Closing the Rural-Urban Food and Nutrient Loops in West Africa: A reality check

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Rapid urbanisation in developing countries intensifies the challenges of making sufficient food available for the increasing urban population, and managing the related waste flow. Unlike in rural communities, there is usually little or no return of food biomass and related nutrients into the food production process. Most waste ends up on landfills or pollutes the urban environment.
This is transforming cities into vast nutrient sinks, while the rural production areas are becoming increasingly nutrient deficient (Drechsel and Kunze, 2001).

In this study, we aimed at gaining a better understanding of the rural-urban nutrient flows, options for recycling and the role of urban agriculture compared to periurban and rural farming.
Four cities (Accra, Kumasi and Tamale in Ghana, and Ouagadougou in Burkina Faso) were selected along a South-North gradient across a variety of agro-ecological zones.

Location of the cities under study

In each city, we analysed, qualitatively and quantitatively, food flows related to all key markets as well as the consumption and fate of the related waste. This involved market, household and street food surveys over different seasons with interviews of more than 1700 traders, 4835 households and 922 street food consumers (Drechsel *et al.*, 2007). Twenty-two food items including fruits, vegetables and livestock products were considered. Presenting food flows in general could be based on various criteria, like the number of each food item, the diversity of food items, or their calorie or vitamin content. As we were interested in the nutrient cycle we looked at mass movements and nutrient content. In a more detailed study in Kumasi, all organic non-food items, such as timber and fodder, were also considered to assess the overall potential for organic waste composting (Belevi, 2002). The present study was accompanied by a demand and willingness-to-pay analysis for waste products in various farming systems, and a number of cost-benefit analysis scenarios for different demand-supply options, compost station sizes, transport capacities etc., using the financial software of GTZ-GFA (1999) for compost production.

Analysing the feasibility and viability of compost production

Organic waste materials can be recycled into carefully processed high-grade compost for agricultural use. Long-term success of commercial production, however, depends on a number of prerequisites. One key factor is economic viability. Before establishing a composting business, it is necessary to make sure that compost production and marketing will be an economically attractive and self-financing activity. In 1999, a GTZ project on municipal waste composting compiled a useful set of materials to assist planners and decision-makers in making feasibility assessments. The information package included a computer-based tool called the "Decision-makers' guide to compost production". The software offers users a quick and easy method to determine, right from the outset of the planning process, the costs that will have to be covered and gives a break-down of those costs (see book section).

In- and outflows

Based on their weight, the relatively heavy staple crops like yam, cassava and plantain form the major component of all food flows moving in and out of the cities, especially in the West African forest zone, which is Africa's tuber belt. This is reflected in about 600,000 tonnes of yam, cassava and plantain entering Kumasi every year, which is nearly two thirds of its total food inflow. The volume of the flow requires that a standard 7t-transporter enters the city every three minutes during daytime, a significant logistical challenge in view of common traffic jams. Further to the north, traditional cereals are an important part of the diet. Rice in particular is

becoming increasingly fashionable as an urban fast food component, both in the north and in Accra to the south. About 30-50 per cent of the food entering the cities leaves them again from wholesale markets.

Food sources

In the four cities, food flows originating from rural areas are the most important overall food sources. Depending on the city, rural farming contributes between 64 and 88 per cent of the total inflow to the urban area, with percentages again largely determined by the weight of tuber crops.

Especially interesting is the differentiation between commodities and seasons, which shows the niche and contribution of urban and periurban farming in terms of fresh leafy vegetables, like spring onion and lettuce. Urban farming provides up to 90 per cent of the cities' consumption. Also, most fresh milk found in Kumasi is produced in the urban area at the local university. In the periurban areas of Kumasi, large poultry farms produce 80 per cent of the eggs consumed in the city, while these farms suffer increasingly from cheap poultry meat imports, especially from Brazil.

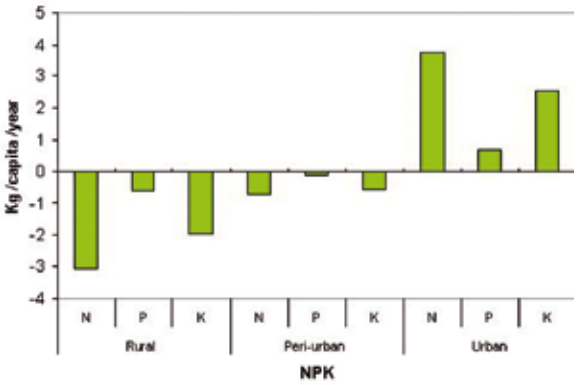
The situation is similar in the other three cities, where urban and periurban farming supplies only certain commodities, and thus does not contribute significantly to overall urban food security but to a diversified food supply. In particular, food rich in Vitamin A, such as carrots, local spinach, tomatoes, lettuce, beans, eggs and milk derive predominantly from urban and periurban farms. All these data refer to market-oriented production. They do not include backyard farming, which contributes to subsistence supply. In the cities studied, backyard farming involves not so much vegetables but staples (see UA-Magazine 22, p.6), and allows the households to save money otherwise spent on food. In terms of the food amount, however, urban agriculture only contributes around 5 per cent to the overall urban consumption in the cities, while periurban areas (40 km radius) can contribute between 10 and 36 per cent.

The urban nutrient sink

With the food, large amounts of nutrients flow into the cities. Some food-borne nutrients find their way back into crop production, e.g. through organic waste recycling in urban backyards. But the overall picture shows significant nutrient losses (depletion) in rural areas and huge nutrient accumulation and loss in urban areas. As the bulk of the waste ends in streets, drains or landfills, urban centres are indeed nutrient 'sinks' (see figure). This has significant implications for environmental pollution.

Closing the nutrient loop – not so easy!

To close the nutrient cycle it is necessary to bring the nutrients back into food production. This might be easy in rural areas where consumption and production are "neighbours", but along the rural-urban corridor this becomes a significant logistical and financial challenge. Nevertheless, it is important to note the fate of food and nutrients in the city "organism": A large share of the food brought into the cities leaves the city again through trade. The data from Kumasi, Ghana, show that out of the consumed food and its waste products before and after consumption in households, about



Balance of imported and exported nutrients per capita in the rural-urban continuum, based on the four cities studied

- 15 per cent of the nitrogen is transferred to the atmosphere from the households
- 20 per cent of the nitrogen and phosphorus are collected with waste and then landfilled or processed in faecal sludge treatment plants
- 65-80 per cent of the nitrogen and phosphorus, respectively, are lost from septic tanks, via wastewater or uncollected solid waste to the environment.

Currently, about 18 per cent of the generated solid waste and 66 per cent of the faecal sludge remain uncollected in Kumasi's streets, pits and septic tanks. The nutrient value of the non-collected solid and liquid waste (sludge) would in theory be sufficient to pay the service costs of solid waste management for the whole city (USD 180,000 per month).

From a technical perspective, part of this environmental load could be reduced via waste composting or co-composting of solid waste with faecal sludge. In Kumasi, 230,000 – 250,000 tonnes of organic waste and in Accra 255,000 to 366,000 tonnes of organic waste are effectively available annually for composting, meaning that these amounts are already collected and have no other current use. The nutrient content of this waste in Accra alone is estimated at 3,500 to 5,300 tonnes per year of nitrogen, 1,700 to 2,600 tonnes per year of phosphorus and 760 – 1,100 tonnes per year of potassium. These amounts could easily cover the entire nutrient demand of urban farming. In a scenario which only considers the amount of waste already collected and transported to a landfill, about 60 per cent of the produced compost could be

Valuable resources not recovered
Photo: Pay Drechsel

used to replenish all urban farm soils in Kumasi. If all waste were collected, 30 per cent of the compost would be sufficient, while the rest could be sold outside the city. However, if the compost is sold at a price which covers its production costs, only a small fraction of about 1000 tonnes per year would be bought, while more than 100,000 tonnes would remain in the warehouses. And even if subsidised, transport costs would limit compost sale to a narrow radius around its distribution points.

Leafy vegetables like nitrogen
Photo: Pay Drechsel

These economic constraints favour community-based projects, with low production costs due to often cheap labour. However, the amounts produced and sold do not need or allow economies of scale, and thus cannot contribute significantly to overall urban waste management.

These limitations clearly show that the idea of "closing the rural-urban nutrient loop" is spatially constrained and not generally realistic. While it is feasible to transport high-value (food) products over long distances and through various middlemen into the city, it is hardly feasible to transport a waste product the same way back, unless there are favourable market conditions, such as a potent buyer, added value, no competition or strong subsidies:

- A win-win situation could for example be a private-public partnership linking public compost stations and real estate developers interested in large amounts of compost for gardening, as observed in Accra.
- In Kumasi, a mix of fertiliser and compost has been tested that increases the value of the waste product. This could create new demand.
- However, in the same city, and many others, compost sales suffer when cheap poultry manure is available. Poultry manure has a high nitrogen content, which is easily available, while compost is often poor in nitrogen and decomposes slowly. Despite its positive impact on soil water content etc., it is not attractive for exotic vegetables, like lettuce, which have a growing period of only 5-6 weeks. Thus market analysis should not only look at a specific product but also at competing products.
- Many city authorities have stressed that composting is most welcome as a means to reduce waste volume (i.e. transport costs). Thus compost production - even without any market - saves money, which could be used to finance the composting itself. Compost sales were considered a secondary issue or bonus. This favourable view of composting stems from the increasing problems faced by authorities in finding community-supported landfill sites in the vicinity of the cities, while local communities are less reluctant to accept a compost station. From this point of view, compost stations should be planned as close as possible to the points of waste generation; and from the sales perspective, as decentralised as possible. Knowing the daily production of organic waste, transport costs and station costs, it is possible to determine the optimal number of decentralised compost stations that would minimise costs. In the case of Accra, these would range from 6 (to cover the most optimistic agricultural and non-agricultural compost demand) to 33 stations (to reduce as much waste volume as possible).
- Arguments in support of subsidies could build on the reduction of environmental pollution in the city (up to 20 per cent in Kumasi), but would of course be more persuasive with improved collection capacity. This concerns in particular improved excreta management from septic tanks, since the most significant nitrogen and phosphorus fluxes to soil, surface waters and groundwater occur via faeces and urine.

Conclusions

While it is easy to demand closed loop concepts, the number of success stories usually decreases with increasing scale from household to community to city-wide initiatives. To look behind the common goals of closed loop concepts, this study put much emphasis on actual compost demand and economic feasibility. The analysis showed that closing the rural-urban loop is possible for manufactured high-value food products, which will return to their rural roots, but only under particular conditions for low-value waste products, like compost. Therefore, any initiative aiming at nutrient recovery should carefully analyse local demand and markets.

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