Easy to operate 'Suame' compost tumbler

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In Kumasi, Ghana, pollution and waste disposal problems are most acute in the periurban areas, where waste management services are seldom provided. These transitional areas are characterized by squalid and hazardous waste.

Container Composting in Periurban Kumasi, Ghana

Daily domestic waste consists mainly of vegetable and fruit peelings (cassava, yam, coco yam and plantain) and wood ash, with only small quantities of sand and plastic bags. Composting domestic waste for use in urban agriculture is one strategy which can be adopted at the household level.

CONTAINER COMPOSTING

When left long enough, all organic matter decomposes due to breakdown by bacteria and other living organisms. Composting is a method of controlling this process by accelerating the decomposition rate while also minimising the nutrient loss. Backyard composting in residential areas requires suitable composting containers to stop disease vectors and vermin from being attracted to the compost pile, thereby ensuring that the composting process remains safe, hygienic, acceptable to local residents and conforms to district and municipal sanitation by-laws. Compost containers can be used to obtain the optimal decomposition conditions by regulating the air, humidity and temperature during the composting process. With appropriate handling the decomposition rate can be greatly accelerated; good practices include the cutting up and shredding of the organic matter, sprinkling water on the pile if it becomes too dry (dusty with ants), mixing the pile to increase aeration and keeping the container closed during heavy rains to prevent (the pile from) water logging.

For effective decomposition, it is equally important to supply the microorganisms within the compost pile with the optimal carbon/nitrogen ratio of 25-30:1 (C/N ratio). To obtain a suitable C/N ratio, materials with a high C/N ratio such as sawdust (C/N ratio up to 400), must be mixed with materials with a low C/N such as chicken manure (C/N ratio of 7). If the C/N ratio is incorrect and there is too little nitrogen, decomposition will be slow and the compost of low quality; and conversely if there is too much nitrogen the compost will become putrid, acidic and compact and the quality will deteriorate (Agromisa, 1999). Turning the pile and adding dry porous materials (carbon rich), such as leaves, sawdust, or straw, can easily rectify this problem.

COMPOSTING DEMONSTRATIONS

During a participatory action research (PAR) project into community based waste management strategies, several container-composting micro-projects were implemented at the household level in six periurban areas of Kumasi (1). The micro-projects have been strategically distributed at prominent points throughout each of the six areas to provide simple demonstrations that can be easily replicated by other community members. By increasing the number and distribution of micro-projects in each village and by conducting composting workshops, the dissemination capacity is increased and a wider community audience can be reached. However, interventions must be well planned due to the time required for compost production, hence local people must be actively participating in all stages of the planning and implementation process.

The main container-composting method being demonstrated was **block-built compost bins** (bricks may also be used). This method was chosen because of the wide availability of clay, wooden and concrete building blocks in the localities. The bins consist of a double-chamber with wooden lids that cover each chamber. Mortar can be used when a permanent structure is required. Otherwise the blocks can be left without, for temporary use or portability (the blocks on the front of the bins are better left unmortared to provide easy access when removing the compost.). Gaps are provided between the bricks in the bottom course to facilitate airflow, while making holes with a sharp stick and mixing the compost pile provides additional aeration. The chambers are filled sequentially and once the second chamber is full, the compost in the first chamber can be emptied and the mature compost stored until ready for use. Each compost bin is sufficient for a household with an extended family. Larger versions consisting of three high-capacity chambers were also demonstrated.

Unlike the brick-built compost bins the '**Suame compost tumbler**' has a smaller capacity and is therefore only suitable for smaller households (2). It is designed to accelerate organic decomposition while ensuring hygienic conditions are maintained; specific design features were included to ensure suitability for local conditions and ease of use by children. The tumbler consists of a 250litre drum mounted horizontally onto a steel axis that is supported by a frame made from 50mm angle iron. The opening is made by cutting out a section in the side of the barrel, which is then reattached with hinges and a hasp to provide a means of closing the barrel when tumbling the waste inside. With the barrel in the upright position (door opening uppermost) two rows of six holes (4mm diameter) are added

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underneath the barrel to allow drainage and 11 holes (4mm diameter) are added at each end of the horizontal drum to allow additional aeration.

Other container composting methods that were demonstrated included **barrel composting** and **vermicomposting** (use of earthworms), both of which were constructed using recycled materials found within the localities. Old 250litre drums can be used as composting containers simply by making aeration holes around the drum and providing a cover on top. If the base of the barrel is still intact then drainage holes need to be made in the base; any draining runoff that is collected (stand drum on some bricks and place small container under drainage holes) can be diluted 1:10 and used on crops as a liquid fertilizer. If the drum has no base it can be placed directly on the underlying soil. Similarly, old 250litre drums or plastic drums can be used to build simple vermin-composting units. First aeration holes are made around the drum before locating the drum in a shaded area, place stones in the bottom up to a depth of 10cm for drainage, cover the stones with a perforated wooden board or nylon sacking with slits (which stops the worms escaping while still allowing drainage), add mature compost to a depth of 10cm for the worm bed and then add local varieties of red worms (e.g. *Lumbricus rubellus*) and brandling worms (e.g. *Eisenia foetida*). Then add a few handfuls of organic waste to start the process, being careful not to overload the container, as until the worm population has increased they will only cope with small amounts of waste. Keep the compost covered with several layers of damp newspaper or plantain and/or banana leaves sprinkled with water to prevent the compost from drying out. Once the container is full, carefully remove the top 10cm of compost for use as the next worm bed as it contains most of the worms. The remainder of the compost in the drum can then be emptied and is ready for use and the cycle can be started again.

PERFORMANCE AND PROBLEMS

After construction of a compost bin or allocation of a tumbler, the respective household members received training in waste separation and composting techniques. In addition, information leaflets in both English and the local Twi language were distributed, which provided clear instructions in environmental sanitation, household waste separation and container composting. The demonstrations were monitored over several weeks during which further training and technical assistance was provided, particularly if any problems had arose.

All the containers proved to be effective for decomposing organic waste, particularly when good composting practices were followed (shredding of organic materials and frequent aeration). Problems that have occurred have resulted when containers are filled rapidly and the waste inside compacts and then putrefies. Removing the top layers and increasing aeration of the remaining compost pile has remedied this. Teething problems were also encountered with the compost tumbler due to insufficient aeration holes, which was easily rectified by making the additional 11 holes (4mm diameter) at each end of the horizontal drum.

In economic terms the most cost-effective have been the containers that were constructed from recycled materials and hence required no financial inputs. These included the barrel composting and vermin-compost containers and unmortared block-built compost bins constructed from recycled blocks. Whereas the average construction cost of each double chamber block-built compost bin was approx. EUR 13, the construction cost of each compost tumblers was approx. EUR 58. Despite the compost tumbler being highly effective in decomposing small quantities of organic waste, the construction cost exceeds the purchasing power of many periurban farmers and therefore could only be viable if financial assistance was provided. Conversely, the wide availability of building blocks (both modern and traditional sun baked) increase the viability of block-built compost bins, particularly the larger triple chamber container as the cost can be divided by several households.

POLICY IMPLICATIONS

Separating and composting domestic waste at the household level can lead to substantial decreases in waste outputs and thus contribute to a cleaner environment, particularly in periurban areas that are plagued by open waste dumps. Furthermore, composting and reusing domestic organic waste is a means of recycling nutrients and restoring soil fertility, contributing to soil structure and humus, increasing organic matter and improving the water holding capacity of soils. However, the implementation of backyard composting programmes requires substantial educational and training inputs, with the beneficiaries participating in all stages of the planning and implementation process. Successful implementation can be enhanced through providing demonstrations and information leaflets and by conducting composting workshops. Financial assistance may also be required to purchase any required materials to build compost containers.

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Block-built triple chamber compost bin being used at Apeadu Junior Secondary School, Kumasi

REFERENCES

- Agromisa. 1999. Preparation and use of compost: Agrodok-series No. 8. Agromisa Foundation and the Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, the Netherlands.
- Caincross, S. and Feachem, R. 1993. Environmental Health Engineering in the Tropics: An Introductory Text. Second Edition. John Wiley & Sons, Chichester, UK.
- GFA-Umwelt. 1999. Utilisation of Organic Waste in (Peri-) Urban Centres. GFA Infrastruktur und Umweltschutz GmbH, Bonn (GFA Umwelt), Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (GTZ), Eschborn and Ingenieurgemeinschaft Witzenhausen Fricke & Turk GmbH (IGW), Witzenhausen, Germany.

Notes

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