Opportunities for managing solid waste flows in the peri-urban interface of Bamako and Ouagadougou

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SUMMARY: This paper examines the links between solid urban waste management and peri-urban agriculture in Bamako and Ouagadougou. Staple crop farmers in the vicinity of both cities value urban waste as a source of organic matter and are prepared to pay for it. Cultivation on degraded soils has even been revived in some cases thanks to this readily available resource. However, uncertain land tenure means that farmers have little incentive to ensure the safe disposal of dangerous elements in solid waste. Current plans would eliminate this recycling practice and promote large-scale composting, but the cost for farmers will be too high, leaving them with an incentive to make their own illicit arrangements for acquiring waste material. Furthermore, small enterprises and associations that have come to play a complementary and innovative role in waste management would be forced out. The key challenges for policy are to build on economic and institutional reality and to regard urban waste not as a dangerous nuisance but as a source of nutrients for agriculture. Opportunities exist to deliver waste that has been sorted, though not composted, to peri-urban farmers.

I. INTRODUCTION

URBAN WASTE PRODUCED in Sahelian cities has provided a source of nutrients and organic material for farmers in the peri-urban interface for quite some time. There is documented evidence of farmers around the close-settled zone of Kano, Nigeria having a long history of applying urban solid waste to their fields.[1] The practice is also known in Bamako and Ouagadougou. A three-year multidisciplinary project, APUGEDU, involving local researchers and NGOs together with collaborators from Europe examined the constraints and opportunities facing this practice, focusing on solid, as opposed to liquid, waste.[2]

Current developments present interesting opportunities for ensuring a safer and more sustainable recycling of solid urban waste in both Ouagadougou and Bamako, where waste management is currently being overhauled. Both cities have grown considerably and, with this, so have the challenges of managing their growing waste production. There seem to be insufficient financial resources available to the municipal authorities charged with ensuring the collection and disposal of urban wastes, and landfills are reaching capacity. Current plans, backed by foreign financing and expertise, plan to leave recycling as an "end-of-the-pipe" solution. By neglecting to integrate the provision of organic material to farmers, these plans risk repeating at least some of the earlier mistakes.

II. SOLID WASTE COMPOSITION AND MANAGEMENT

HOUSEHOLD SOLID WASTE management presents a challenge in cities such as Bamako and Ouagadougou due to the dispersed production and diverse composition of the waste, as well as the relatively weak administrative and financial capacity of municipal authorities. The production of organic waste in residential areas means that it poses an immediate hygiene risk and requires some form of effective management. In contrast, solid waste produced by markets, hotels, restaurants or industry tends to be more homogeneous and is concentrated in greater quantities at fixed locations, resulting in possibilities for lower collection costs, recycling and disposal.

Households in Bamako and Ouagadougou produce approximately 0.6–0.7 kilogrammes of waste per person per day, with wide variations according to season and household income. This amounts to an estimated 600–700 tonnes per day for a city population of around 1 million. The organic fraction of this waste accounts for about one-third of the total and also varies considerably among income groups. Higher-income households produce almost four times as much organic waste as lower-income households. Whilst the amount of organic waste produced doesn't appear to vary much with different seasons, the amount of sand and dust in household waste increases considerably during the dry season. Together with plastic, paper, metals and textiles, the presence of these inorganic components means that the non-organic components need to be separated, in order to ensure a relatively safe recycling of organic matter.

Growing concern about the situation is resulting in an increasing number of actors (other municipal departments, local councils, associations, etc.) becoming involved in the search for solutions. In the years following Independence, the municipal authorities in both cities assumed responsibility for collecting waste, backed by investments in lorries and depots. By the 1990s, the growth of the cities, combined with a lack of ongoing investment and administrative difficulties, led the government to accept the participation of waste management enterprises and non-profit organizations, whose emergence was often supported by NGOs.

In Bamako, small enterprises known as "Groupement d'Intérêt Economique" (GIE) began to complement the municipal collection system in specific neighbourhoods by establishing a clientele of households who pay monthly fees for waste collection. These GIEs generally work with simple donkey-pulled carts and limit themselves to transporting waste to collection depots within the immediate vicinity. Individual entrepreneurs often sort out some of the more valuable components and the municipality's lorries remove the remaining waste.

A similar informal and private sector has established itself in Ouagadougou, consisting of small enterprises and also some local associations. There were 11 such enterprises and 10 associations active in 1999 in areas of the city no longer being effectively serviced by the municipality, which removes only an estimated 40 per cent of total solid waste produced. There are a large number of "unauthorized" waste collection points within the city.

III. PERI-URBAN AGRICULTURE

THE PERI-URBAN area of interest in the recycling of urban waste is generally located within 15 kilometres of the urban boundaries, depending on

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1. Mortimore, M (1993), "The intensification of peri-urban agriculture: the Kano close-settled zone, 1964–1986" in Turner, B L, G Hyden and R W Kates (editors), *Population Growth and Agricultural Change in Africa*, University Press of Florida, Gainsville, pages 358–400; also Lewcock, C (1995), "Farmer use of urban waste in Kano", *Habitat International* Vol 19, No 2, pages 225–234.

2. The Potential for Development of Urban and Peri-urban Agriculture in Relation to Urban Waste Management in West Africa Project (French acronym: APUGEDU; website: www.lei.dlo.nl/apugedu) was financed principally by the INCO Programme (contract number ERBIC18–CT98–0288) of the European Commission Directorate-General Research's 4th Framework Programme, with additional funding from the North-South Research Programme of the Netherlands' Ministry of Agriculture, Nature Management and Fisheries.

the possibilities for transporting waste. In the APUGEDU project, detailed surveys were undertaken at sites that were most relevant for recycling urban waste due to their proximity to routes accessible to municipal waste lorries. In Ouagadougou, this was at Kamboinsé, situated approximately five kilometres north of the city. In Bamako, attention focused on the northern plain bordering the Niger River upstream of the city.

There is a diversity of production systems in the rural–urban interface, although this is more pronounced in Bamako due to greater variations in water availability. Farmers in the peri-urban zone of Ouagadougou tend to grow only staple crops, in particular sorghum, millet and *niébé*, with some minor livestock activities. The presence of the Niger River in Bamako provides more opportunities for diversified cropping systems. Most peri-urban farmers along the river plain cultivate a variety of vegetables and fruit in addition to the staple crops of millet, sorghum, rice and peanuts (often in inter-cropped systems). The mixture of crops varies with location and farmer characteristics. Twelve farms, covering 9.7 hectares, were surveyed intensively in this area as part of a larger survey that also included urban farmers. These peri-urban farmers devoted almost three-quarters of their land to maize. Strawberries and garden peas each accounted, on average, for another 5 per cent and a range of other vegetable crops, including tomatoes, onions and okra, for the remainder. But strawberries earned 35 per cent of the total average cash flow of approximately FCFA 460,000 (Euros 700) per hectare, whilst maize essentially broke even, indicating the economic importance of diversification for farmers.

Land used for agricultural purposes is at great risk of giving way to residential settlements, and some of the farmers in the peri-urban fringe are often relatively recent arrivals. In Kamboinsé, local subsistence farmers have been joined by a few city residents whose harvest is also destined primarily for their own household use. Aside from local residents holding customary rights to land use, many farmers in the upstream river plain west of Bamako are retired workers, often former civil servants, who purchased land concessions as their own form of pension. Among both types of farmers, staple crops are grown primarily for own consumption, whilst the majority of vegetable and fruit crops are sold commercially.

IV. CURRENT USE OF SOLID WASTE IN PERI-URBAN AGRICULTURE

AS SOLID HOUSEHOLD waste contains a significant percentage of organic material, it has not gone unnoticed by farmers. Farmers in Kamboinsé and other surrounding areas of Ouagadougou regularly make informal, and illicit, arrangements with drivers of the municipal waste lorries to have solid waste dumped near their fields.[3] A similar practice takes place in Bamako, although the DSUVA (Direction des Services Urbains de Voirie et d'Assainissement), the city department responsible for waste management, does not currently attempt to restrict it. In Ouagadougou, drivers are officially at risk of being fined, although it is not clear to what extent this is enforced.

Farmers sort out the larger inorganic objects and spread the remainder over their fields before the onset of the rainy season. Residents of the area indicated that cultivation in some fields had almost ceased some years

3. This is also said to occur with liquid waste, in particular the specialized "vacuum" lorries that evacuate latrine contents, as this is an even more valuable source of nutrients and organic matter. Although none of the farmers surveyed in Kamboinsé admitted to this practice, it has been studied somewhat in Bamako. See, for example, Visker, Cinty (1999), *La gestion des excréments humains à Bamako et à Niono, Mali: une utilisation comme fertilisant dans l'agriculture*, Royal Tropical Institute (KIT), Amsterdam, 29 pages plus annexes.

ago and that access to urban solid waste has since revived cultivation. Solid waste provides a source of nutrients and organic matter. The nutrient content has been estimated on average at 0.29 per cent for nitrogen and 0.16 per cent for phosphorus. Farmers indicated that they most valued the organic matter content, averaging about 11 per cent. As it is highly biodegradable and immediately available to micro-organisms in the soil, this type of relatively unstable organic matter can be useful in the restoration of soil fertility in highly degraded soils.[4]

The extent and frequency of applying urban waste is difficult to estimate given its illicit nature (see discussion below on policy). In a survey of 13 farmers in Kamboinsé, three indicated that they had made use of urban solid waste in 2000. These farmers "purchased" on average about 18 tonnes of waste per hectare, although how much of this ended up on fields versus being sorted is not known. In the peri-urban zone of Bamako, farmers practising mixed cereal and horticultural crop farming prefer to use the solid waste primarily on their staple crops. The form and manner in which waste is applied is also more appropriate for cereal crops than for the relatively intensive cultivation methods used for vegetables and strawberries, particularly with respect to soil management. In this sense, urban waste is a second-choice product as a soil improver/fertilizer for horticulturists. But given the relative scarcity of the preferred animal manure, there remains a demand from this group of farmers.

As the waste is only semi-decomposed when it is applied to the fields, questions are often raised about the associated risks to both farmers and consumer food safety. Partially decomposed waste may present risks of pathogenic contamination. Samples from waste were taken and analyzed for the presence of salmonella, *E. coli* and *B. cereus*. Salmonella was present in only one sample and levels for *E. coli* fell within European norms for compost.[5] Modest presence of *B. cereus* was probably related to the relatively low amounts of animal and human excreta in the waste. But these pathogens are not taken up by the cereal crops and it appears that they are eliminated after extended exposure to the sun, once spread across the fields. This may well present a risk for farmers handling and spreading the waste, although this could probably be limited with the use of simple protection measures. These pathogens would carry a greater chance of passing into the food chain if waste were applied to horticultural crops, although casual observation indicates that more serious risks of pathogenic contamination are probably associated with the quality of irrigation water and post-harvest handling.

There are risks, however, in the form of inorganic contamination. The lack of thorough sorting of the solid waste means that fields become strewn with smaller pieces of inorganic material, particularly fragments of plastic bags but also glass and other small metallic objects, including batteries, a potential source of heavy metals. Analyses of waste samples showed levels of some metals, such as lead and cadmium, which moderately exceeded World Bank norms for compost. The levels were not high enough to warrant alarm, and soil samples showed little evidence of heavy metal accumulation. Nonetheless their presence indicates the potential for long-term contamination of either the soil or the local water table. Together with the accumulation of inert objects in farmers' fields, these are good grounds to promote a better sorting of waste before it is applied, so that only the organic fraction finds it way into the soil (Figure 1).

Current practices indicate that farmers are willing to pay for unsorted urban solid waste. At present, farmers in Kamboinsé pay approximately

4. Final APUGEDU project partner report for the Centro Edafologia y Biologíca Aplicada del Seguro (CSIC-CEBAS), Spain.

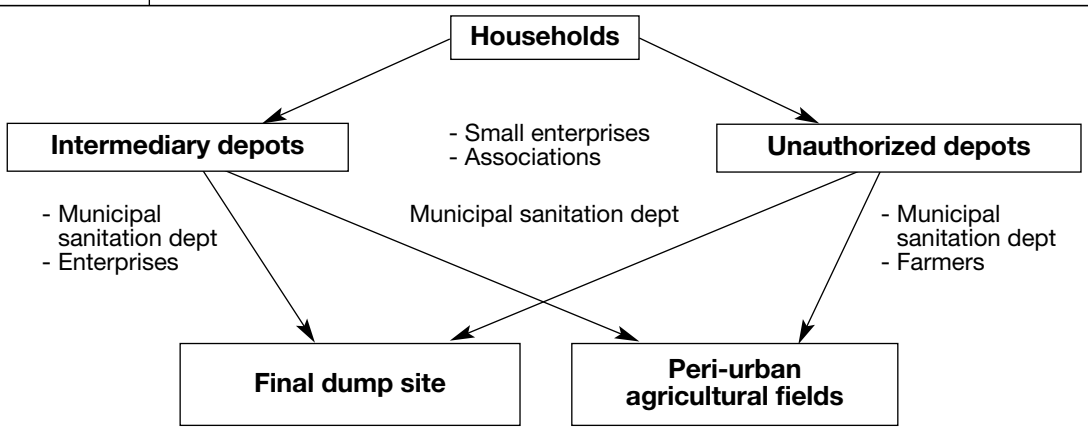
5. Analysis for pathogens and heavy metals was undertaken by the State Institute for Quality Control of Agricultural Products (RIKILT) of the Netherlands.

Figure 1: Sorghum fields in Kamboinsé, Ouagadougou where urban solid waste has been applied

FCFA 400 (Euros 0.60) per tonne. In Bamako, some urban horticulturists are paying FCFA 1,900 (Euros 2.90) per tonne for *sorted* solid waste. Peri-urban farmers would probably also pay somewhat more for a sorted product, although maybe not as much as intensive horticultural farmers, who are more commercially oriented.

Figure 2 illustrates the current flow of solid organic waste from households to either official or unauthorized intermediary depots by small enterprises or local associations. Some of this waste finds its way into farmers' fields as a result of illicit arrangements between farmers and the municipalities' lorry drivers.

Figure 2: Current situation in the management of solid household waste



V. LOCAL INITIATIVES TO IMPROVE WASTE MANAGEMENT AND RECYCLING

IN MALI, MUNICIPALITIES have become responsible for waste management and all now have waste management plans, often developed with support from donors, but most have not started implementation. For many decision makers, urban waste management, let alone the promotion of recycling, does not seem to be an urgent priority.

However, in two of Bamako's six communes, the political will does exist to tackle the problem of waste management in order to improve the local health situation. Platforms have been created to bring together the various actors involved in urban waste management, with support from one of the APUGEDU project partners, Cabinet d'Etudes Keita Kala Saba (CEK). These are the Comité de Pilotage des Déchets Urbains en Commune IV (COPIDUC IV) and the Comité sur la Gestion et Valorisation des Déchets Urbains en Commune VI (COGEVAD). Both COPIDUC and COGEVAD bring together the local council, GIEs, community associations of women or youth, local leaders and farmers. The mayor of Commune VI has issued a decree that formalizes the position of COGEVAD. Farmers have joined the waste management working group to help set up sorting and separation procedures that would improve the quality of waste deposited in their villages. Reasons given for promoting recycling are to improve food security and create income-generating activities. These groups have tried to regulate the disposal of waste by lorry drivers (setting prices and improving access), in consultation with the DSUVA, but the implementation was blocked by the drivers who currently pocket the fees paid to them by farmers. This underlines the need to find organizational solutions that offer as little opportunity as possible for some to profit by circumventing the formal arrangements.

Systematic production of compost is done only by a few associations in Ouagadougou, but other forms of transformation are more frequently found. One example is the work of the women's association Wogodogo. For several years, these women have collected waste and produced compost that is mostly sold to hotels for their gardens. These associations have received training and advice from APUGEDU project partner, the Centre Régional pour l'Eau Potable et l'Assainissement (CREPA). Both associations and small-scale firms involved in waste collection and transformation have formed their own umbrella groups, Coordination des Entreprises de Gestion des Déchets (CEGED) and Coordination des Associations pour l'Assainissement et la Valorisation des Déchets (CAVAD), respectively. These groups are also supported by CREPA and are regularly invited to discussions with policy makers.

In Ouagadougou, many associations and enterprises currently involved in waste management are particularly concerned about the possibility for their continued involvement in the sector, given plans for the privatization of waste management and the contracting out to a few large local or international companies. This is of particular concern to relatively small groups such as the Wogodogo women's association. Small-scale entrepreneurs fear that they will either go out of business or be relegated to the role of sub-contractor. Wogodogo, and some of these small-scale enterprises, are now setting up companies and trying to meet the minimal requirements to be eligible for tendering. At the same time, they are lobbying for the exemption of some zones from international tender and to reserve them for experienced local organizations.

VI. POLICY ISSUES

a. Peri-urban agriculture

PERI-URBAN AGRICULTURE in Bamako and Ouagadougou has been relatively neglected by government authorities.[6] The main issue for farmers in both cities is land tenure. Farmers on the outskirts of Bamako and Ouagadougou are threatened with loss of land and, as a result, seem less concerned about the long-term soil quality of their fields. For peri-urban agriculture to develop on a sustainable and safe basis, it is important that farmers are given clear signals from the government concerning land tenure. Increased security would give them more incentive to take a longer-term view with respect to managing the quality of their soil, and this may help promote the use of (sorted) organic waste products.

6. Agriculture is actually forbidden on urban land in Burkina Faso, and a similar regulation exists in Bamako although this may refer only to tall crops. In practice, urban farmers generally experience a situation of benign neglect.

b. Recycling organic waste

A strict application of environmental and health-related legislation would make recycling of urban waste very difficult, since the storage and use of waste within city boundaries is forbidden. The ministries responsible for environmental management are reluctant to soften their position, fearing that farmers' fields will become discharge zones. Waste continues to be viewed in such circles as an environmental and health risk, which in turn is the reason why its use in agriculture should be forbidden. No waste should be deposited on farmers' fields and farmers should be prevented from taking uncomposted waste from depots. The authorities thus insist on applying the law rigorously to prevent pollution and public health risks.

However, general laws are often not implemented due to the lack of corresponding operational decisions or regulations and the shortage of landfills in both cities. In Bamako, officials seem to tolerate lorry drivers negotiating with farmers for the disposal of waste on the latter's fields, as long as there is no landfill available. While the practice is formally forbidden in Ouagadougou, it is difficult for the authorities to control. Farmers are also trying to come to some agreement with the small enterprises involved in waste collection on the creation of depots where the former could go and collect waste.

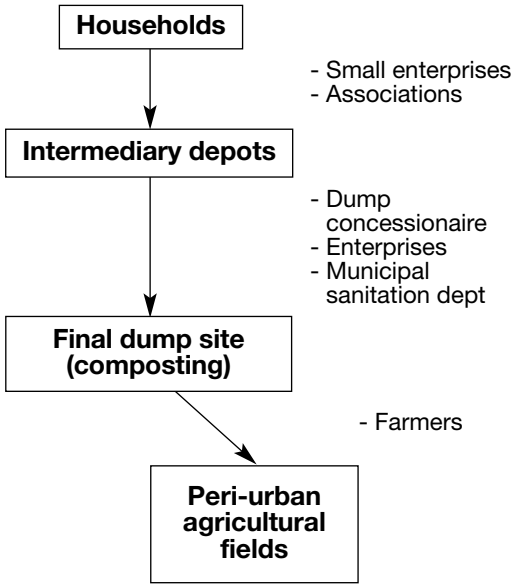
However, some observers argue that the disposal of urban waste on farmers' fields cannot be stopped, given the strong demand. These fringe zones of the cities are used primarily for staple crop production by local households. Many of these have become reliant on a cheap source of organic material in the form of urban solid waste evacuated by municipal trucks. From this perspective, a more effective approach to reducing pollution in the short term would be a selective application of the law: waste can only be applied to fields when dangerous elements have been separated. The main concern is that the waste should not be contaminated with industrial and biochemical waste, plastics, batteries or glass.

c. SGDG – Schéma Directeur de Gestion des Déchets

Changes are taking place in urban waste management policy in Ouagadougou. The most important programme at this time is the new Schéma Directeur de Gestion des Déchets (SDGD, a master plan for waste management) being implemented with World Bank funding, as part of the third Plan de Développement Urbain (PDU, Urban Development Plan).

This plan foresees the creation of a new solid waste treatment centre on the outskirts of Ouagadougou, and the complete privatization of waste collection and delivery to this centre which would operate as a private concession. The municipality would withdraw from direct participation in waste management and occupy itself with regulation and enforcement of standards only. Financial support would be made available for building the infrastructure and in the form of a credit for the companies that win the bid. Implementation has started, with the construction of the landfill and the preparation of tender procedures. Figure 3 illustrates the implications of the SDGD for the flow of organic household waste to the agricultural sector.

Figure 3: Solid household waste management foreseen under SDGD, Ouagadougou



In Bamako, a master plan for waste management was approved many years ago but never implemented. At present, the relevant departments are reviewing it, again with financial support from the World Bank and technical support from a consultancy firm. Stakeholders have been invited to participate in several commissions and give advice but farmers were not included. The basic set-up of the Bamako master plan is similar to the SGDG in Ouagadougou.

The approaches to overhauling urban waste management are based on a centralized system involving large investments in equipment and infrastructure. However, the plans are ambitious in terms of achieving certain levels of service and cleanliness, in particular with regard to estimations of households' capacity to pay. Furthermore, little attention is paid to existing organizational structures or the small waste-collecting firms. Instead, large-scale technology (with respect to, for example, transport vehicles) is selected, whilst the relevant, larger private sector companies who could bid on the relevant contracts are not yet present.

The characterization of current waste management systems in both cities indicates the sustainability problems of such an approach, tried in

the past and now plaguing current management. Such problems may arise in part because the plans were largely drawn up by foreign consultants. Particularly in Burkina Faso, local stakeholders expressed a sense of frustration at the lack of meaningful consultation during the development of the SGDG.

The fact that the resulting approach follows an industrialized-country model became a sensitive issue of discussion in stakeholder workshops with municipal officials, who sometimes expressed the view that what works in Europe or America should also work in Africa.

VII. ECONOMIC ANALYSIS

AN ECONOMIC ANALYSIS of alternative scenarios envisaged in Ouagadougou indicates that the proposed core plan carries a number of risks in terms of its economic viability. Under the SDGD, households are expected to pay a fee for rubbish collection (at least FCFA 1,000 or Euros 1.50 per household per month) that is optimistic in comparison to current amounts and coverage. Furthermore, it is not clear that the municipal government will have either the means or the incentives to enforce the requirement that waste collectors remove all solid waste material to a single depot, as opposed to finding other "alternatives" entailing smaller transport costs. A third weak point is the high price of processed organic waste products to be made available to farmers, partly because of increased distances between source and field. It can therefore be envisaged that revenues for private waste processors awarded exclusive contracts by the municipality will be insufficient to cover costs.

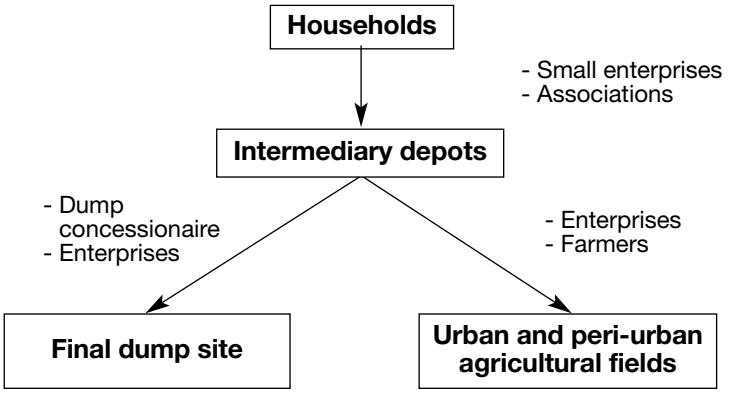
As with the current situation, strong incentives will remain for households, farmers and waste processors to pursue their own courses of action, with associated risks for the environment and food safety.[7] Expectations that the municipal government will become and remain a much more effective enforcer of regulations than it currently is do not seem to reflect institutional reality.

7. Some fear a *déménagement des ordures*, that is, dumping waste in someone else's zone, which then becomes responsible for disposal.

The analysis in both cities illustrates the difficulty of making the link between the two sectors. None of the schemes envisaged can foresee the provision of compost to farmers at a price they can afford. The forecasted price of producing compost – at best estimates at least 10 FCFA/kilogramme – is not at a level that is of interest to intensive urban horticultural producers let alone cereal farmers. One solution might be to reduce the costs of transport. If unsorted waste is brought to an intermediary depot still within a local ward or district, and then sorted, the resulting organic fraction could be delivered to certain urban farming sites instead of the final depot or dumping site (Figure 4). Thus, the costs of transport would increase only marginally and the private enterprises responsible would transport only the non-organic fraction to the final depot, and not the entire amount of waste. A similar type of cost covering already occurs in both cities whenever peri-urban farmers make illicit payments to municipal truck drivers to deliver waste to their fields instead of to the dumping site. In such instances though, the farmers are not paying the full cost of waste delivery; this is paid for by the municipality which owns and operates the trucks.

Developing a more decentralized system of waste management is also constrained by land availability, with space being needed for temporary storage and possibly some composting. In Ouagadougou, no space has

Figure 4: Proposed framework for solid household waste management with separation at intermediary depots



been planned for such an activity in or close to the city centre and, with the frenzy of land speculation that is taking place, it is unlikely that municipalities will make such space available. Access to land for a depot seems less of an issue in Bamako, but such depots are viewed as health risks and a potential nuisance.

In each of the core plans being proposed in both cities, the use of organic material for composting is proposed as an "end-of-the-pipe" solution. The SDGD in Ouagadougou even suggests that the municipality is prepared to subsidize the sale of the compost by the operator of the waste depot to farmers, in anticipation of the mismatch between production costs on the supply side and the willingness of farmers to pay on the demand side. At the very least, it is worth considering the possibility of filling empty lorries returning from the depot to the city with organic waste for delivery (against payment) to farmers' fields along the way.

VIII. CONCLUSION

THE MANAGEMENT OF solid waste in Bamako and Ouagadougou is problematic and requires urgent attention. Analysis indicates that the proposed master plans are flawed and that there is a real risk that the cities and their surroundings will not become cleaner, should the plans fail. Indeed, with the companies that won the bids for the concessions withdrawing from the sector, then the situation may be even worse if the existing network of waste management enterprises and associations were to be forced out by these larger companies.

There are alternative scenarios and their economic logic can be summarized as follows. Effective and safe waste management entails waste being removed from where it is produced and then being processed or disposed of. This process has a certain cost, which appears to have been accepted by the municipalities (on behalf of their citizens). By altering the design somewhat, but without increasing the costs, the organic fraction of this waste can be recycled in agriculture. This provides benefits for farmers and reduces the costs of waste management by decreasing the disposal or burial costs. Equally important, by integrating, with sound economic

logic, recycling into the waste management process, the incentives for unregulated and unsafe use of waste products that currently takes place in both cities will be reduced.

Organizational links need to be strengthened between the waste management and (peri-)urban agricultural sectors but, at present, there are few, if any, formal structures for this cross-sectoral dialogue. Among the possibilities for enhancing these links is the inclusion of recycling of organic waste as a core element in new waste management plans. This may require some formal participation of official agencies (e.g. Ministry of Agriculture) and farmers' associations in the municipal committees reviewing the new core plans for waste management.

The key challenge for policy is to regard urban waste not as a dangerous nuisance but as a source of nutrients for agriculture, provided that a system for separating dangerous wastes is in place. In Ouagadougou, however, there does not appear to be much political space for any alternative scenario other than the SGDG, despite the concerns of some key actors involved relating to its feasibility. The master plan is not yet finalized in Bamako, and local actors there seem convinced that pilot initiatives as undertaken by Communes IV and VI will be integrated in the plan. The experience in Bamako indicates the value of some form of new stakeholder platform that addresses these linkages in a more concrete manner by working at the more local level of the communes rather than that of the entire municipality (district of Bamako). It is at commune level that most existing actors (waste processors, farmers' associations, etc.) are defined. Further progress in this area will be dependent mostly on one or more actors carrying forward such an initiative as the research has also highlighted the institutional rigidities to be overcome.