

Characterisation and Recovery of Solid Waste from Hotels in the Town of Zuenoula (Central West of Côte d'Ivoire)

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ABSTRACT

The town of Zuenoula, located in central west of Côte d'Ivoire, lacks socio-cultural activities that could have a positive impact on the accommodation sector. It has a small number of hotel establishments. Despite this, hotels benefit from stays for ceremonies, seminars, and funerals. This frequentation of hotel establishments generates waste, which is difficult to manage properly. They dispose of their waste in the same way as ordinary household waste. To reduce waste, some is recycled and then recovered. The aim of this study is to show how waste from hotels in the town of Zuenoula is recycled. To achieve this, the chosen methodology is based on documentary research and field surveys supported by questionnaires and direct observation. For the selection of the sample, the reasoned choice method was used, supported by the snowball method, for greater efficiency. The results revealed that hotel establishments produce various types of solid waste, of which the recovered waste (25%) is water bottles, unusable sheets and towels, faulty appliances, and leftover food. As for no recycled hotel waste (75%), 13% is collected by municipal services, 62% is disposed of on the streets, 13% on empty lots, and 12% around wetlands. All the hotel establishments surveyed had no infrastructure for collecting the waste produced on a daily basis, which degraded the population's living environment.

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1. INTRODUCTION

Since 1974, the United Nations Environment Programme (UNEP) has taken environmental degradation to heart in order to encourage governments, businesses, and citizens to become more aware of environmental problems. The production of household and similar waste has harmful effects on the environment, creating an unhealthy living environment. This is everyone's business, especially in cities, which are the lungs of economic activities that produce large quantities of waste, the management of which is problematic. Hotel waste added to household waste increases the amount of rubbish to be disposed of.

The town of Zuenoula, in central-western Côte d'Ivoire, is suffering from environmental degradation (Fig. 1). The urban waste management system is failing, and the waste produced and collected is not treated appropriately. This infrastructure malfunction has led to the emergence of unauthorised dumps used by hotels to collect and dispose of their waste. Catering and accommodation waste

is produced when hotels are frequented, and only a small amount of this is recycled. Recovered waste is that which, after recovery, is directly reintroduced into the life cycle through re-use. This phenomenon can be seen in the observation units in the study area, particularly hotels.

This leads us to the following question: How is waste produced in hotels in the town of Zuenoula managed and recycled? In other words, how is hotel waste managed in the urban area under study? What waste is recovered from its hotels?

The aim of this study is to analyse the methods used to manage solid waste from hotels in the town of Zuenoula and to highlight how this waste is recycled.

The aim of the study is to propose strategies for improving the recovery of solid waste in order to reduce its negative impact on the environment and the health of the population.



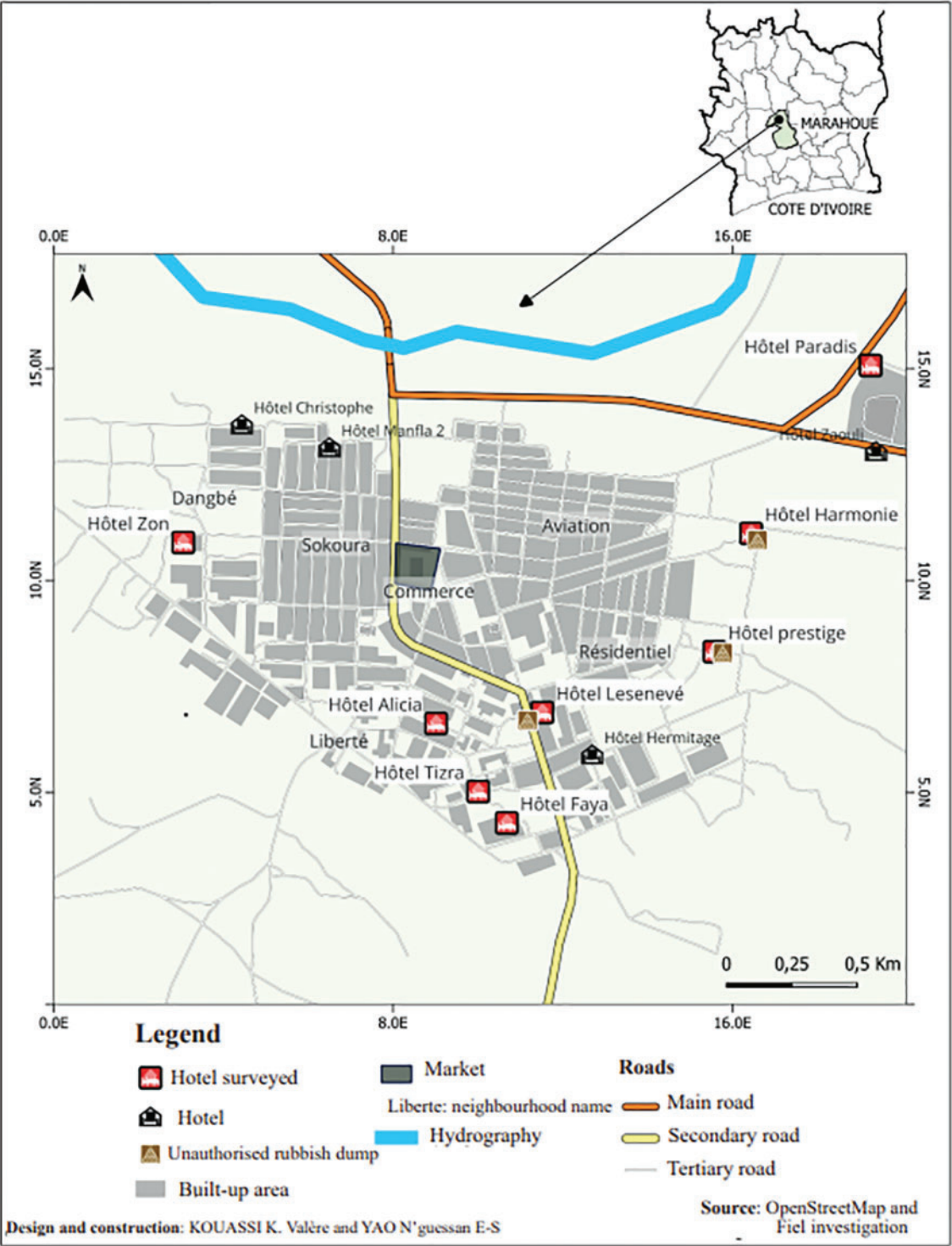


Fig. 1. Location and presentation of the town of Zuenoula.

2. METHOD AND MATERIALS

To carry out this study, data collection was based on a literature review, direct observation and field surveys.

The first stage was a literature review relating to our subject. The second stage consisted of consulting administrative data from the mayor's secretary general. The third and final stage involved direct observation and fieldwork. Direct observation involved taking photographs and comparing the data read and perceived. The fieldwork began in August and ended in September.

We began by conducting semi-directive interviews with the urban players, in particular the municipality. At the town hall level, the interview with the secretary general of the town hall focused on their involvement in hotel waste management, the number and distribution of hotel establishments in the town, and their standing. Questionnaires were then administered to hotel managers on how their solid waste was managed and recycled. To select the hotels, we used purposive sampling preceded by an exploratory phase, which made it easier to choose the hotels to be surveyed. Our survey covered half of the hotels (1/2), i.e., eight

(8) hotels out of a total of fifteen (15) hotels. These hotels were selected on the basis of their solid waste production and management methods.

To quantify hotel waste, we first sorted it before weighing it to determine the quantity of waste produced by accommodation structure and by category in the waste stream. The equipment used to weigh the waste was an electronic digital scale (fifty kilograms). We used an Infinix Smart5 camera to take photographs. For the cartographic data, we used the UTM GEO MAP 3.9.2 application to take the geographical coordinates of the hotels and their solid waste disposal sites. Qgis 3.34.1 was then used to produce a map of the city.

The quantitative data were processed using Excel 2010 to produce statistical graphs for interpretation.

3. RESULTS

3.1. Production of Solid Waste in Hotel Establishments in the Town of Zuenoula

3.1.1. Characterisation of Solid Waste from Hotels in the Study Area

The solid waste produced by the town's hotels is grouped into two categories: not recyclable waste and recyclable waste (Fig. 2):

- Not recyclable waste is waste that is systematically dumped after use. This waste includes tissues, plastic packaging, food and drink cartons, and faulty light bulbs.
- Recyclable waste is waste that can be reintroduced into the life cycle for a second use. This includes food peelings, water bottles, metals, sheets and towels, faulty household appliances, tree leaves, and leftover food.

This figure shows the quantities of recovered and not recovered waste from the 08 hotel establishments surveyed. Recovered waste accounts for 25% of all hotel waste produced, while not recovered waste represents 75% of the total. This low level of waste recovery is due to the lack of a system for recovering, sorting, and recycling recoverable waste in the city.

The quantity of not recovered waste at the Faya hotel, i.e., catering and accommodation waste, is estimated at an average of 6.75 kg per day, with an average occupancy rate of 25% overnight stays per day. This is one of the busiest

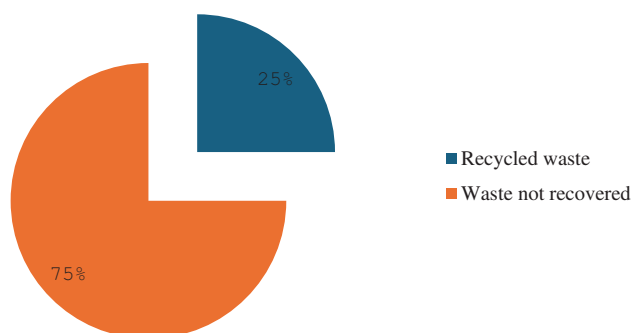


Fig. 2. Production of hotel waste in the city. Source: Authors, September 2023.

hotel establishments in the city, as it is open to the public for catering. The different types of waste produced are managed differently in each hotel.

3.1.2. Solid Waste Management in the Town's Hotels

Solid waste from hotels in the town of Zuenoula is managed at three levels: pre-collection, collection, and disposal. The disposal routes for this solid waste are the shallows, the street, empty lots, and the municipal collection service (Fig. 3).

Generally speaking, the city's hotels do not benefit from municipal refuse collection services. Only 13% of hotels do. Their waste is collected by a tricycle, which is responsible for collecting household waste in the neighbourhoods. The common reality is that 62% of hotels dump their waste in the streets. They therefore do not benefit from the municipality's waste collection service, as there are no refuse collection sites in their vicinity. These include the Tizra and Alicia hotels in the Liberte district and the Prestige and Harmonie hotels in the Residentiel and Château districts, respectively. In view of this situation, some hotels are relying on the illegal refuse dumps created by local residents in the Liberte district to get rid of their waste. A further 13% of hotels dispose of their waste on empty sites. One example is the Paradis hotel in the ONUCI district. A further 12% of hotels dispose of their waste in marshy areas. This is the case of the Faya hotel in the Liberte district.

At the Faya hotel, waste is pre-collected each morning by staff in the various departments, particularly the catering and accommodation departments. Waste buckets are placed in the courtyard to collect the waste produced each day. After collection, this waste is taken to a site where household waste is dumped on the banks of a river not far from this establishment (Fig. 4). Once a large quantity of waste has been dumped, local residents incinerate it to make room for the next waste dump.

Fig. 4(A) shows the solid waste disposal site at the Seneve hotel, while Fig. 4(B) shows the solid waste disposal site at the Faya hotel. This panel shows two uncontrolled waste dumps that damage the environment through visual nuisance and plastic, soil and air pollution. These nuisances are exacerbated by climatic effects such as high temperatures and heavy rainfall in the city, which encourage the decomposition of non-plastic waste and make for an unhealthy living environment. With 87% of hotels disposing of their waste in unauthorised dumps, the soil

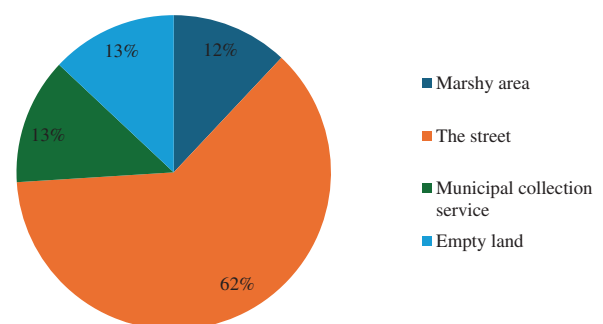


Fig. 3. Solid waste disposal routes for hotel establishments. Authors, September 2023.



Fig. 4. Unauthorised dumping of solid waste in the Liberte district: (A) Solid waste disposal site at the Seneve hotel and (B) Solid waste disposal site at the Faya hotel. Source: Authors, September 2023.

is particularly affected by the quantities of solid waste dumped there. These unauthorised dumps damage the aesthetics of the urban landscape, degrading the living environment for local people and having harmful effects on their health. It is the source of the spread of disease vectors such as malaria. Local residents claim to be victims of illegal dumping in their immediate environment. For example, 85% of those surveyed said that they commonly suffer from malaria. In addition, 51% said they suffered the effects of waste pollution during incineration.

In addition, the photographic images in the plate above show waste that is very rich in plastic. This substance is not biodegradable. It can therefore remain in place for decades, even hundreds of years, denying the soil on which it is placed the opportunity to fertilise.

In any case, what can be done to reduce the amount of hotel waste that is not recycled in Zuenoula?

3.2. Recovery of Solid Waste from Hotels in the Study Town

3.2.1. Recovery of Textile Waste

Used sheets and towels are turned into rags for other uses.

Towels that cannot be used for toilets are used as rags for cleaning rooms. The hotels surveyed give this type of waste a second life. One manager mentioned that these towels clean better and are more effective than those bought and used for cleaning. For example, 100% of unused room towels are reused for cleaning hotel premises. After this second use, they are thrown in the bin for final disposal.

As for the sheets, they are stored and then taken away by the owner, either for reuse at home or for sale to second-hand goods dealers for a second use. This marketing of sheets that cannot be used for bed dressing provides a source of income and helps to offset certain hotel expenses such as cleaning materials (Fig. 5).

3.2.2. Recovering Leftover Catering Food in Hotels

In the catering sector, waste prevention is a priority. Preservable food is purchased and stored in a freezer so that it can be used when needed. Most menus are made to order to avoid food wastage and lost savings. When there is food left over, it is either kept in the freezer to be used again the next day or given to catering staff for consumption on



Fig. 5. Storing sheets in a bag at the Faya hotel. Authors, September 2023.

the premises or at home. 100% of hotel restaurants adopt this strategy to prevent waste and food wastage.

3.2.3. Recovery of Household Electrical Waste

Waste electrical appliances from hotels are fans and air conditioners. These appliances are stored in a room for another use. In the case of damaged fans, the parts that are in good condition are removed and used to replace the faulty parts in another fan that can still be used in order to solve the problem of the malfunctioning appliance. As for the splits that are in poor condition, some people go to hotels to buy these units so that they can be repaired and used at home. In this city, 12.5% of hotels engage in this practice of recycling household electrical waste.

3.2.4. Recovery of Plastic Bottles and Metals

The water and drink bottles recycled mainly by women in the hotels are sold either on the market or directly to sellers of medicines or food products. These water bottles are given a second life through the sale of traditional infusions or medicinal powders, sorrel or ginger juice, dairy products, traditional palm oil commonly known as “red oil” and liquid soap. 99% of the women visit the hotels to buy these valuable items.

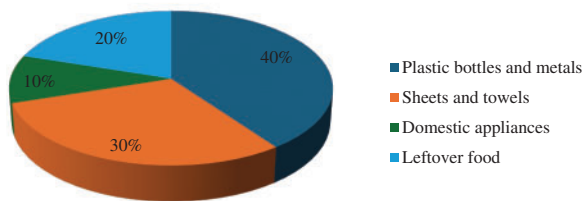


Fig. 6. Share of recovery by type of hotel waste in Zuenoula.
Source: Authors, September 2023.

As for recycled metals such as cans, they are sold directly to blacksmiths to make kitchen utensils. 100% of hoteliers have made this their personal business.

3.3. Recovery by Category of Hotel Waste in Zuenoula

Solid waste produced in hotels in the town of Zuenoula is not recycled to the same extent. Some hotels recover more of their waste, while others lag behind (Fig. 6).

This figure shows the proportion of waste recovered by category in all the hotels in the study area. The graph shows that plastic bottles and metals are the waste that hotels recover the most (40%). In fact, these are objects that are easy to recycle and are produced most frequently in high-standard hotels such as Faya, Paradis, Prestige and the Seneve. Used sheets and towels come second, accounting for 30%. The rest of the food, at 20%, is recycled less than the previous waste. Household appliances come last in terms of solid waste recovery, accounting for 10%. This low level of recovery of faulty household appliances is explained by the fact that many hotels prefer to repair them until they malfunction for good.

The hotels that are most involved in recycling are Faya, Paradis, Prestige and the Seneve. The other hotels, such as Harmonie, Zon, Alicia and Tizra, produce little waste, so they do not bother to recover it.

All of the above-mentioned recovery methods help to reduce the significant quantities of waste produced. The financial resources generated by this waste recycling go back into the hotels' coffers.

However, there is still a lot to be done in terms of recycling waste from hotels in the town of Zuenoula.

3.4. Strategies for Maximising the Value of Hotel Waste

When it comes to recycling hotel waste, it is the informal sector that absorbs most of the recycled waste. Each type of waste corresponds to a particular recovery method. To manage this waste properly, sorting by category is unavoidable. This is the basis for effective waste recovery. Waste sorting is a very important stage in the management of hotel waste, and must be carried out at all levels of the chain, particularly during pre-collection in the room, to facilitate the collection of waste by category.

There are significant issues surrounding hotel waste, which can be collected and treated in the same way as household waste, given its characteristics and the quantities produced. Efficient waste recovery begins with selective collection by installing bins for each category of waste in each hotel establishment. This should be followed

up by raising customer awareness through selective collection during the stay. Room cleaning staff should also receive training so that waste is sorted before being pre-collected in the bins. This will reduce the amount of waste to be treated and increase waste recovery. In addition, the municipality must create and place skips at each household and similar waste collection sites for the classification of solid waste, which will be monitored by officers. This categorisation will enable recoverable waste to be stored and non-recoverable waste to be sent to landfill sites for immediate incineration in order to reduce the amount of waste produced in the city.

In addition, the municipality must encourage the setting up of channels for the reuse and recycling of solid waste through local communiqués. Similarly, it should call on solid waste recycling companies and seek cooperation/partnerships with other cities around the world that have already succeeded in this challenge of effectively recovering municipal waste in order to learn about appropriate waste treatment techniques. This cooperation/partnership should lead to the installation of municipal solid waste treatment and recycling companies.

4. DISCUSSION

This section provides an analysis of the types of hotel solid waste recovered in our study area in relation to other similar studies.

In the town of Zuenoula, with the exception of cans, a large amount of waste is recycled as directly reusable waste, in particular plastic bottles, unusable sheets and towels, and faulty household appliances. This waste recovery is similar to the waste recycled in Yaoundé. The waste produced at the Merina Hotel is only roughly sorted by employees, who collect certain packaging, mainly PET bottles and empty cleaning product cans. These items are resold to informal collectors who have turned them into a real business [1]. Furthermore, in our study area, 75% of waste goes to landfill without treatment. This situation, which is common to West African cities, is at odds with waste management in Western urban areas. In the United Kingdom, according to [2], 75% of hotels adopt recycling, including reuse (25%) and energy recovery (19.2%). Furthermore, going in the same direction, 60% of hotels in Vietnam sell their food waste to local collectors, of which 10% to 30% of the waste is sold for recycling to the latter. Solid recyclable waste consists of plastic bottles, paper, cardboard, and cans [3], as in Zuenoula. Also, in Vietnam, large hotels, particularly those with restaurants and bars, produce a large amount of waste every day. Some of them sort the food waste, sell it, or donate it to breeding facilities. This contributes to a considerable reduction in the amount of waste that has to be transported to landfill sites. In addition, according to [4], recyclable waste is collected and sold to informal collection systems by hotel staff, with the profits going to the hotel's union fund. In contrast to the types of waste mentioned above, the Association of Cities and Regions for Recycling and Sustainable Resource Management [5] shows that in Mahdia, Tunisia, the recovery of solid waste from hotels includes glass waste and garden furniture and that some hotels also have initiatives

to collect large metal waste (plumbing), which is recovered by the metal industry. Hotels in the Djerba region of Tunisia also recycle polyethylene terephthalate (PET) plastics, paper and cardboard, and used cooking oil. To recycle this waste, some hotels have signed agreements with Tunisian waste recovery companies. PET plastics are also collected by hotel employees for resale to recycling companies such as ECO-lef at a price of 0.5 TND/kg. Hotels work with informal collectors to recover paper and cardboard. Used edible oils are recovered by the company Eco Oleo for the manufacture of biofuel [6]. In Morocco, the best-recycled waste is cardboard, paper, and iron. Around 20% of used paper is recovered, and its reuse rate is 40%, while recycled plastics account for only a small proportion of household waste [7]. Overall, the percentage of waste recovered in Morocco varies around 8%. Paper and cardboard are recycling products that form the cornerstone of the paper industry in Morocco. The most sought-after recycled materials are cardboard and printing trimmings. Paper recycling activity is mainly driven by demand from the Moroccan Cardboard and Plastics Company (CMCP), around which the collection chain for recycled materials is perfectly organized [7].

Unlike the city of Zuénoula, which does not yet have a solid waste recycling and selective collection system for hotel waste, recycling in Vietnam's Hoi An is a success story. The sorting rate for waste produced in hotels is 76%, and 32% for restaurants. The recycling rate was 39% for the hotel sector and 56% for restaurants. In this Vietnamese city, recyclable materials are collected by the informal sector [8].

Moreover, Nkula *et al.* [9] gives examples of solid waste recovery in their article. In Tunisia, plastic bottles discarded on beaches are transformed into boats. It took 3,000 1.5-litre plastic bottles to build six boats. In addition, several recycled boat races are organised. The same authors also claim that furniture, bags, sandal soles, and slippers can be made from them. Cardboard is reused as packaging for food made from sheep and goats. Non-ferrous metals are recycled to make aluminum cooking pots. Textiles and rags are used to make bags, clothes, and mattresses. For them, the recovery of solid waste should reduce the volume and spread of waste in unauthorised dumps and generate economic activity that creates jobs. What's more, the products derived from recovery, which are generally less expensive, will also enable households with low purchasing power to buy them. In Algeria, the Tonic paper company presented its experience through its paper and cardboard waste recovery plant, which has a capacity of 150,000 tonnes/year but collects only 42,000 tonnes/year. In addition to its own collection capacity, this company works with other public and private recyclers, such as the public paper and cellulose industrial group GIPEC, which supplies it with 15,000 tonnes of waste per year, and private recyclers, which supplies it with 43,000 tonnes per year [10]. In Mali, recycled metal objects are sold to scrap metal dealers for processing. Bottled PVC is also washed and sold to sellers of juice and traditional medicines. Empty sacks, for their part, are turned into rope on the spot by shoemakers, while bags are sorted according

to quality and sold to processing units to be made into plastic sheaths and articles [11].

In France, a study of the Normandy waste streams in 2019 shows that the Normandy players are developing treatment solutions for each type of waste. The flow of household and similar waste collected at drop-off centres in 2019 by the public waste disposal service was 994,100 tonnes, 38% of which was green waste. The overall recovery rate for occasional waste collected at drop-off centres is around 68%, with the remainder not recovered (over 32%). Recycling through reuse accounts for 61.1%, material recycling for 16.1%, agronomic recycling for 36.2%, and energy recycling for 9.2%. The remaining 32.4% is landfilled [12].

Managers of hotel establishments do not yet behave in an eco-responsible manner when managing waste in the city surveyed. Moreover, they do not receive any real support from the municipality, which is responsible for the efficient management of urban waste. However, in some countries there is support from the municipality. This is shown by Eurostat, where Germany ranks as one of the countries most committed to waste recovery. It recovers more of its plastic packaging, and of the 97% of waste recovered, 70% is recycled, and the rest is incinerated. This high level of waste recovery is due to a real culture of waste sorting. This is due to education and strong encouragement from the authorities over many years [13].

With a view to the ecological management of solid urban waste in the city of Porto-Novo in Benin, the transformation of targeted fermented waste into compost for use in urban agriculture is a sustainable management alternative with a twofold benefit. On the one hand, it will clean up the urban environment, which until now has been plagued by uncontrolled rubbish dumps due to a lack of technical and financial resources. Secondly, in view of the growing demand for food in cities due to high population density, there is an urgent need to opt for ecologically intensive agricultural production methods that have less impact on the environment in order to satisfy urban demand for quality food products [14]. Yao and Tape [15] makes a similar point in their article on solid waste management in hotels in the town of Bouaflé, Côte d'Ivoire. In their view, the classification of hotel waste promotes the development of the circular economy. Waste that is recycled and classified should be sent to recycling units for further processing and use. Organic waste can be used as compost to fertilise humus-depleted soils, providing an ecological fertilizer. This situation leads to a significant recovery of the waste produced and a reduction in its environmental and health impacts.

5. CONCLUSION

This study defines the waste management methods used by hotels in the town of Zuénoula, which are carried out in four different ways. Some hotels dispose of their waste by taking advantage of the town hall's household waste collection service. In addition, most hotels dispose of their waste in the street. Hotel waste is also disposed of on empty plots of land and in marshy areas. This poor management of hotel waste in the town of Zuénoula has repercussions for the environment and the health of the

people living near these illegal dumps. Hotels make little use of their solid waste. However, maximising the recovery of hotel waste is the best option for effective management of the solid waste produced, which could be a factor in the town's attractiveness. Environmental requirements in terms of waste management are the responsibility of all stakeholders, from production to disposal. At every level of the chain, every player must behave in an eco-responsible way, in line with the concept of sustainability.

CONFLICT OF INTEREST

The authors declare that they do not have any conflict of interest.

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