

The Practice of Local Composting through the Circular Bioeconomy of Biowaste: Finalized in Market Gardening: Case of the Commune of Ngor/Senegal

Mbengue Ramatoulaye

Department of Geography, Faculty of Arts and Humanities, Cheikh Anta DIOP University of Dakar, Dakar 5005 Dakar Fann, Senegal

Abstract: Taking into account personal or collective ownership of food security, can the reuse of organic waste be a waste management solution? The use of organic matter in market gardening. Bio-waste refers to organic waste produced by human and animal activities. It accounts for approximately 30% of household waste in my research. Biowaste can be recycled through composting or methanization. Organic recycling should be of interest to many people, and each of them should have reasons to use the organic waste produced. The objective of this article is to highlight biowaste recycling through composting in the municipality of Ngor. The method adopted is essentially based on a combination of techniques for collecting data in the field. This is known as the empirical method. Following an assessment of the situation in the field, we drew up maintenance guides and developed a questionnaire. The starting point for this contribution is the assumption that the recovery of organic waste helps to reduce the amount of waste going into household bins and that public action should focus on raising awareness among the local population. This contribution focuses on three main areas: firstly, sorting household waste (food waste) at source; secondly, methods of composting this waste and the use of compost for small-scale market gardening will be analyzed.

Key words: Recovery, organic waste, market gardening, home, Ngor, Senegal.

1. Introduction

Municipal solid waste [1] currently raises significant and pressing issues. It causes problems for both human health and the environment, resulting in various forms of pollution (soil, air, water). Solid waste management is considered a public good [2, 3]. Cleanliness and waste disposal are essential for public health and environmental protection [4]. Thus, waste disposal [5] is one of the essential conditions for respecting hygiene rules, not only inside homes but also in the general environment [6]. Therefore, waste prevention allows for a better reconciliation of socio-economic benefits and environmental protection. Waste is now considered a valuable and inexhaustible resource from which raw materials and energy can be extracted.

Waste recovery allows for the consolidation of

socio-economic benefits and environmental protection. Biodegradable waste is now considered a valuable and inexhaustible resource from which raw materials and even energy are derived. Therefore, stakeholders must invest in supporting the establishment of household waste recovery systems.

Energy recovery is a technique that provides energy in a world obsessed with scarcity, while simultaneously disposing of what we least want: our waste. This technology becomes almost miraculous when we realize its potential benefits in combating climate change. The lack of specialized and targeted studies addressing this issue from a scientific perspective in Algeria has reinforced this approach. The objective of this article is to demonstrate that the recovery of solid household waste can be a solution for managing urban household waste. This article analyzes three main points: firstly,

Corresponding author: Mbengue Ramatoulaye, lecturer and researcher, research field: urban geography, environment, and waste, geomatics, GIS, and remote sensing.

the sorting of household waste (food waste) at the source; secondly, composting methods for this waste; and thirdly, the use of compost for small-scale market gardening.

2. Conceptual Framework or Theoretical Framework

In environmental matters, and more specifically in waste management, it is not simply a matter of using existing management methods, but also of responding to increasingly complex issues through a constantly renewed “reinvention” [7]. Added to this are the limitations of waste disposal policy [8, 9]. This policy remains fundamentally archaic and is characterized by the ineffectiveness of public intervention [10, 11]. Indeed, the operational strategy for waste management is limited solely to collection, transport, and landfilling. To date, this strategy lacks any complementary disposal and treatment structure [12]. Recycling and recovery activities are, *de facto*, carried out by informal actors. This allows Bulkeley et al. [13] to assert that these actors have brought added value to waste management activities.

Modern waste management employs several techniques. Research refers either to recovery or recycling [14], or to sorting or selective collection, or to incineration or landfilling [14-16]. Another work, by Chang et al. [17], places great emphasis on the impact of pre-sorting on incineration plants. Specific issues are analyzed: heat balance, ash properties, and combustion gas quality in the incineration process. The studies by Baboy Longanza et al. [18] support this view. Indeed, this author, pursuing the objective of reducing liquid and gaseous emissions in storage facilities, proposes the thermal or biological process of organic matter mineralization as a solution.

However, the use of these technologies requires consideration of environmental safety [19], as many authors have noted: new technologies and various treatment methods (sorting, incineration, storage and landfilling of waste, composting, recycling, etc.), which

until now went “unnoticed” [20] or were considered beneficial, can lead to unexpected disasters [21]. Furthermore, Baboy Longanza et al. [18] highlight the environmental damage caused by the emission of significant quantities of pollutants into the atmosphere.

The constraints to the environmentally sound management of waste, whether hazardous or not, are numerous. The most significant constraint is undoubtedly the limited financial resources available to establish intermediate or final waste treatment infrastructure. The recovery of urban solid waste is a crucial step. Experts have proposed this option to ensure efficient waste management. Indeed, Tchaou [22] suggests that waste management should be considered a profitable activity, generating income and creating jobs, and integrated into the economic context of African cities. To achieve this, waste should no longer be viewed as a nuisance, but as a resource. The author gives waste an economic connotation, perceiving it as a form of currency that benefits households. Gbedo [23], in his work on local solid waste recovery practices in Cotonou, attempted to identify and describe these practices and their effects on the existing waste management system. According to him, there are two types of solid waste recovery: energy recovery and material recovery. Lawson et al. [24] reinforce Gbedo’s statements in the final report of their activities, “The Support Project for Waste Management in Decentralization”, for the NGO Bethesda. They inventory the various recovery techniques implemented in Benin, where material recovery is the most widely used. These include recycling, composting, and reuse. Material recovery exists in Senegal and is generally used in market gardening. This process reduces the amount of organic waste sent to landfills. The seminar on organic waste recovery thus provided an opportunity to visit several market gardeners during their composting operations.

Some authors propose anticipating the valorization process at the end of waste management by assigning a market value to waste from the moment it is produced.

Recyclable waste is sold by households to collection companies for a flat fee, and these companies then resell it to recycling companies [25, 26]. Similar practices exist in the area studied, where we observed that many artisans use scrap metal and old clothing for production, and that artists use discarded objects to create their artwork.

According to these authors, households should be encouraged to sort their waste themselves in this way; the waste eliminated and the transport costs to the landfill are reduced; the LES (Sanitary Landfill Site) thus has a longer lifespan.

In summary, it appears that numerous relevant solutions have been developed to improve the management of household solid waste. However, it is clear that most of the work and studies carried out have proposed general solutions that would benefit from being rethought spatially and temporally, taking into account the specific characteristics of each city and the needs and constraints of its population. Furthermore, apart from the specific planning studies conducted by the Dessau firm, there are no waste management planning documents that can serve as a framework for better organizing urban waste management in a city like Cotonou. This study will therefore focus on ways to reduce the proliferation of household solid waste by developing an appropriate pre-collection planning framework.

3. Tools and Methods or Methodological Framework

The method adopted is essentially based on a combination of techniques for collecting data in the field. This is the so-called empirical method. It includes qualitative data such as interviews, interview guides, and focus groups. Quantitative data, including a questionnaire, are also used. On-site observation allowed for the production of images through photography. The study is based on lived experience in the field. During our investigations, we met residents who value their biowaste production. This caught our attention and prompted us to develop this scientific

article proposal. This article aims to be an experience that can be replicated by each resident at the municipal level and nationally. Therefore, given the number of municipalities and the number of people practicing biowaste valorization, it is very difficult to speak of sampling. This study is the result of monitoring a resident's municipality who decided to valorize their biowaste. Regarding the methodology for monitoring waste collection, the unit of measurement used was an empty five (5) kilogram bucket. The bucket was used only for biowaste produced solely by the household. Sorting was therefore carried out at this level. Non-biodegradable waste was placed in its bin. The study was conducted in the municipality of Ngor. The municipality of Ngor (Fig. 1), the subject of the study, is located at the western tip of the Cap-Vert Peninsula. It is bordered to the east by the municipalities of Yoff and Ouakam; and to the west, south, and north by the Atlantic Ocean. It covers a total area of 442,082 hectares, including 0.496 hectares for the islet of Ngor, 11.656 hectares for Ngor Island, and 429,930 hectares for the remaining land. It comprises a compact settlement, primarily located within the traditional village, originally encompassing the old quarters of Grand Ngor, Petit Ngor, Khatakhéli, and Ndiogorann, the area known as Ngor. An extension, connected to Petit Ngor, corresponds to a low-lying sandy-clay area that extends to the old Ngadié well and the Ndaré quarter, as well as the residential neighborhoods of Almadies and Ngor Virage, which includes the site of the FESMAN (World Festival of Black Arts) village. However, as part of the land consolidation project for the Almadies and Ndaré sector, the land registry service subdivided this area into 18 zones.

The unique aspect of the Ngor commune in this study lies in its production of biowaste. According to the waste characterization (previous study), biowaste production represents approximately 48% of total waste production. This percentage pertains to the sample taken during the waste characterization carried out in Ngor.

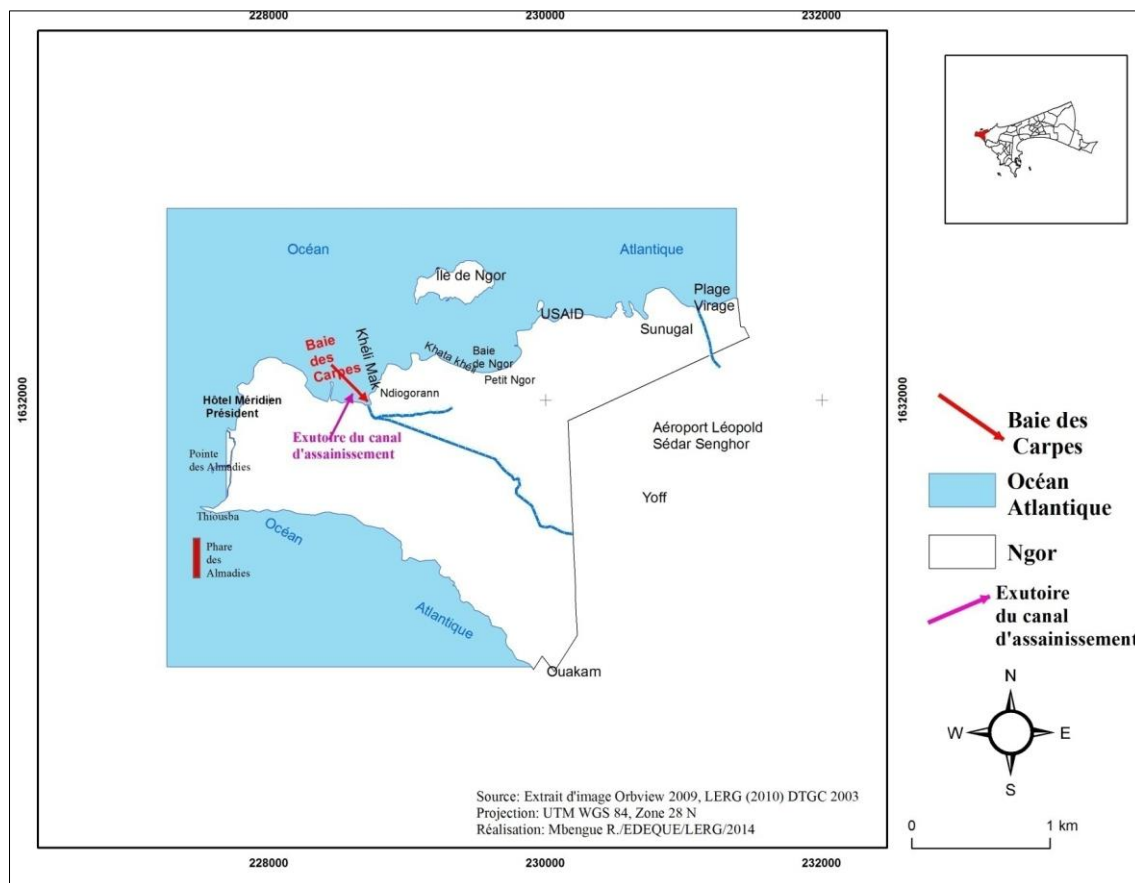


Fig. 1 Location of the study area.

4. Results

4.1 The Production of Biowaste

Biowaste production refers to biodegradable organic waste, such as green waste from food products. Waste categorization allowed us to identify the different types of biowaste produced in the study area. This biowaste can be recovered through energy production and composting. In this study, biowaste is recovered through compost production. Biowaste production is significant in the surveyed neighborhoods of Ngor and varies from one area to another (Ngor village and the residential neighborhoods of Almadies). Household waste production is also significant in the surveyed neighborhoods of Ngor and varies from one area to another (Ngor village and the residential neighborhoods of Almadies). However, in the traditional village, it varies between half a bucket and a 5-kilogram bucket.

Fig. 2 shows the quantity of biowaste produced in the neighborhoods. The quantification of household solid waste was carried out using an empty 5-kilogram bucket as a reference (an empty plastic bucket that had previously contained butter). The amount of biowaste collected differed depending on whether one was in the residential area, where more than half produced a quarter of a bucket, or in the traditional village of Ngor, where the amount varied from half to a full bucket.

4.2 Composition and Classification of Household Solid Waste

The waste stream is a heterogeneous mixture of products and materials whose composition varies according to the source as well as the socio-economic classification of the locality. The results of the field survey reveal several types of solid household waste (Fig. 3). A predominance of fine materials was

**The Practice of Local Composting through the Circular Bioeconomy of Biowaste:
Finalized in Market Gardening: Case of the Commune of Ngor/Senegal**

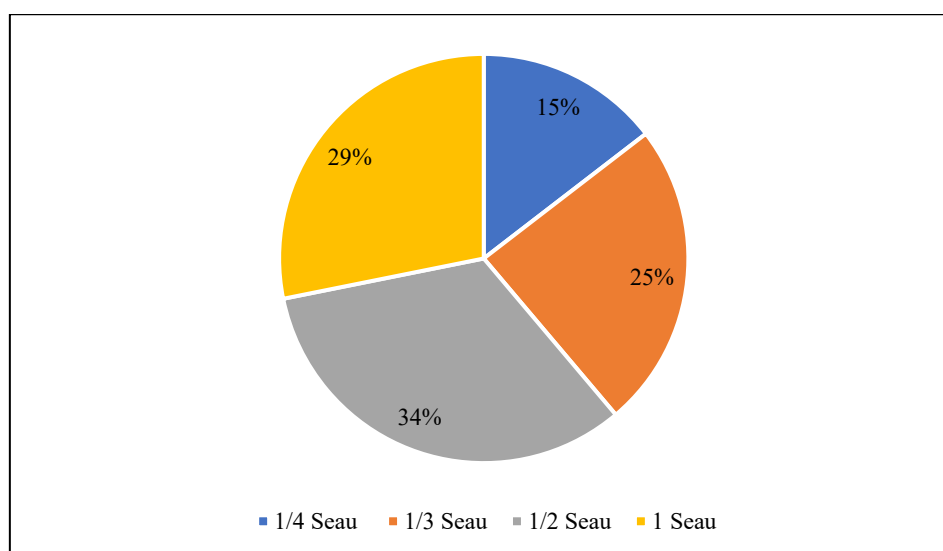


Fig. 2 Estimated waste production in the municipality of Ngor.

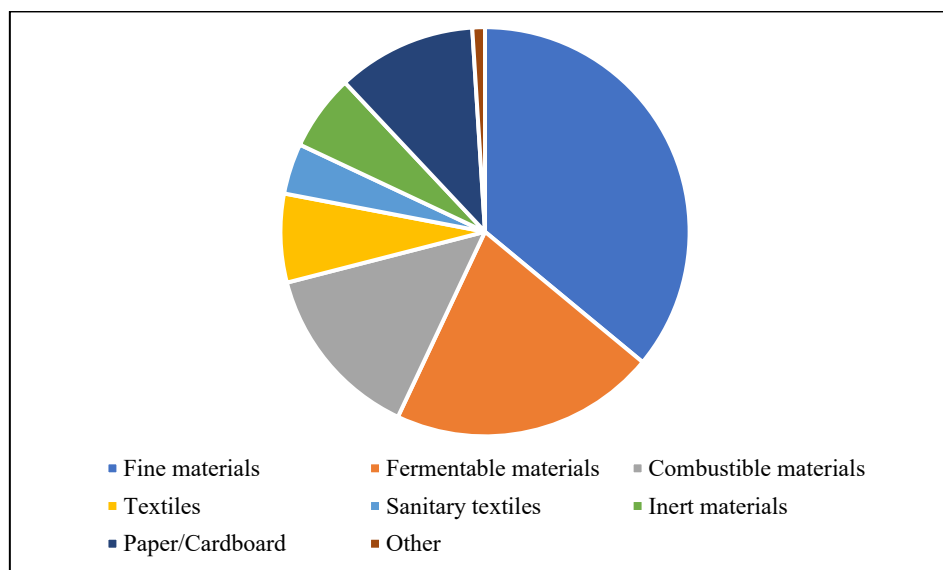


Fig. 3 The composition of waste.

observed in the collected waste, with sand being the most abundant component by weight. The practice of sifting waste before placing it in the bin has been abandoned by households, yet the sand contributes to the increased volume of garbage and causes rapid deterioration of mechanical equipment. According to the waste collectors, fine materials can make up as much as 50% of the collected waste in some neighborhoods, a situation particularly noticeable in Ngor village.

Fig. 3 shows that this composition reflects the consumption patterns of Ngor households, largely

based on fresh produce (fruits and vegetables), combined with the absence of a tradition of consuming canned goods. Plastic is the second most common component of a typical Ngor household garbage bin after organic waste. One consequence of products packaged in bottles relates to liquids: particularly oils, milk, and various beverages (soft drinks, mineral water, and others), and, consequently, plastic bags, the preferred packaging for replacing the traditional basket. However, the composition of waste can vary considerably, both geographically and over time.

4.3 The Potential for Sorting Biowaste

It is the responsibility of each municipality to define strategies for managing urban solid waste to combat unsanitary conditions. These strategies must therefore reduce the amount of waste produced. The municipality must define solutions adapted to its territory for sorting waste at the source, both in general and biowaste in particular. This involves separate collections or local management. However, only a small proportion of the

population in the municipality practices biowaste recovery. The municipality struggles to find facilities dedicated to the collection, storage, and recovery of biowaste. Field surveys conducted in the municipality show that.

Source separation is an effective method that has allowed for the sorting of waste. It has provided information on the categories encountered during household monitoring. A series of figures were used to illustrate the importance of source separation (Figs. 4, 5, and 6).

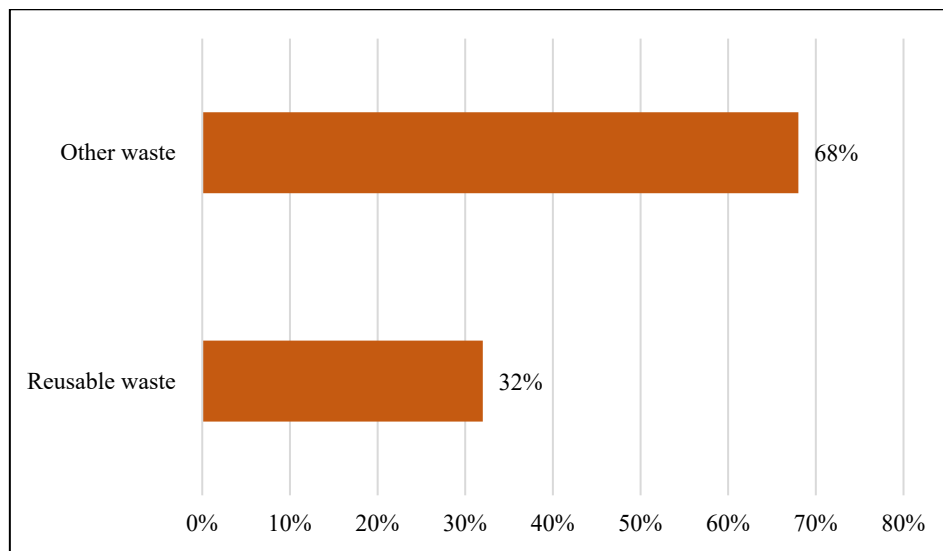


Fig. 4 Reusable waste.

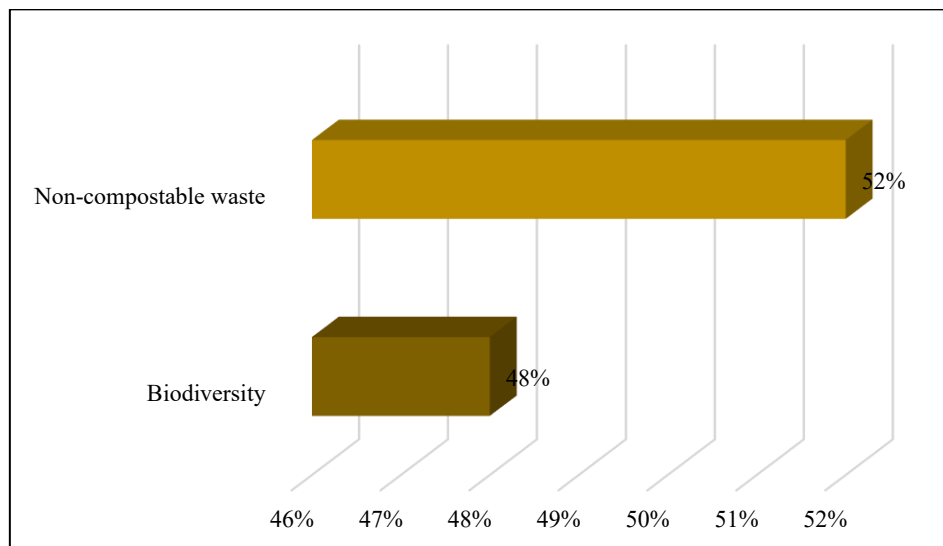


Fig. 5 Percentage of compostable waste.

**The Practice of Local Composting through the Circular Bioeconomy of Biowaste:
Finalized in Market Gardening: Case of the Commune of Ngor/Senegal**

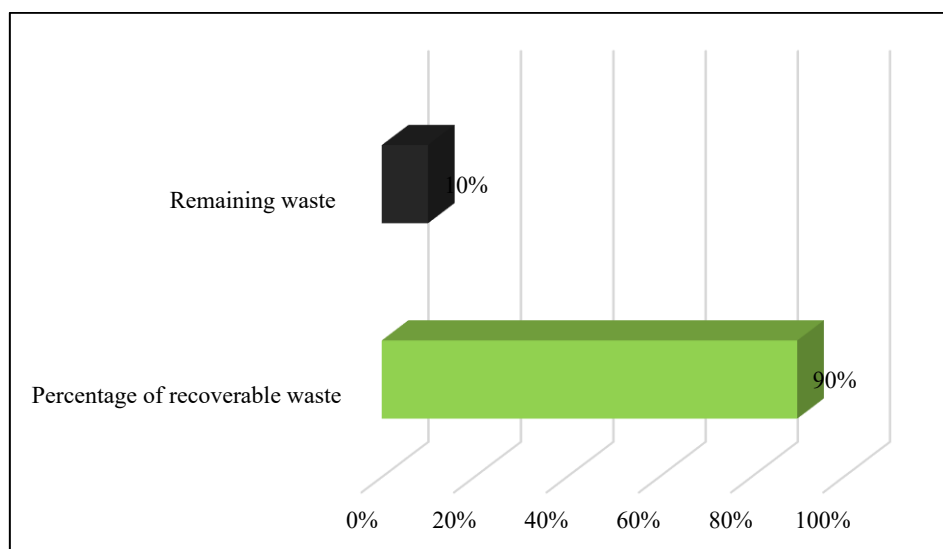


Fig. 6 reusable waste.

Table 1 Nature and function of biowaste.

	Nature	Function
Biodegradable waste for compost	Chopped fruit and vegetable peelings (raw, cooked or spoiled)	Aid in decomposition (earthworm culture)
	Banana peels (rich in potassium)	Improve the quality of the compost
	Wood chips, sawdust, and small branches	They improve the quality of the compost
	Eggshells (crushed, they're better)	Decompose more easily
	Fresh (shredded) tree leaves	Decompose more quickly
	Soil and manure (nitrogen), sheep and goat manure contain microorganisms.	Favorable to decomposition and act as activators to heat the pile

Sorting waste at the source facilitates the determination of the percentage of biowaste collected in the Ngor municipality during fieldwork. It demonstrates that sorting is a crucial step in efficient waste management. It also contributes to decision-making in the fight to reduce household solid waste production. Sorting biowaste allowed for the differentiation of waste at two levels: its nature and its function (Table 1).

Composting biowaste from households in the Ngor commune reduces the amount of waste going to landfill. Economically, it reduces transportation costs and also lessens the environmental impact.

Household waste in the municipality of Ngor is moist and rich in organic matter. Sorting this waste at the source allows the putrescible fraction to be recovered as high-quality compost.

4.4 The Implementation of Concession Composting

Composting is not very common in the study area.

During fieldwork, only a very small percentage of people engaged in this activity of recovering organic waste, representing just 1% of the sample. Implementing composting on a concession level reflects an individual desire to utilize organic waste. There are two methods for implementing composting on a concession. In the first case, the organic waste is placed on the ground to enrich the garden trees (Fig. 7).

In Fig. 7, a woman tends flowers in her home. The compost she uses to fertilize her garden comes from recycling certain materials from waste. Composting is a common practice among both professional and amateur gardeners. It reduces the amount of bagged waste and the risk of environmental pollution.

In the second case, it involves individual composting in residences: waste is composted on-site and then used for vegetable gardening. The composting process was carried out in three ways. First, it was piled directly on the ground; second, closed-cell polyethylene bags were



Fig. 7 Composting in the home garden.



Fig. 8 Waste used for setting up the concession composting system.

used; and finally, the waste was treated as leachate. For all three scenarios, determining the nature and quantity of biowaste during monitoring proved very difficult. The quantity depended on daily consumption, while the nature of the biowaste depended on seasonal production. The photographic plate below shows some of the food waste used for the compost pile.

The waste shown in Fig. 8 was used to feed the composting process and to guide the steps involved in producing good compost. Monitoring and controlling the aerobic/anaerobic conditions of the process follows the different phases. This can be done by a nasal test, checking the smell of the soil to see if it is fresh or foul. For the recovery of biowaste, the municipality must find space to manage biowaste collection at the neighborhood level in particular, and at the municipal level in the other. It is becoming mandatory, even necessary, to raise public awareness about source separation on the one hand, and to promote recovery at the concession level on the other. The Environmental Code [27] in Senegal emphasizes the economic recovery of waste to address the problem of urban solid

waste management. The observation is that, with the changes implemented at the institutional level, services are facing difficulties in applying policies. Yet, a significant portfolio falls under the management of urban solid waste: from collection to treatment.

Composting takes four months before it can be used on a household scale. Fig. 9 shows how the compost is used. Given the limited space, wooden raised beds are used for tiered vegetable gardening. The growing season is slower compared to using chemical fertilizers. The produce from vegetable gardening using repurposed organic waste lasts longer than produce grown with pesticides or chemical fertilizers.

In the figures, we have just transplanted the tomatoes, cabbages, eggplants, peppers, etc. It allows us to minimize daily purchases of condiments (green onion, parsley, flat-leaf parsley).

4.5 Local Composting Platforms

For this study, the local composting platforms focus on the available spaces within the targeted households. Outside of these spaces, no local composting platforms



Fig. 9 Use of compost.

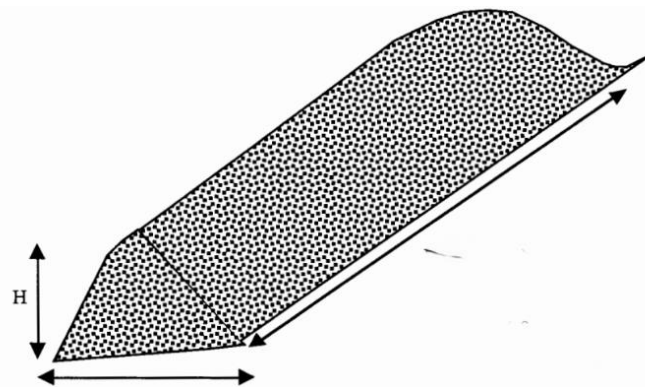


Fig. 10 Schematic representation of the geometric shape.

were observed at the neighborhood or municipal level. This is one of the reasons that prompted this contribution. Moreover, the main problem faced by the population in the study area for implementing local composting at the neighborhood level is the lack of space. In the Ngor village area, for example, the narrowness of the alleyways does not favor such a composting site. However, fieldwork reveals that a significant portion of waste production consists of fermentable material. This study suggests that the municipality identify sites for local composting to valorize the biowaste produced within its boundaries. Municipal authorities must also consider the socio-economic realities of the residents.

For small-scale composting units, the example given concerns the concession. Composting organic waste is crucial because it reduces the volume of household waste requiring disposal. This practice offers significant environmental benefits by lowering emissions of methane—a potent greenhouse gas—and promoting carbon sequestration in the soil, even if the amount sequestered is relatively modest.

During our training on the recovery of biowaste, the trainers suggested measures to take for setting up

composting units. For small or medium-scale composting units, heap composting seems to be the most appropriate. The size of the heap is important: not too high to avoid self-compaction, not too wide to facilitate turning. The optimal dimensions are 1.5 m high and 2 meters wide. The minimum length should be 3 meters, and the maximum will depend on the volume of the individual heaps and the fermentation area. A length of 8 meters, corresponding to 12 m³, is recommended for small units. When using a windrow-turner, the width of the heap should be adapted to the width of the machine and can be 4 m. The length can be increased to 15 m.

Fig. 10 shows the shape of the compost pile. This shape allows you to see the dimensions and form of a windrow to prevent any loss.

As part of the initiative to utilize organic waste, tomato, cucumber, and pepper plants were sown. The figure shows the first cucumber harvest, which was distributed to neighbors. This distribution serves as a way to raise awareness among them about the importance of repurposing organic waste. A reduction in pesticide levels in the produce was observed, alongside savings in both money and time.





Fig 11 some results from composting: Cucumber production.

5. Discussion

Studies conducted for this research show that waste in Senegal, like that of most other developing countries, is characterized by high moisture content and a high level of compostable organic matter [25, 28]. Incinerating excessively wet waste is therefore technically difficult, not to mention the prohibitive cost for the vast majority of local authorities in developing countries [18]. His work demonstrates that attempts to valorize biowaste

have consistently faced challenges in implementation.

According to Charnay [29], the successful valorization of biowaste necessarily depends on the development of a working methodology. African authors have been debating the valorization of organic waste for several years [5]. The main objective is to ensure the production of quality compost that is regular and continuous, adapted to the conditions of developing countries. In developing countries, biowaste valorization was practiced by our grandparents. Biowaste was stored behind the

rooms. During the rainy season, they cultivated tomatoes, peppers, corn, millet, and soybeans. Today, advanced urbanization in our study area is hindering the availability of space.

Plant waste represents 12% of similar household waste and is also subject to mandatory source separation. Despite the regulatory ban on open burning of vegetation, 15% of people with private green spaces report resorting to this practice, a source of air pollutants harmful to health and the environment. To combat burning, it is up to each local authority to propose alternative solutions (dedicated collection and/or on-site local management solutions) adapted to its territory. In all cases, these solutions are accompanied by communication and awareness campaigns. According to ADEME (the French Agency for Ecological Transition), municipalities must conduct awareness campaigns for residents and all stakeholders to support the sorting of biowaste within their communities. Tools to support behavioral change help generate mobilization and encourage citizens to adopt sorting practices [30, 31]. To address these challenges, local authorities can work with other stakeholders in the area. The local area is the most appropriate scale for mobilizing the numerous actors producing biowaste within a circular economy approach [28]. Local authorities must study and identify the sources, relevant collection methods, destinations, and types of recovery possible through short supply chains [32]. This study advocates for the recovery of biowaste at the municipal level to improve the management of municipal waste, promote economic recovery, protect the environment, and safeguard public health.

6. Conclusion

The objective of this study is to promote the use of compost in the commune of Ngor, producing compost on a concession-wide scale. This offers an alternative to landfilling waste, thus protecting the environment. The study focused on the heaping of various types of food waste generated from household production. In addition, a biodigester produced leachate, which was

used to irrigate the vegetable garden established after the composting process. According to the test results, composting could significantly contribute to reducing the use of chemical products and improving crop yields. Therefore, as the valorization of food waste is assessed on a concession-wide scale, the implementation of composting has proven crucial for the production of high-quality vegetables. It can thus play a significant role in sustainable development. Composting could also serve as an alternative to the use of chemical fertilizers.

References

- [1] Onibokun, A. G. 2001. *Urban Waste Management: Solutions for Africa*. Paris: IDRC-Karthala, 250 p.
- [2] Mbengue Ndiaye, R., Ndiaye, B., Traore, V. B., and Diaw, A. T. 2021. "Household Solid Waste, a Challenge of Urban Sanitation: Case of Ngor Municipality (Dakar, Senegal)." *American Journal of Remote Sensing* 9 (1): 47-54. Published online: April 26, 2021. <http://www.sciencepublishinggroup.com/journal/paperinfo?journalid=138&doi=10.11648/j.ajrs.20210901.16>.
- [3] Mbengue, R. 2015. "Local Management Strategies for Urban Solid Waste in Ngor. Forms of Sanitation Organization and Problems." Doctoral thesis, EDEQUE, FST, UCAD, 266 p.
- [4] Cisse, O., and Wone, S. S. 2013. "Waste Management in Dakar (2000-2012): The Institutional Imbroglio." In *CRES-Karthala*, edited by Diop, M.-C., pp. 759-88.
- [5] Waas, E. 1996. *Valorization of Organic Waste in working-Class Neighborhoods of African Cities*. FNRS Project No. 5001-038104. Module 7, Development and Environment. Priority Program PATINAGE, 143 p.
- [6] Oosterveer, P. 2009. "Urban Environmental Services and the State in East Africa; between Neo-developmental and Network Governance Approaches". *GeoForum* 40 (6): 1061-8.
- [7] Hounkpatin, R., and Kottin, M. C. 2009. *Household Solid Waste (HSW) Management in Cotonou: Proposal for an Appropriate Planning Framework Territory*, 178 p.
- [8] Patin, R. H., and Kottin, M. C. 2009. *Household Solid Waste (HSW) Management in Cotonou: Proposal for an Appropriate Pre-collection Planning Framework, EEAM/UAC-DST in Planning and Land Use, Study Report*, 50 p.
- [9] Rocher, L. 2006. "Governing Waste. Territorial Management of Household Waste and Public Participation." Doctoral thesis in spatial planning-urbanism (dir. Larrue, C.), University of Tours, 409 p.

- [10] Cisse, O. 2012. *Garbage Dumps in Africa Mbeubeuss in Dakar, Senegal, Karthala and CREPOS*, 329 p.
- [11] Botta, H., Berdier, C., and Deleuil, J.-M. 2002. *Challenges of Urban Cleanliness*. Presses Polytechniques et Universitaires Romandes, 180 p.
- [12] Diene Kane, A. 2010. "The Problem of Household Waste Management in the Boroughs of Dakar. Case of the Borough of Grand Dakar." Final year dissertation at the National School of Specialized Social Workers (ENTSS), 17th class, 133 p.
- [13] Bulkeley, H., Watson, M., and Hudson, R. 2007. "Modes of Governing Municipal Waste." *Environment and Planning* 39 (11): 2733-53.
- [14] Duval, C. 2009. *Plastics and the Environment: Recycling, Recovery, Biodegradability, Eco-design*. Coll.: *Technology and Engineering*. Paris: Dunod/L'Usine Nouvelle, 352 p.
- [15] Barbier, R., and Laredo, P. 1999. *The Internationalization of Waste*. Paris: ECONOMICA, 111 p.
- [16] ADEME. 2006.
- [17] Chang et al. 1998.
- [18] Baboy Longanza, L., Kidinda Kidinda, L., Tshipama Tamina, D., Tombo, J. A., and Tshijika Ikatalo, M. 2015. "Agricultural Valorization of Waste as an Alternative to Its Management in Sub-Saharan African Cities: Characterization of Urban Waste in Lubumbashi and Evaluation of Its Effects on Food Crop Growth." *Afrique Science* 11 (2): 76-84. doi:info/document.php?id=4505. ISSN:1813-548X.
- [19] TISSOT, B. 2004. Health safety and waste management: what are the links? Paris: Tec Doc, 188 p.
- [20] . Le Bozec A., 1994, Household waste disposal service: costs, organization, management. Systemic and economic analysis of waste recycling. L'Harmattan/CEMAGREF.
- [21] Ngô, C., and Régent, A. 2008. *Waste, Effluents and Pollution. Impact on the Environment and Health. Universciences Collection*. Paris: Dunod, 178 p.
- [22] Tchaou, M. C. 2011. *Contribution to the Improvement of the Urban Solid Waste Management System in the Municipality of Lomé: Case of the Gbadago District*. International Master, Environment, Water and Health, 51 p.
- [23] Gbedo, V. 2002, Study of indigenous practices for the valorization of MSW in Cotonou: an approach to sustainable municipal solid waste management, DEA thesis in environmental management, FLASH, National University of Benin.
- [24] Lawson et al. 2008. Valorization of municipal solid waste in Benin: assets and limitations, Final Report, NGO DECAM-BETHESDA, PAGED, 98 p.
- [25] Cointreau-Levine, S. 1996. "Financially Sustainable Solid Waste Management Systems." In *Solid Waste in Urban Areas of West and Central Africa—Towards Sustainable Management*. February 14-16, 1996, Abidjan, Ivory Coast, pp. 29-34.
- [26] Adegnika, F. M. 2004. "The Management of Solid Household Waste in Urban Areas of Africa under the Dual Constraint of Public Service and Economic Efficiency: The Case of Cotonou in Benin." DEA thesis in environmental management, FLASH, University of Abomey-Calavi.
- [27] Environmental Code. 2001. *Law No. 2001-01 of 15 January 2001 Establishing the Environmental Code, Decree No. 2001-282 of 12 April 2001 Implementing the Environmental Code, Ministry of Youth, Environment and Classified Establishments*, GTZ, 79 p.
- [28] Soudi, B. 2001. *Composting of Household Waste and Valorization of Compost: Case of Small And Medium-Sized Municipalities in Morocco*, edited by Actes, 104 p.
- [29] Charnay, F. 2005. "Composting of Waste in Developing Countries: Development of a Methodological Approach for Sustainable Compost Production." Doctoral thesis, University of Limoges (France), 448 p. Accessed August 13, 2024.
- [30] ADEME. 2021. *Guide to Drafting Specifications: Preliminary Study for the Implementation of Incentive-Based Pricing and Source Separation of Biowaste*.
- [31] ADEME. 2023. *Guide: Implementing Actions to Support Behavioral Change* (36 p.)
- [32] ADEME. 2019. *Guide to Drafting Specifications: Preliminary Study for the Implementation of a Local Biowaste Management System*.