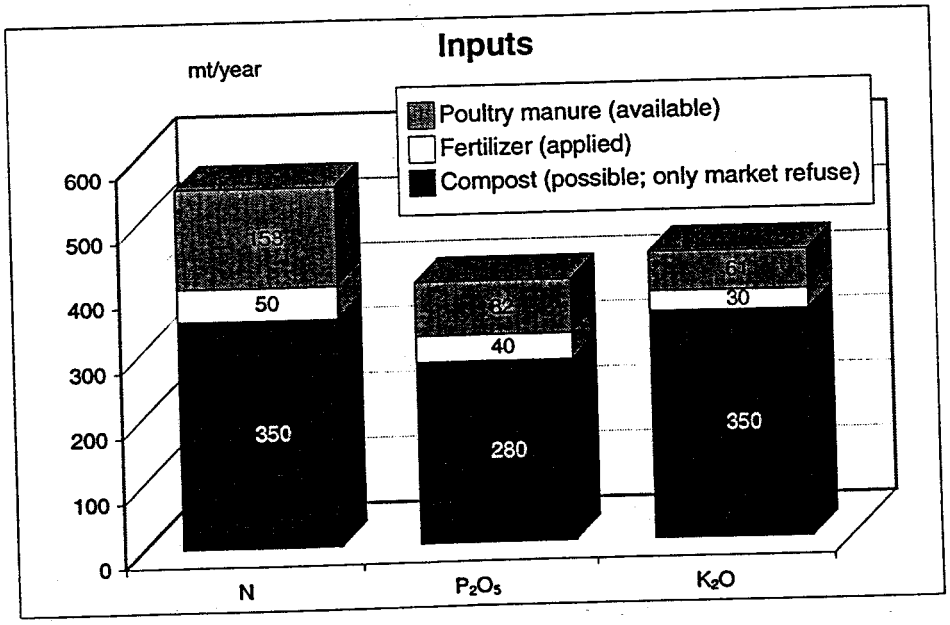
In 1991, the Association pour la préservation de l'hygiène et de l'environnement (ISUKU) started to collect market wastes in Kigali for large-scale composting. They collected about 8 t of organic residues daily from the 5 biggest markets in the capital (Rushomwintwali et al. 1993). The resulting compost had high final P concentrations of 0.22% (Drechsel, unpublished). The NGO designed this project also to offer work for "children of the streets."

Opportunities for the use of urban waste products, from markets and industrial processes, may be greater within the urban rather than the peri-urban area due to a shorter transport distance. In fact, urbanization creates a greater separation between farmer and nutrients.

Several on-farm studies show that peri-urban farmers are aware of soil fertility degradation. But they are constrained in their ability to address the situation, among other things, by financial and tenurial issues and, to some extent, by lack of knowledge of how to solve the problem. Lack of knowledge exists because peri-urban agriculture is a dynamic phenomenon and nutrient sources — such as poultry manure or urban waste composts — are little-known in rural areas. As well, prejudices against their use can be anticipated and taken seriously. Also, resource recognition must become the task of the municipal authorities, and "recycling" should no longer be a keyword solely of more developed countries.



Nutrient export via maize, cassava, yam, cocoyam, plantain



Nutrient import/recycling (urban and peri-urban)

Figure 3. Magnitudes of nutrient export and import (return) in urban and peri-urban agriculture, Kumasi, Ghana (IBSRAM 1998; unpublished)

Taking care of pollution

Urban and peri-urban areas also interact in terms of environmental pollution. The pressure for more intensive, commercial peri-urban farming gives greater incentives to use inputs such as fertilizer and biocides. Because vegetables are often produced along river basins, off-site effects are likely. Moreover, once brought with the products into the city, pesticides can become primary health concerns and generate secondary problems by making waste unsuitable for re-use. In general, when untreated waste is used as fertilizer, consumers risk contracting diseases like cholera and hepatitis, or heavy metal contamination. Too often, governments have confronted these problems by attempting to ban urban agriculture, thus denying cities an important source of food and economic growth. Alternatively, a private or public institution must function as a control and monitoring institution. Accompanying research activities — such as lowering the pathogen contents in municipal composts, or finding management practices to reduce pesticide applications — should be possible. Such programs must consider the time delays involved before pollution levels reach critical limits. Evidence from Asia (Jansen et al. 1995) shows that current practice in commercial peri-urban vegetable production will lead to a buildup of minerals and pesticides, particularly in the edaphic environment, which over the long term can only create detrimental health and environmental consequences if no adequate measures are taken (Midmore 1996).

Policy support

Urban and peri-urban vegetable production systems need development support because projections estimate that within less than thirty years, half of the world's population will live in urban areas. Measures to boost vegetable production, play a double role in achieving development policy goals: they reduce malnutrition, and increase income and employment opportunities (De Haas and Gura 1996).

Peri-urban agriculture offers partial solutions to several problems created by rapid urban growth in the developing world. Increased production through the application of efficient technologies to peri-urban agriculture decreases food prices and increases consumption. If vegetable production systems are prominent among peri-urban and urban agricultural enterprises, people's consumption of them and, therefore, of vitamins and minerals, will increase. For the poorest of the poor, this means access to food and a way to overcome malnutrition. For the "stable poor," it is a source of income and high-quality food at a low cost. For middle-income families, it offers the possibility of savings and a return on investment.

Even vegetables grown in the house-garden possess a double advantage: they bring self-reliance in high-quality foodstuffs and higher income as a result of selling surplus produce on the market. Vegetable growing requires low investments of capital and is becoming a priority income-generating activity, both in savings and small-scale loan projects — or in projects which promote women in development. In fact, women are the traditional vegetable growers and they significantly benefit from urban agriculture promotion programs.

In addition, urban farming is a competitive economic activity providing new jobs to many in the city, especially for people with limited mobility, low skills and little capital, including women and children. In Yaoundé, for instance, every fifth or sixth household is engaged in urban agriculture (Fodoulop 1997); in other cities up to two-thirds of all families can be engaged in urban agriculture, a lot of them with no other source of income. The world's poorest urban households spend between 50% to 90% of their income on food. For them, urban agriculture offers an opportunity for a better diet and a chance to shift household spending toward other needs, such as health care and housing (Rabinovitch and Schmetzer 1997).

A simple calculation illustrates the magnitude of the increasing urban employment problem. For a city of 2.5 million inhabitants, assuming a net urban work-force growth rate of 4%, an average 100 000 new jobs must be created annually. However, job creation has not kept pace with work-force growth, resulting in a large number of families with submarginal income and under- or un-employed members who can find jobs in peri-urban agricultural production and distribution. Moreover, sorting, composting and distribution of waste products generates employment.

However, the benefits of urban agriculture extend beyond better nutrition, poverty reduction and jobs for the poor. Agricultural methods make the most out of scarce land, water and other natural resources, and often make use of wastes and industrial by-products as well. From the environmental and economic point of view, waste reduction is interesting. Finally, reducing environmental pollution in towns contributes to poverty alleviation because the urban poor are mostly exposed to, and constrained by, bad environmental conditions (Songsore and McGranahan 1993).

Need for action

The challenges described above call for action at different levels: at a national level, and with respect both to research and development aid.

At the national level

Because governments have often failed to support urban agriculture and rural-urban links, their economic potential remains largely untapped and often there is no authority directly responsible for the sector.

In order to solve this problem, national and municipal institutions and stakeholders must come together to streamline their activities in a participatory way. Such a group would include representatives from different ministries, branches of municipalities, public health, agriculture, public works, justice, finance, planning, NGOs, projects, farmers' associations, and the private sector. Coordinated activities between them are necessary. This requires the development of the appropriate policy and regulatory framework, and the building up of the necessary urban management capacity. Two key issues are critical for the formulation of future development plans:

- the creation of urban-rural linkages so that neither urban nor rural development are treated in isolation; and
- the evaluation and valorization of peri-urban and urban agriculture, and the exploration of different possibilities for nutrient recycling and waste reduction.

Research

Understanding food (nutrient) flows and the quantities and qualities of the different under-exploited nutrient sources can facilitate decisions for sustainable, environmentally sound land management.

Knowledge gap: nutrient flows and budgets

In view of nutrient flows and budgets related to food and waste, significant efforts are needed to bring together what is known, and to make additional crucial observations about food import and fishing. For example, it would be worthwhile quantifying nutrient fluxes for a number of specific cities, for instance of three to six different agro-ecological zones, (humid forest, savanna, and Sahel), with their associated urban, peri-urban, and rural areas.

Nutrient replenishment and waste recycling

There are four key strategies to improve nutrient replenishment and waste recycling:

- Creating an inventory of soil ameliorant resources, notably urban waste products — their quantities and quality for agricultural purposes (nutrients, heavy metals, pathogens, biocides).
- Stratification and characterization of beneficiary groups for soil replenishment, and the identification of those groups that require soil replenishment.
- Review of the present and potential use of these resources, taking economic issues (costs, feasibility) and socio-cultural factors (aversion to the use of waste) into account.
- Joint development with the farmers of appropriate, integrated nutrient management (INM) options for long- and short-term situations.

The knowledge obtained should help to:

- minimize peri-urban nutrient depletion and maximize environmentally sound land management;
- indicate the opportunities for effective involvement of the urban and peri-urban sector in nutrient recycling; and
- allow for an integration of these data and extrapolation with, for example, geographical information systems (GIS) to cover the entire rural–peri-urban–urban areas.

Finally, the development of decision support systems for city planners and other institutions involved should be envisaged. These would clearly identify different pathways of linking peri-urban and urban agriculture, waste recycling, and environmental protection, so as to integrate nutrient management by isolating the beneficiary group, crops, distance to town, and other factors.

Development aid

Development aid is necessary "now" to avoid harmful and irreversible developments.

Urban centres need qualified, experienced advisory services. If they are operated on an intensive basis, both peri-urban and urban vegetable-growing must be well managed. In addition, the correct use of production inputs (particularly seeds, fertilizers and pesticides) are a basic condition for sustainable, environmentally sound success.

As well, urban centres require technical and logistical assistance in waste management and financial support for large-scale waste recycling into compost. In conjunction with the compost projects already operating in different countries, an assessment of appropriate and viable compost production systems for peri-urban agriculture could be a research link.

Possible research approach

The research activities recommended above can be carried out according to their priority as central activities and satellite projects of a corresponding urban and peri-urban research network. They can integrate existing projects on urban agriculture, such as the quality of waste and its composition, water contamination, city planning, long- and short-term nutrient release from different materials (and their interaction), waste marketing, waste improvement, waste-processing economics, waste and compost transport requirements, and so on.

A major point of interest is to compare cities and to understand and learn from differences. But it is also critical to save time by learning from cities which already possess advanced waste management and recycling systems. In this way, a network could link to similar networks in Asia, Europe and North America. European cities have had many years to develop effective waste management and recycling initiatives, experiences that are of high value for Africa. Asian cities, on the other hand, face similar climatic and soil fertility constraints as in Africa.

Such a network has to involve all stakeholders of peri-urban agriculture in a participatory way, because the challenges are complex and require a holistic approach. It is complex because of the many disciplines involved and because many partners must tackle the challenges. On a national level, the network should include governmental and non-governmental institutions, and those farmer associations involved in city planning, peri-urban agriculture, waste generation, sanitation and health. Of similar importance are those areas within the private sector that are interested in waste processing, agro-business, and public welfare.

At the next level, advanced research institutions can bring in know-how, and assist the National Agricultural Research Services (NARS) in the analysis of, for example, biocides. International agricultural research institutions, such as the International Fertilizer Development Centre (IFDC), International Board for Soil Research and Management (IBSRAM) or the United Nations' Food and Agriculture Organization (FAO) can contribute with the compilation, processing, and evaluation of the data obtained, the development of decision support systems, and the international coordination of such networks, possibly through a consortium.

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