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DECENTRALISED COMPOSTING: LESSONS LEARNED AND FUTURE POTENTIALS FOR MEETING THE MILLENNIUM DEVELOPMENT GOALS

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ABSTRACT

In order to allow decentralised composting to unfold its full benefits for developing countries, environmental, social and economic aspects need to be considered. Successful composting is only achievable if municipal administrations are open-minded enough to accept new working partnerships and appropriate technologies. The needs of citizens and the market have to be considered and potential sources of income must be developed.

*This paper summarises the research findings of Sandec's research programme on decentralised composting. It presents the strengths and weaknesses and provides indicators for sustainable decentralised composting schemes. Furthermore, it introduces the latest outputs of Sandec's work including the *decomp* database and a users manual on decentralised composting.*

1 Introduction

Composting is an ancient agricultural practice for the reuse of organic wastes and nutrients for crop production. In the course of ongoing urbanisation and changing living conditions, organic waste lost its link to the traditional reuse practices in rural agriculture. Instead, it became a health hazard for cities and an environmental burden due to the lack of appropriate management. Since the 1970s, composting has experienced a renaissance in the field of solid waste management. However, due to technological and managerial mistakes, composting gained a questionable reputation. It was believed that large-scale, highly mechanised solid waste composting plants could solve the waste problem in urban areas. Most of these composting plants turned out to be failures with serious financial consequences (Dulac, 2001). A study carried out in India (UNDP/WB RWSG-SA, 1991), analysed eleven heavily subsidised mechanical municipal compost plants constructed between 1975 and 1985, ranging in refuse handling capacity from 150 to 300 tons per day. The study concluded that in 1991 only three were in operating condition and that these plants were operating at much lower capacities than their design capacities. The study recommended: *"Instead of setting up one single large mechanical compost plant, it will be beneficial to set up several small manual composting plants."*

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Since the 1990s, many small-scale composting initiatives have been initiated by NGOs, or community groups, which often received international assistance. Some of these still exist, but many others have disappeared after a few project years due to managerial mistakes similar to those of centralised plants. Two major problems could be identified.

- Many of the initiatives focused on the treatment of waste and neglected the need for marketing of the product compost. The lack of a sufficient and constant market led to income losses which could not be compensated for by collection fees.
- Often, these initiatives lack a link or cooperation with the municipal solid waste management system. Almost none of the schemes have the official approval from the municipal authority. Once the seed money provided by the funding agency was used up or the initiator withdrew from the project, the management was significantly weakened and the project often terminated operation soon afterwards.

Despite these discouraging experiences, many organisations all over the world are still putting efforts into composting with special focus on decentralised composting. In Europe, where the legal framework promotes resource recovery and recycling, composting has become an interesting income opportunity for farmers, and municipalities are promoting decentralised composting (Commission, 1999). Furthermore, a diverse market for various compost products has been established over the past few years. Both centralised and decentralised schemes are implemented, depending on the needs and possibilities of municipalities. Already Hoornweg (1999) et al. stated that “*the issue of compost marketing is not so much finding a use for the finished compost but rather finding cost-effective applications*” (Hoornweg et al., 1999).

Unfortunately, this trend towards improved municipal organic waste management can hardly be observed in developing countries, where solid waste management still remains one of the major challenges of sustainable urban management. Considering the high organic content of urban domestic waste of up to 70 % (Diaz et al., 1996; Rytz, 2001) composting remains an interesting treatment option.

Sandec has conducted research on composting, analysing the issue from different perspectives in order to bring together all key indicators for successful composting. Figure 1 illustrates the research approach. Apart from a detailed assessment of best (and worst) practices of decentralised composting plants, it is important to understand well the market environment and institutional requirements for decentralised composting.

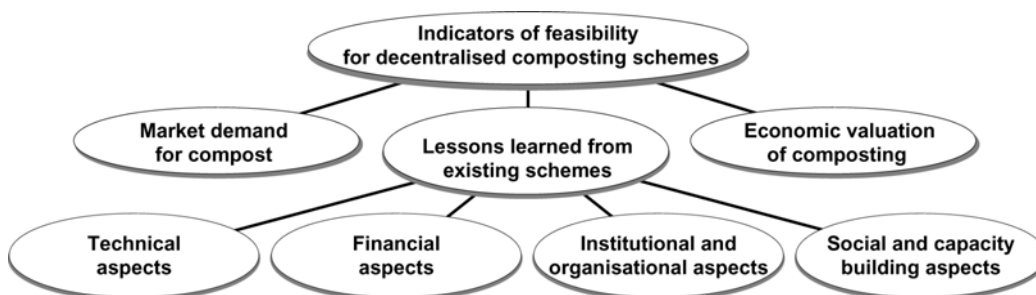


Figure 1: Research approach for determining indicators of feasibility of decentralised composting

Decentralised composting can significantly contribute to achieving several Targets of the Millennium Development Goals (MDGs). Controlled handling of organic waste improves the hygienic conditions within cities, leading to a healthier environment for the inhabitants (Targets 10 and 11). Decentralised composting provides new job opportunities, particularly for marginalised and underprivileged people with low education typically working in the informal sector (Target 1). With the use of compost from organic waste depleted soils benefit from the input of organic matter and nutrients. Furthermore,

compost augments the effectiveness of artificial fertiliser thus contributing to increased crop yields and food security (Target 2). Finally, composting is an integral part of integrated resource management and sustainable development. The treatment and reuse of organic waste returns organic matter into soils which otherwise cause greenhouse gas emissions (methane) in inadequately managed landfills (Target 9).

2 What is decentralised composting?

Decentralised composting schemes exist in various scales and organisational settings. The general features can be highlighted when comparing centralised with decentralised schemes. Centralised schemes are large-scale, highly mechanised composting plants mostly located outside a city, often close to a dump site. The incoming waste is either market waste which has been collected separately or mixed household waste which needs (but often lacks) a separation process prior to composting. Depending on the population size of a city, such plants are designed to process 50 to 600 tons of waste per day (Hoorweg et al., 1999). The handling of large amounts of waste requires mechanical equipment like conveyor belts, turning equipment and rotating drum sieves in order to avoid nuisances such as odour from anaerobically degrading organic waste.

In contrast, decentralised composting schemes are located inside the city, close to the neighbourhoods where waste is generated. The smallest unit of a decentralised composting scheme is backyard composting, where the waste of just one household is treated individually. Community-based decentralised schemes handle waste of one neighbourhood resulting in plant capacities hardly exceeding 10 tons of waste per day. These low amounts of waste still allow manual handling with little mechanical support, keeping investment costs down. Waste is often delivered on a daily basis, ensuring little odour nuisance as anaerobic degradation is prevented.

2.1 Techniques and capacities

In developing countries two composting techniques are popular: windrow composting and box composting. The choice of a composting technology is mainly dependent on space availability, the availability of labourers, and initial funds. Box composting units (Photograph 2) are suitable for limited space and can be placed even along roadsides, whereas windrow composting schemes (Photograph 1) need sufficient space for a proper setup. In any case the schemes should be protected from unauthorised access and public view. Table 1 provides an overview of criteria to facilitate selection of the most appropriate technology.

Table 1: Matrix for selection of the most appropriate technology

Constraining criteria	Windrow composting	Box composting	Explanation
Space is limited		X	Box composting requires less space than windrows.
Long-term availability of land is not ensured	X		Windrow composting requires fewer investments in stationary infrastructure.
Financial constraints for initial investments	X		Windrow composting is less expensive due to lower infrastructural requirements.
Labour is hard to find		X	Box composting requires less manpower than windrow composting.
Working with waste is perceived as “dirty work”		X	Box composting is less work-intensive than windrow composting.



Photograph 1: The composting site of Waste Concern at Mirpur, Dhaka, Bangladesh

The capacity of decentralised schemes broadly varies depending on the number of households served, the land available and the skills of the operators. Table 2 shows a selection of assessed composting schemes in India and Bangladesh. Experience shows that decentralised composting schemes should not exceed a capacity of ten tons/ day, as manual waste handling becomes too exhausting for labourers.

Table 2: Overview of community based initiatives in India and Bangladesh, sorted by the number of households served

Name of Site/ Company	City	Composting Technique	Space available (m ²)	No. of households served	Amount of waste composted (kg/day)
Sandu Lane ALM	Mumbai	Bin-composting	16	120	no records
Diamond Garden Residents Forum (DGRF ALM)	Mumbai	Bin-composting	100	125	60
Scientific Handling of Waste Society (SHOW)	Bangalore	Bin-composting with active aeration	190	180	50
Sindh Colony	Pune	Shallow windrows	150	264	200
Pammal	Chennai	Vermi-composting in bins	300	476	100
CEE Kalyana Nagar Residence Association	Bangalore	Bin-composting	500	980	122
Residents Initiative for a Safe Environment (RISE)	Bangalore	Bin-composting	290	1200	300
Mirpur Composting Site	Dhaka	Windrow composting	800	1300	2000-3000
Green Road Composting Plant	Dhaka	Box Composting	1000	2000	4000

2.2 Organisational set-up

Decentralised composting schemes are managed in various ways. Sandec developed categories which represent the most typical organisational set-ups found in Africa, Asia and Latin America:

- Neighbourhood initiatives and community-based waste collection and composting schemes.
- Initiatives of companies and institutions composting on their premises.
- Medium-scale private sector composting enterprises.
- Public-private partnerships in large scale composting schemes (not discussed in this paper)

In only a few cases are the municipalities themselves the initiators of such schemes. One example is Mumbai's Advanced Locality Management Initiative: ALMs are formed streetwise or within small areas.

Municipal support to these schemes is provided by a frequent exchange of information and communication between ALM representatives and municipal authorities. Solid waste collection is often considered a priority for action. Composting activities usually follow at a later stage. Support involves technical advice as well as organisational assistance. However these support structures are still provisional and unfortunately are not yet institutionalised into the regular municipal functions.



Photograph 2: Composting bins of CEE Kalyana Naga, Bangalore, India

Key common features of community-based schemes are their small scale of operation and the high degree of public participation. They have all been initiated by residents as a response to a crisis in local hygiene and poor waste management, often in areas lacking satisfactory services. Therefore the needs and priorities of the residents have set the framework of the scheme. In all schemes observed, composting was included as an activity to reduce waste amounts for further transport, a problem often persisting due to the unreliable secondary collection service of the municipal authorities.

House-to-house collection is the core activity of many initiatives for which residents can be motivated to pay additional fees. It is this financial contribution of the residents which usually guarantees the financial viability of the whole scheme, including the composting activities, rather than income from compost sales. As most of these schemes are not officially acknowledged by municipal authorities, the payment of fees is voluntary and initiators must invest a lot of effort to convince people to pay. Many households are not willing to pay fees in addition to the taxes they already pay, and which they consider should cover the provision of a proper municipal solid waste management service. This unofficial status as well as the lack of cooperation with the municipal waste management department forced many decentralised schemes to stop operation.

3 Potentials of decentralised composting

Decentralised composting is often considered to be non-viable as a singular activity, ignoring the enormous positive contribution to the city's solid waste management system as a whole. It furthermore contributes to achieving many targets set by the MDGs on the local level as well as national and global levels.

3.1 Local Potentials

Municipalities have the overall responsibility for solid waste management in their cities; hence they are one of the key stakeholders in the promotion of decentralised composting. Many municipalities are currently unable to fulfil their duties in ensuring environmentally sound and sustainable ways of dealing with waste generation, collection, transport, treatment and disposal, but this does not mean that their involvement should be excluded from non-governmental local initiatives. Both the municipal authorities and private initiatives can profit from a formal collaboration.

- Decentralised composting often goes along with primary collection services which improve the overall performance of the municipal service; consequently, it significantly improves the hygienic conditions within the service area thus contributing to Targets 10 and 11 of the MDGs.
- Decentralised composting diverts the major fraction from the municipal waste stream close to the source of generation thus significantly reducing transportation costs and prolonging the life span of landfills. Additionally, it enhances recycling activities and final disposal.
- Small-scale composting schemes can easily be initiated without need for large investments. Instead of setting up one capital intensive centralised plant, decentralised plants can sequentially be set up over several years thus distributing capital requirements over time. This facilitates a stepwise approach towards integrated solid waste management. Given their smaller size and location, they are more flexible in management and operation and can better adapt to changes in the neighbourhoods (e.g. variable waste generation, increased population);
- Composting schemes provide employment in the neighbourhood/community as labour-intensive technology, adapted to the local socio-economic situation is applied. Composting offers new and safer income opportunities particularly for poor and underprivileged people typically working in the informal sector. (MDG Target 1)
- Finally, decentralised composting activities and the interaction between residents in issues of waste handling, hygiene, cleanliness and environment can significantly enhance environmental awareness in a community.

Consequently, prerequisites for the introduction of decentralised composting are not extensive funds for implementation but rather necessary changes in the solid waste management policy and strategy of the responsible authorities. Municipal authorities have the overall responsibility for efficient and environmentally sound solid waste management. This does not mean that they themselves need to undertake all the work involved in solid waste collection, treatment, transport and disposal. The design and strengthening of partnerships with NGOs or the private sector are main factors for success. Municipalities need to consider existing non-governmental or private organisations as collaborators, rather than rejecting them as competitors. Decentralised approaches in particular require municipal authorities to concentrate on the regulation and monitoring of such schemes. For instance, the municipality can encourage citizens and companies to initiate decentralised composting by establishing and staffing a resource centre that offers advice and support. In the framework of a municipal composting programme, formal partnerships can be established in which the role of all stakeholders is clearly defined. Municipalities can additionally promote the use of compost through buy-back programmes and by establishing links to fertiliser companies.

3.2 National and global potentials

From the national perspective, decentralised composting certainly produces a valuable soil amendment for agriculture and a product for various other purposes (Enayetullah et al., 2005) and (Tyler, 1996). Despite significant increases in crop production, the green revolution has caused negative side effects through excessive use of artificial fertilisers, causing depletion of top soils and ground water pollution. For instance, in the year 2000, the consumption of nutrients in India amounted to approximately 11 million tonnes of nitrogen, 4.5 million tonnes of phosphate (P₂O₅) and 1.5 million tonnes of Potash (K₂O). Nevertheless, TERI reports that, in several regions, studies indicate that crops remove more nutrients than are added, which makes the soil progressively poorer and in need not only for nutrients but also for organic matter (TERI, 2002). Furthermore, long-term fertilizer experiments in India have clearly demonstrated that, in addition to fertilizers, the use of organic manure is essential for sustaining crop productivity.

The high organic matter content in compost can help to re-establish the natural soil structure, leading to improved crop production when supported by the careful use of artificial fertilisers. Urban agriculture

plays an exceptional role in the provision of fresh food for urban centres and carries a great market potential for compost. Target 9 of the MDGs stipulates the integration of sustainability in country policies and the reversal of the loss of environmental resources. Target 2 demands a halving of the proportion of people who suffer from hunger. The reuse of organic waste in agriculture is not the complete solution but it can certainly contribute to reaching both targets in a sustainable way.

3.3 The clean development mechanism - a new driving force for composting?

Composting receives increasing attention also in the global context. Indicator 28 under Target 9 addresses the carbon dioxide (CO₂) emissions per capita. One measure for reducing greenhouse gas emissions at lowest cost and in a sustainable way in developing countries is the clean development mechanism (CDM), an initiative of the United Nation (UN). The CDM derives from the Kyoto Protocol which entered into force in spring 2005. Within the CDM, industries and governments in developed countries can finance greenhouse gas abating measures in developing countries in order to extend their activities in their own country. A global exchange of CO₂ certificates ensures that new greenhouse gas abating investments are made at the right place in a CO₂ neutral way.

Composting falls under the category of greenhouse gas avoiding measures. Organic waste, which is composted under aerobic conditions, produces less greenhouse effect (in terms of CO₂ equivalents) than organic waste incorporated in landfills. As landfills are typically anaerobic, the waste generates methane which has a 21-fold stronger impact on global warming than CO₂. In October 2005, the Dutch company World Wide Recycling together with the NGO Waste Concern succeeded in registering composting as greenhouse gas abating measure under the *United Nations Framework Convention on Climate Change* (UNFCCC)³. (World Wide Recycling and Waste Concern, 2005). This pioneering effort opens up opportunities for new financing options for composting schemes in many developing countries which have ratified the Kyoto Protocol. Composting schemes can now count on significant revenues from selling CO₂ certificates additionally to the revenues from compost sales.⁴ Those revenues can support the start-up phase, particularly to develop and establish the still weak market and distribution networks for compost products in a country.

However, the title of the UNFCCC methodology “*Avoided emissions from organic waste composting at landfill sites*” (UNFCCC, 2005) suggests that it is promoting large scale centralised composting plants like those constructed in the 1970s. Failures of the past are likely to be repeated. Being blinded by the new financing options there is the danger that investors forget the prevalent institutional problems in relation to solid waste management. Considering the potentials of decentralised composting, additional efforts are necessary for also enabling the submission of decentralised composting schemes as CDM projects under UNFCCC. Of course, it will not be feasible to register single small-scale composting plants, but it should be possible for a project developer or municipality to bundle several decentralised schemes into one project for CDM approval. Such decentralised schemes would ensure that composting is implemented with appropriate technologies, secured funding and community involvement, resulting in a cleaner urban environment and reduced financial burden for municipalities. However, it requires a broad strategy involving all stakeholders from urban planning and solid waste management.

4. Sharing knowledge - building alliances

The process know-how and management experience of decentralised composting schemes is often specific to the particular case, but comparison shows that the schemes face similar technical and

³ www.unfccc.int

⁴ For further information see Lüthi, Christian (2005): *The Clean Development Mechanism - An Opportunity to finance decentralised sanitation?*, Diploma Thesis, ETH Zürich

organisational challenges. Most decentralised schemes struggle with either their informal status or a lack of marketing channels for their product. In fact, initiators and operators have few opportunities of sharing these experiences among themselves. As almost none of the composting initiatives are embedded into larger municipal or national programmes, even operators of composting schemes in the same city do not know about each other. Since 2000 Sandec and its research partners have been assessing various decentralised composting sites in Asia, Africa and Latin America. During workshops and stakeholder meetings organised by Sandec, participants frequently expressed their need for an improved national and international exchange of experiences. Workshops are appreciated but are seldom accessible for small initiatives. Addressing this demand, Sandec developed a database of decentralised composting schemes. The **decomp database** was launched in autumn 2005 and contains data on a collection of small-scale and medium-scale composting sites all over the world, but concentrating on schemes in developing countries. It aims at the exchange of information and the strengthening of a global composting network. The **decomp database** contains key information on different composting schemes and their characteristic features further illustrated by pictures or detailed reports, which can be attached to the file (Table 3).

Table 3: Screenshot of the entry form of the decomp database. Information is entered freely or by using provided categories.

Information Required for the decomp database	
Name and address of organisation	Does the composting scheme include waste collection service?
Contact person, e-mail	Type of input material (for composting)
Region	Input capacity of composting scheme
Country	Type of technology
Organisational setup	Output compost
First year of operation	Compost products and price
Initial investment costs	Typical customers
Number of employees	Further information (attachments, pictures, link to web sites)

Furthermore, it provides addresses of local initiators and experts who are willing to share their experiences and give additional hands-on information. The database shall foster the bilateral exchange between composting schemes. However, the **decomp database** is only as comprehensive as its entries. Its relevance increases with each contribution of initiators and operators. The **decomp database** is accessible by internet and free of charge. Stakeholders and experts are invited to add information on composting schemes which are not yet in the database. It is planned to update the information on an annual basis to maintain its relevance for the sector. (<http://sandec.instanthost.ch>)

In addition to the **decomp database**, Sandec and the NGO Waste Concern have accumulated their experience on decentralised composting on neighbourhood level in a handbook for practitioners. The book *Decentralised Composting for Cities of Low- and Middle-Income Countries - A Users Manual* leads the reader step-by-step through the planning and implementing stages and operational processes of a decentralised composting scheme. It aims at contributing to the dissemination of knowledge in the field of composting and more sustainable composting schemes. The book will be published as hardcopy in February 2006 and will also be available as download in March 2006. (at www.sandec.ch)

5 Conclusions

Municipal authorities are at the centre of urban waste management as they are ultimately responsible for designing and implementing solid waste management strategies.

- It is crucial to establish formalised partnerships with the private sector and citizens in order to improve the overall solid waste management services leading to better health conditions in urban areas.
- Although centralised composting plants have a very bad track record, decentralised composting can play an important role in this process. This requires a shift of mindset of municipal administrations towards promotion of appropriate technologies.
- For large cities, decentralised small-scale composting in combination with medium-scale centralised composting schemes seems to be an ideal organic waste management strategy. For small towns it may even suffice to rely solely on decentralised composting schemes.
- Whatever strategy is applied, the success is constrained by the scope of municipal support for decentralised approaches and national regulations promoting resource management.
- Decentralised composting can assist in attaining a number of MDGs which are relevant for the improvement of urban living conditions, national food security and global environmental sustainability.
- The recently launched **decomp database** and the **Users Manual on Decentralised Composting** are two initiatives for strengthening the composting community of practice. Both products promote composting as one measure to improve urban environmental health and to meet the MDGs.

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