Developing Policy Support on Closing Rural-Urban Nutrient Recycling for Urban and Peri-urban Agriculture in West Africa: Application of multi-stakeholder processes and approaches, DANSO G.[1], DRESCHEL P.[1] and COFIE F.[1].

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Abstract:

The major challenge of urbanisation to decision makers is the provision of sufficient food for the emerging mega-cities and appropriate urban sanitation management. This paper focuses on the results of a project carried out by International Water Management Institute (IWMI) in three major cities of Ghana. The project was designed to provide decision support for nutrient recycling from organic waste in urban and peri-urban areas, i.e. through waste composting or co-composting with nightsoil. Experiences from Nigeria, Benin and Togo were also taken into consideration. Apart from technical aspect, the study looked at actual waste supply and its quality, a quantification of the compost demand as well as economic viability of different scenarios and legal implications. Among other findings, the analysis shows that municipalities need large volumes of waste to be composted to reduce waste transport costs while compost sale (and use) is not a necessary condition. Although farmers expressed interest in compost, a cost vs. willingness-to-pay (WTP) analysis showed that the effective demand is low. The paper concludes that closing the rural-urban nutrient cycle through composting is unrealistic though it could be possible to close the loop partially by serving urban and peri-urban farmers. Financial viability is however unlikely although there are low-cost options for win-win situations.

Développement d'une politique de soutien au recyclage des déchets ruraux et urbains pour l'agriculture urbaine et peri-urbaine en Afrique de l'Ouest : application de procédés et approches avec de multiples intervenants

Résumé

Le principal défi auquel font face les décideurs en urbanisation est la provision de nourriture en quantité suffisante aux mégalopoles émergeantes, ainsi qu'une gestion adéquate de l'hygiène publique. Cette étude se concentre sur les résultats d'un projet conduit par l'Institut International de Gestion des Eaux dans 3 grandes villes du Ghana. Le projet avait pour objectif d'apporter une aide à la prise de décision sur le recyclage des substances nutritives issues des déchets organiques dans les zones urbaines et peri-urbaines, à savoir par compostage ou co-compostage avec du fumier d'excréments humains. Il a été tenu compte des expériences au Nigeria, au Bénin et au Togo. En dehors de l'aspect technique, l'étude s'est intéressée aux quantités réelles de déchets et leur qualité, à la quantification de la demande en compost et à la viabilité économique des différents scénarios et leur implication légale. Entre autres résultats, l'analyse a montré que les municipalités ont besoin de grandes quantités de déchets à composter afin de réduire le coût du transport des déchets tandis que la vente (et l'utilisation) du compost n'est pas une condition nécessaire. Quoique les agriculteurs aient montré de l'intérêt pour le compost, une analyse du coût par rapport à la volonté-d'achat a montré une faible demande effective. En conclusion, il s'avère que le bouclage du cycle des substances nutritives à travers le compostage n'est pas réaliste, quoiqu'il soit possible de boucler partiellement ce cycle en servant les agriculteurs des zones urbaines et péri-urbaines. La viabilité financière n'est toutefois pas évidente, malgré l'existence d'options à moindre coût pour gagner à tous les coups.

Developing Policy Support on Closing the Rural-Urban Nutrient Cycle for Urban and Peri-urban Agriculture in Ghana: Application of multi-stakeholder processes and approaches.

1. Introduction and background

Sub-Saharan Africa (SSA) is experiencing one of the fastest rates of urbanization in this decade. Especially, in regions with large coastal cities, such as humid West Africa, already today more people live in cities than in rural. Cities are growing because of rural-urban migration coupled with natural population growth. This ever-increasing trend in urban population has not only brought about congestion and put stress on limited resources and services but has also led to problems of food insecurity, malnutrition, unemployment, poverty and deterioration of the environment. It must be emphasized that both urban poverty and basic sanitation services concerns need to be tackled in these countries. Internationally, these issues and other related ones are on the priority list of the Millennium Development Goals (MDGs). In addition, Policy-makers in these countries have started to respond to these challenges. Usually, the provision of sufficient food and basic sanitation services are the major challenges in these mega-cities. Both challenges are linked as the urban food supply contributes significantly to the generation of urban waste (Drechsel and Kunze, 2001). In an attempt to revitalize the urban environmental deterioration and ensure urban food security, there is the need to recovery nutrient from organic waste for food production. The panacea is that if well planned, the costs of waste disposal could be reduced. However, what appears like a logical win-win- situation for city authorities and farmers, is seldom in the developing world. A combination of factors accounts for why urban areas have not been able to successfully constructs and operate composting stations. The most notable ones in West Africa are lack of affordable equipment, technical personnel, frequent mechanical breakdowns, and financial restrictions (Drechsel et al., 2004; Asomani-Boateng et al., 1996). In situations where funding is secured from donor agencies, the conditions accompanying such funds are often disincentives to good practice. Technological know-how on financial analysis, engineering design of composting facilities and transport schedule modelling have been very much limited in developing countries (Cointreau-Levine, 1997). In addition, technological transfers of compost processes and equipment from developed countries were often done in the past without considering local constraints (Hoornweg et al., 1999; Etuah-Jackson et al., 2001) and the technologies transferred were often not applicable in the receiving country. Also comprehensively planned composting stations, based on a demand-supply analysis, are unusual. In fact, waste management authorities in West Africa have hardly the “luxury” to plan for recycling but to focus their limited resources on the priority needs “waste collection” and “safe disposal” which are consuming an immense share of the municipal budgets in low-income countries as cost recovery is low (Drechsel et al., 2004).

Initiated through a pan-African conference on (peri)-urban agriculture and nutrient recycling (Drechsel and Kunze, 2001), the IDRC agreed to co-sponsor a corresponding project in Ghana in order to develop nutrient recycling strategies to close the rural-urban nutrient loop. The objective was to develop decision support for three Ghanaian municipalities on waste composting. The project received French support allowing the construction of a pilot co-composting station in Kumasi, which is so far unique in Africa and allowed us to gain practical insights into compost station management and co-composting. The study employed the ‘multidisciplinary situation and stakeholder analysis as a major method of analysis.

2. Study Area

The detailed studies were conducted in four cities in West Africa (Accra, Kumasi, Tamale, Ouagadougou), which all lie almost on the same longitude, but spread out more than 1,000 km from South to North of the Sub-region. The study was designed to cuts across several ecological zones, from the humid forest belt to the border of the Sahel (Figure 1). In order to understand composting dynamics in terms of sustainability and policy recommendations in the sub-region, a survey was conducted on the existing composting stations Ibadan (Nigeria), Tsévié and Lomé (Togo), Cotonou (Benin). The study was conducted in and around Accra, Kumasi, and Tamale, each located in a different agro-ecological zone in Ghana. Accra, the capital, is located in the coastal-savanna zone with about 1.6 million inhabitants. Population growth rate of Accra is approximately 3.4% per annum in the city itself but up to 9% in its peri-urban districts (Drechsel et la., 2004). Kumasi is located in the humid forest zone and has a population of about 1 million and an annual growth rate of 6%. Tamale is in the northern savanna zone and has a population of 200,000 with a comparatively low growth rate of 2.5 % (Ghana Statistical Services, 2002). Ouagadougou the capital and largest city of Burkina Faso is situated in the centre of the country and covers an area of about 200 km². The population today is about 900,000 with an average annual growth rate of ca. 6.8%, against the national average of 3.2%. The cities were selected because of their differences in cultural, social, economic and eco-zonal characteristics. These characteristics are expected to affect, for example, the availability and use of organic biomass (including waste and night soil) and the related demand for compost.

3 Materials and Methods

The overall objective of the project was to develop strategies to close the rural-urban nutrient cycle, which would simultaneously help to preserve the quality of the urban environment by reducing (the pollution effects of) waste accumulation. It aimed in a more concrete sense at decision support for the Municipalities on composting options which should - in short - be viable in the specific city context. The idea was to go beyond any ideal of compost production and use, and to work on a realistic, qualitative and quantitative assessment of all related pros and cons. The nutrient recycling loop developed in this project (Fig. 2) was used as its framework.

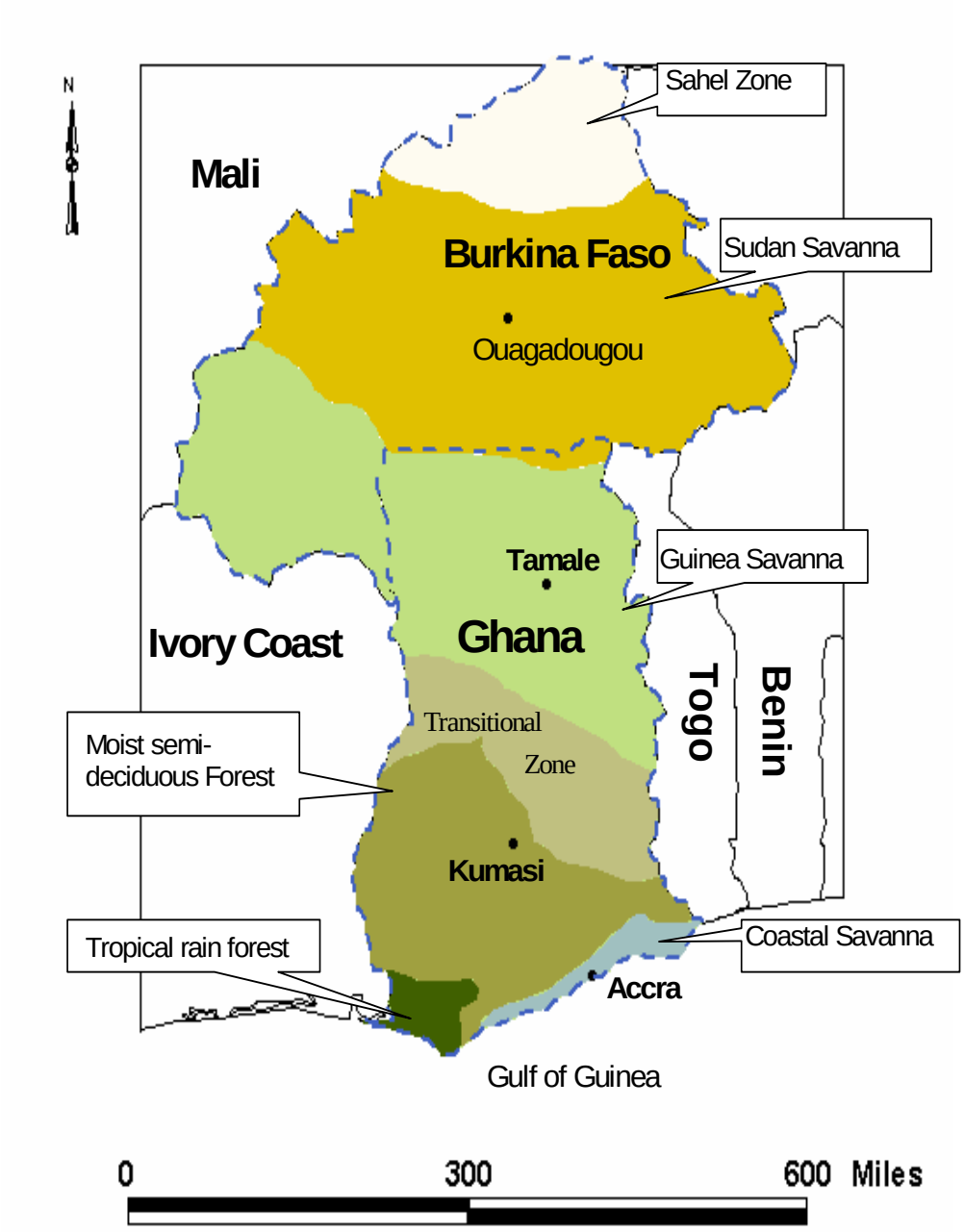

Figure 1: Main study sites (Accra, Kumasi, Tamale and Ouagadougou)

The nutrient recycling loop has the following study segments:

1. The **supply** of organic waste (production, quality, quantity, time, availability, …)
2. The **demand** for waste compost (who, where, how much, when, perception, possible price, …)
3. The **process** of waste composting including the determination of optimal number,

capacity, and location of compost stations per city (linked to segment 1, 2 and 4)

4. The **economic** analysis linking supply, demand and process segments.
5. **Legal, institutional and communal** factors affecting the set-up and sustainable management/ownership of compost stations.

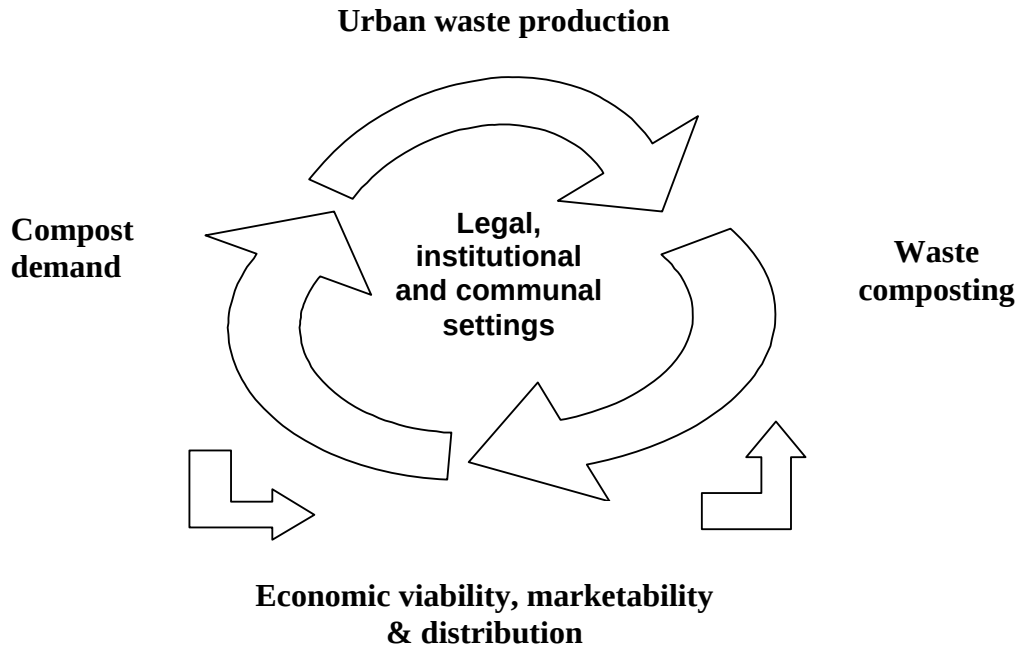

Figure 2. The project framework with the five study segments of the loop

This required a holistic 'multidisciplinary situation and stakeholder analysis' (Drechsel et al., 2004) and a competent project team involving more than 15 different university departments of three national and several European universities, which emphasizes the multidisciplinary nature of the study. Other stakeholders were urban and peri-urban farmers, communities, municipal authorities, especially the waste management departments, schools, and parts of the private sector. In total, more than 100 students worked on their final thesis in the project, mostly through data collection and analysis. Regarding this, students obtained prior training through IWMI, which included questionnaire development, several test runs and revision of the questionnaires, all jointly done with their supervisors. Students working on similar task in different cities had joint test runs. This capacity building aspect, which also included the statistical analysis of the data with local project assistants, was an important part of our

collaboration with local Universities. Both primary and secondary data were used. In all a total of 75000 stakeholders were interviewed.

4. Literature Review in the Sub-region

A team of scientists from Ghana visited Togo, Benin and Nigeria to ascertain and understand the state of the art of the existing compost stations. In addition, a review was carried out on compost stations in Mali and Burkina Faso. In all cases, the review was centered on the link between the municipal waste composting and urban and peri-urban agriculture development. The survey of compost stations in West Africa was carried out to provide knowledge and experiences from the other stations. The survey showed that Municipal authorities often consider composting as high-risk, low-yielding business venture. Too often, stations were set up because initial funds were available but without analyzing the different segments of the recycling loop, especially the institutional settings, demand and marketing, and related profitability analysis. In fact, compiled project data showed that the stations under study are not financially viable. However, the stations might be economically viable, i.e. under consideration of social and environmental impacts.

In general, the case studies showed that compost stations in the subregion suffer from one or more of the following omissions:

- Missing market and feasibility analysis (no consideration of alternative soil inputs, transport costs, farmers demand and willingness to pay etc.), thus unsustainable compost sales
- Missing crucial partners, thus – for example - unsustainable waste collection or compost marketing
- Missing (maintenance) funds after initial set up, thus financially not viable
- Missing legal frameworks and difficult land access, thus subject to conflicts

All these points enforced the need for a comprehensive feasibility study before the set up of any municipal compost project. The above described recycling loop gives the required framework and potentially best practice except that it was never applied before. Therefore, one of our tasks was to verify the usefulness of this framework. The following sections present the specific methods and results associated with each segments of the recycling loop applied.

5. Specific Methodology, Results and Discussions of the Segments

5.1. The supply of organic waste

5.1.1 Methods: The key question in the waste supply context is: ***Where*** within the rural-urban zone is ***which*** amount of waste of ***what*** kind of quality ***when*** de facto ***available*** for composting. Regarding this question, the supply studies focused on the various types, amounts, quality, present and potential uses, current value and availability of organic municipal waste for composting. Only major sources were considered (markets, households, agro-industry, abattoirs, sewage plants, timber mills, etc.) although minor ones (e.g. bone meal producers) could locally become important additives. The data was collected through:

- ***Secondary data*** on the amount, location, quality and disposal of municipal waste from the waste management departments, NGOs or projects.

- ***Questionnaire surveys*** among organic waste producers using randomly selected sources from a stratified total per product. We address breweries, wood/food/ fruit processing industries, poultry farms, etc. to quantify the amount, kind and fate of waste generated in different periods of the year (i.e. seasonality consideration).
- ***Laboratory analysis*** of the amount of nutrients in the waste as well as of potential contaminants including heavy metals and E. coli.

Special consideration was given to the availability of nightsoil (human excreta) due to its use in agriculture in Ghana (Owusu-Bennoah and Visker, 1994; Asare et al., 2003).

5.1.2 Results and Discussions: The analysis of the waste supply and demand segments of the recycling loop confirmed our initial expectation that the availability of organic waste is not the limiting factor for compost production in our study cities. The supply analysis helped to avoid an overestimation of the amount of actually available organic waste. Not every waste is available as there are often alternative uses (fodder, fuel etc) and seasonal variations. The study showed that in all cities the largest share is household waste (Table 1).

Table 1: Waste and nutrients available for composting per capita in case study cities in kg / head/ year

Type	Accra	Kumasi	Tamale	Ouagadougou
Total available waste	**153-220**	**223-243**	**49-58**	**31-38**
Household waste	100-167	62	38-44	23
Market waste	44	58	9.6	7.8-12.2
Food processing waste	2.8	0	0	1.8
Abattoir waste	0	2.3	2.0	0.3
Sawdust	1.7	102-117	0	0
Settled sludge	3.4	1.1	2.9	1
Poultry manure	1.6	2.7	0	0
Total N	2.12-3.22	1.60-1.66	0.78-0.91	0.50-0.58
Total P	1.05-1.58	0.83-0.84	0.39-0.45	0.25-0.27
Total K	0.46-0.66	0.41	0.16-0.17	0.10-0.12

However, market and agro-industrial waste are usually more accessible for compost operators as their sources are concentrated in some few points and often of better quality for composting. Waste analyses conducted in Accra and Kumasi indicated relatively low levels of heavy metal contamination. Similar results are reported from other West African cities (Drechsel et al., 2004). Especially market waste combines very high organic content and a low potential of metal contamination. The analysis of the seasonality of the waste supply shows among others that more food products are produced, traded and processed in the rainy season than the dry season. As matured, dried compost can be stored, we concluded that there should be no significant seasonal shortage. A comparison of waste generation and availability along a South to North gradient from Accra, Ghana to Ouagadougou in Burkina Faso showed that with decreasing biomass production also the amount of organic waste and related nutrient availability per capita decreases progressively as dryer eco-zones are entered(Fig.3).

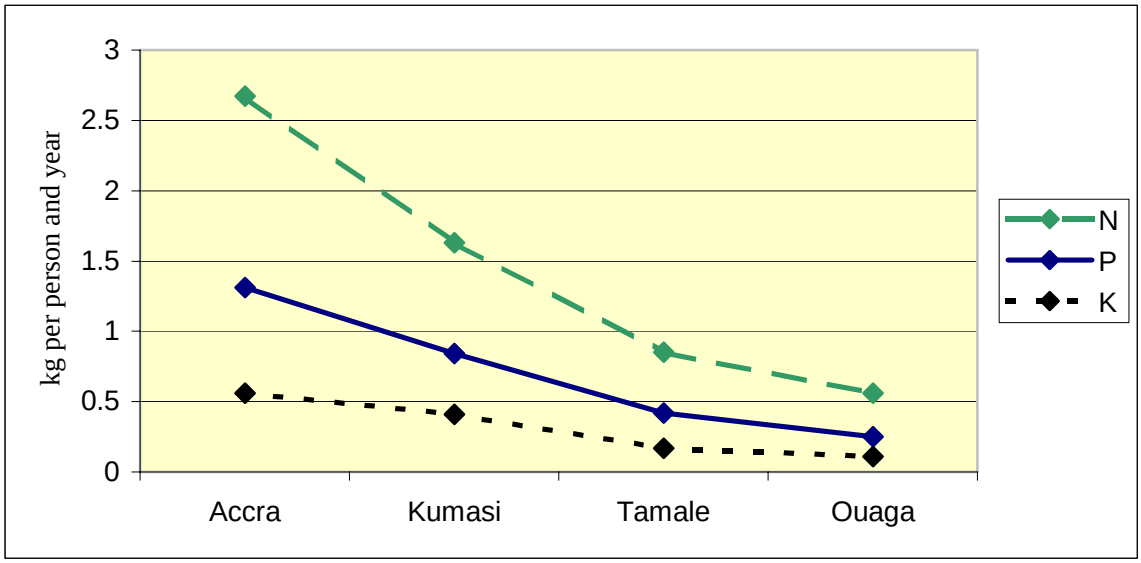

Fig 3: Nutrient availability kg / person * year through different agro-ecological zones

5.2. The demand estimates for compost

5.2.1 Methods: The demand assessment started with the characterization of all potential clients under consideration of their willingness and ability to pay and increasing compost transport costs with increasing distance from a potential compost station. This part of the study had to go beyond agriculture as for the city authorities any customer is of value. It is expected that a major and higher demand will come from rapidly expanding cities (especially) because of large landscape designers (horticulturists, parks and gardens) and real estate developers. The demand analysis also considered socio-cultural aspects, farm economics, attitudes/perceptions of the users of waste compost (e.g. with or without nightsoil), and actual demand projections. Methods used to answer these are:

- **Identification** of the different UPA farming systems, estate developers, landscape designers, if possible with and without compost experience.
- This is followed by **stratification** (in terms of farming systems, experience and no experience with compost, urban and peri-urban sites farm size, crops grown, current input use, etc) of the various potential and actual compost buyers for randomly selected

individuals as representative samples for each group.

- **Structured questionnaires** consisting of both open-ended and closed questions were used. The open ended questions gave the farmers/real estate developers etc, the chance to express their views about the use of compost and other factors that will affect their willingness to pay for it (e.g. fertilizer availability and costs, tenure arrangements etc.). Repeated pre-testing of questionnaires reveals faults and allow for improvement in preparation for the actual survey.
- For the assessment of attitudes and perceptions of farmers on the use of composted organic waste, we used ***individual interviews*** followed by ***focus group discussion***, differentiated by e.g. gender or compost user/non-users. Another PRA tool used in our studies is **matrix ranking** to compare advantages and disadvantages of different (demonstrated) nutrient sources (cf. Drechsel et al., 2004) Real estate developers were only interviewed individually. If one did not like to give information about his/her own enterprise, they were asked to describe their larger and smaller competitors.
- For the willingness to pay (WTP) study, ***contingent valuation*** method was used. This involves direct questioning of individuals in a survey to determine if and how much they are willing to pay for waste compost. This exercise results in a bidding game, which helps to determine the maximum amount the consumers are willing to pay for the compost. It was assumed that certain variables like wealth, age, sex, and experience with and no experience with compost, level of education etc. will have influence on the individual willingness to pay. Therefore, the **probit model** was used to analyse the impact of these variables on the WTP, as compared to a regression analysis.
- To give the WTP analysis a reality check, the different UPA farming systems were analysed for their farm finances and *de facto* ability-to-pay for further soil inputs.

5.2.2 Results and Discussions: In relation to other segments, our assumption was that the design capacity of a municipal compost station(s) will largely depend on the quantification of the compost demand. Different compost clients such as farmers growing vegetables, staple crops, fruits, and ornamentals were identified. The results indicate that most of the farmers have positive perceptions and are willing to use compost but mostly without related experience. The analysis showed that compost use, even from farm residues, is not common in Ghana's forest belt but known in its savannah. Compost was mostly compared with "black soil[*]". Farmers' interest in compost concerned both, a plant-growth enhancing (fertility) effect and soil amelioration. Large variations in WTP were recorded between farmers with and without compost experience, different farming systems, urban and peri-urban farmers, as well as between different cities with different compost alternatives. Although most of the farmers were positive, the actual amount farmers were willing to pay was low (0.2 to 2.0 USD per 50kg bag), often explained with the low price of poultry manure. The reference price of compost reflecting self-sustaining stations was set as ca. 3-5 USD per 50kg bag. Only a relatively small group of commercial pineapple growers (and exporters) around Accra expressed a corresponding WTP under the condition that product quality and (fertilizer like) packaging would be satisfying. The WTP expressed by farmers who already used compost was in several cases lower than among (still) non-users. This discouraging result was based on the unsatisfying performance of e.g. the compost produced in Accra (Teshie plant) or the negligible market demand for "organically" produced crops in Kumasi. The municipal compost produced in Ghana is generally low in heavy metals but also in nitrogen, especially if

[*] Dark, mostly organic soil from old waste dumps, which is considered very valuable.

compared to poultry manure. We could conclude that a better product might raise the WTP. However, due to large quality variations among the waste inputs, a standardized high value compost product was so far only achieved in the Bodija plant in Ibadan through blending with mineral fertilizer (Drechsel et al., 2004).

Without subsidies, only few farmers, mostly in compost station vicinity, could afford a viable compost production price of USD 5 per 50 kg. Scenarios assuming a fully subsidized production, on the other hand, showed spatial limitations in compost dissemination due to transport costs. The consideration of transport costs showed clearly that the idea to "close the **rural-**urban nutrient loop" is not realistic. While it is feasible to transport high value (food) products over long distances and different middlemen into the city, it is not feasible to transport a low value product the same way back. Another reason is the practice of shifting cultivation in the rural areas, which has lower (opportunity) costs than any intensification measures. Thus mostly urban and peri-urban agriculture (UPA) with no or very short fallow periods could benefit from compost application. Another exception is commercial pineapple growers in Accra and cotton growers near Tamale. A significantly higher demand for compost was estimated from estate developers than from UPA farmers around the three cities. The house-building sector is generally using black soil from local waste dumps for gardening and landscaping and is contributing to land degradation through topsoil mining where black soil is scarce. If a policy could be applied that the use of compost could become mandatory for all "black soil" suppliers of real estate companies, significant amounts of compost could be sold especially in Accra. In comparison with agriculture, the real estate sector has much lower qualitative requirements as compost will mostly be used for lawns and ornamentals. Thus the real estate sector could be the "favorite" customer group with interesting options for private-public partnerships and **win-win** situations as the first example in Accra shows. The financial strength of the estate sector could in this set-up even subsidize parts of the compost production for agriculture.

The comparison with the 'Supply analysis' showed, that the amount of waste required to satisfy UPA and estate development could be provided **solely from the waste generated on the city markets** in Accra, Kumasi and Tamale. This would in addition guarantee quality and easy collection. While the study put much emphasis on actual compost demand and economic feasibility to cover at least station running costs, city authorities stressed that composting is principally reducing waste volume and transport costs, thus compost production - even without any market - is saving money which could be used to finance composting. Compost sales were considered a secondary issue or bonus. This perception is based on increasing problems of authorities to find community-supported landfill sites in city vicinity, 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. To reduce transport costs for supply and demand several stations around the city would best serve potential users.

5.3. The process and economics of waste composting

5.3.1 Methods: This part focused on possible ways of composting as well as the number of potential compost stations and station capacity, two factors which largely depend on the other two segments of waste supply and compost demand.

The approaches used under this segment include:

- **Visit to related compost plants** within the country and in neighboring countries to observe, study, exchange and obtain information on the technical/operational, institutional

and economic aspects of composting. In this regard, we studied different composting plants in Nigeria, Benin, Ghana and Togo which differ in scale and level of sophistication to allow us determine and recommend the most appropriate technology of composting facility for each city in order to minimize system cost and maintenance requirements as much as possible.

- **Our co-composting pilot station in Kumasi** allowed us to get hands-on experience in station operation and to test different options for solid waste and nightsoil co-composting. These trials continue. The co-composting station was built with French funds and in collaboration with the city of Kumasi, the Kumasi University, and our Swiss partners of SANDEC/EAWAG.
- **Field testing** of different options and combinations of solid and liquid organic waste to give a safe (assured through laboratory tests) and rich (assured through fertilization trials) product that is acceptable and safe for the farmer and consumer.
- **Surveys** of 2500 urban households in Accra, Kumasi and Tamale targeted – among others - the possibility of organic waste separation at the household level ('source separation'). The surveys were organized in collaboration with 35 junior secondary schools (JSS) covering all parts of the three cities.

5.3.2 Methods: The economic analysis linked the supply, demand (quantity and willingness-to-pay study) and process segments (actual compost costs). It considered the viability of existing compost stations in the subregion, the economic performance of our pilot station in Kumasi, and a comparison of the compost option with landfill and incinerator. Different scenarios (with and without subsidies) were calculated under consideration of different demand estimates, WTP and transport costs. The software tool on the economic feasibility of compost stations, developed by GTZ-GFA (1999), was used wherever possible. Scenarios addressed different levels of technical sophistication and the actual and potential (but realistic) transport capacity of the city-specific waste collection system. The analysis included:

a) an assessment of the viability of different compost stations in the subregion,

b) a profitability and investment analysis for constructing and operating compost facilities in the example of Accra, and

c) a comparison of the economic and financial costs and benefits of composting, incineration and land fillings considering set-up as well as running costs under the economic conditions of Accra.

Besides computer-based simulation models, standard economic indicators, such as the Net Present Value (NPV) were used. The analysis was based on 2001 market prices and interest rates, where possible updated for 2004, under the assumption that whoever plans the compost station will have to pay for it, i.e. the establishment will not be for free.

5.3.3 Results and Discussions: The analysis was carried out for two contrasting years in terms of interest rate on borrowed capital (2001, 2004) on the assumption that whoever builds the compost station will have to pay for it, i.e. the establishment will not be for free. The studies revealed that all the stations surveyed in the sub-region were established (and are in part running) with financial aid and are not profitable and sustainable. The survey also showed that the reasons are often poor partnerships with the local communities or a poor market analysis. Thus all stations in the subregion sell their compost under production value, which can vary between USD 200 and 500 per ton of compost under consideration of discounted investment costs. Sales prices are usually in the range of 15 to 30 USD per ton and

often hardly covering station running costs. Even under consideration of collection fees etc., a deficit remains. A reasonable (unsubsidised) price would be 60 to 100 USD per ton or 3-5 USD per 50 kg. This, however, is hardly competitive in view of alternative local poultry manure and black soil except with a convincing evidence of better quality than the so far available compost. A comparison of land-filling, incineration and composting in Ghana confirmed that no alternative is actually profitable. However, the overall cost of building and operating composting facilities in the Accra-Tema Metropolitan Area is much lower than the other two methods. Further more, land-filling is about 95% cheaper than incineration under prevailing Ghanaian conditions. The unavailability of land for landfills, incinerators and their transfer stations, and the requirements for meeting environmental quality standards are the major causes of the high capital cost of land-filling and incineration in the area. On the benefits side, composting urban solid waste appears to have the highest total economic benefits especially through labour-absorption. A combination of land-filling with other methods could be associated with higher economies of scope and scale than any single method. Our analysis considered two basic scenarios, a) of a fully subsidized production, and b) a self-sustaining production. The later addressed the vulnerability of many stations due to common arrears in payments. It considered cost recovery, actual compost demand, station running costs and farmers' willingness to pay. Our project stakeholders preferred the first scenario stressing that compost production makes already sense without any demand as it is reducing the waste volume.

The general challenge we see is that potential/actual savings through composting were in no case study used neither to invest in composting nor to maintain existing stations. One reason might be that the waste volumes were insignificant and station costs higher than any savings. The challenge would become even larger, if different public and private entities would be in charge of compost station, waste collection, and landfill operation. This confirms the need for a clear legal/financial framework describing tasks and duties. While the project had its main focus on municipal compost stations, the municipal stakeholders stressed the importance (but also risks) of household composting. The general consent was that household composting should not be mandatory but focus on awareness creation among those households with highest potential (middle income, space in backyards and own urban gardens) and lowest risk for spreading diseases.

5.4 Analysis of legal, institutional and communal settings

This part of the study targeted the legal, institutional and administrative context within which composting and use of compost could be feasible. It involved an assessment of environmental and sanitation by-laws and policies as well as public awareness and the roles and perceptions of authorities and other interest groups, especially CBOs and NGOs in waste management, with special regard to organic waste recycling. The key question is who should own and manage a planned compost station and who should be otherwise involved as partner?

5.4.1 Methods used are:

- Study of the legal framework, sanitation policies, medium term plans, project plans and other documents (**literature review** and **interview of key persons**)
- Stakeholder identification through **expert consultation**.
- **Questionnaires** for assessing strength, weaknesses, opportunities and threats (SWOT) of stakeholders as well as their perceptions via **open interviews** with municipal

authorities, their clients and other interest groups (NGOs, CBOs, projects, World Bank, etc.) and the private sector.

- **Focus group discussions** with community leaders and community members on environmental issues, waste management, and organic waste recycling discussing possible scenarios of community-based compost station (perception, options, by-laws, realization potential, etc.).
- **Stakeholder clustering according to potential roles and linkages for the visualization of an institutional framework.**

5.4.2 Results and Discussions: In general, all institutions expressed their supportiveness and willingness to participate in case a composting project was to be initiated. It was mentioned that in order to overcome obstacles, care must be taken in all planning stages so that all stakeholders' inputs are considered. The survey revealed a constellation of stakeholders' roles to play in project implementation based on the expertise and abilities of each organization. A cluster analysis was used to group the identified stakeholders into four general clusters: 1) Regulators: i.e. institutions in power to draft by-laws, legal instruments, and policies; 2) Organisation & Management: institutions in charge of running composting plants; 3) Supporters of initiatives: institutions providing external support (financial, material, knowledge); 4) Beneficiaries: users of sanitation services (households and markets), communities and workers receiving income through composting (composting producers), and farmers (users of compost). Some of the institutions fall into more than one cluster; they are in the position to work as inter-cluster channels of linkage facilitating the flow and exchange of information. The institutional platform at the centre of the rural-urban nutrient cycle is to facilitate the framework of regulations, managerial and organisation skills, and external support to the beneficiaries. In the case of Kumasi, at the very centre is the Kumasi Metropolitan Assembly (KMA), this institution plays a role as regulator, a manager, a supporter of initiatives and as a beneficiary due to municipal savings; its central role doesn't mean it should be the chief institution or the one in charge, but it should be the main facilitator. More information on this can be found in Vasquez et al (2003).

6. Conclusion

The study showed that the amount of organic waste available for composting is seldom the limiting factor. Already the market waste would be sufficient in every city to satisfy compost demand from agriculture and estate development. Compost contamination does not appear as limiting factor, while the nutrient content is only modest. A detailed demand and stakeholder analyses appears crucial for compost sale and station set up, especially where subsidies might not be lasting. Major prerequisites for long-term success and project sustainability are besides careful financial planning also effective project partnerships linking public and private sectors, the local community and (at least for monitoring) research institutions. One lesson was that the target to close the rural-urban loop would remain a myth. As compost is no high-value product, transport costs would quickly raise too high. Thus it will only be possible to close the loop partially by serving urban and peri-urban farmers and estate developers, but not rural ones. Other key lessons are:

- Waste management including composting is costly if done at any significant scale. However, large scale composting is less costly than incineration or landfilling. The scenarios show that composting is not automatically a classical win-win situation for farmers and municipalities. Municipalities need large waste volumes composted for any

significant impact. Large sales, however, are neither matched by farmers' willingness to pay, nor the agricultural demand. In the best case (Accra), the real estate sector (plus urban and peri-urban farming) could absorb about 20% of the available organic waste. Still, a financial breakeven is unlikely, thus subsidies will be needed for set-up and maintenance of any compost station. A related win-win situation could be private-public partnerships linking public compost stations and private real estate developers.

- Research into compost projects must therefore include a comparison between public resource investment and social benefits streams. If these arguments will be acknowledged with subsidies remains doubtful, as public budgets are tight. Research is therefore even more needed to determine the least costly method of organic waste collection, transportation and processing including composting.
- City authorities stressed that composting is generally reducing waste volume and transport costs, thus compost production - even without any market - is saving money, which could be used to finance the stations. Compost sales were considered a secondary issue or bonus, thus the capacity of the stations should go far beyond actual demand.
- If such external support/subsidies are uncertain, compost stations do not appear to be sustainable as it is unprofitable. Low-cost alternatives are controlled waste dumping and mining at landfills (the product - "black soil" - has in Ghana an excellent reputation).

For more details and further conclusions please see the abstract of the final research report on our webpage (Drechsel et al., 2004).

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