

Impact of waste treatment methods used in urban agriculture on environmental pollution risks and producer health

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ABSTRACT: The waste is used to fertilise fields. Their pre-treatment can impact on human health and the environment. A study was carried in Bobo-Dioulasso, precisely in Kuinima and Dogona, with the main objective of assessing the impact of waste treatment methods on the environment and health. The data was obtained from individual interviews with farm managers. The results show that 56.67% of the producers practise sorting followed by incineration and 20% practised sorting only, 23.33% of the producers did not perform any treatment. Sorting caused injuries to 33.33% of the producers, 10% were harassed by insects. As for the impact of the treatment methods on the environment, 83.33% of the producers who sorted their waste had their fields invaded by new weed species, compared to 76.47% of those who sorted and incinerated. For 88.23% and 66.67% of the producers who were sorting followed by incineration and sorting only respectively, the crop yield was good. From these results, we can conclude that the waste treatment methods used by producers have negative effects on the environment and human health.

KEYWORDS: Urban waste, human health, environment, Bobo-Dioulasso.

1 INTRODUCTION

The demographic explosion of the last few decades, combined with the increase in the production of waste, force urban populations to live daily with rubbish. Thus, in order to reduce the pollution of cities by waste, the Burkinabe authorities have encouraged the valorisation of waste. Among these management strategies is the use of waste in agriculture as organic fertiliser. In the context of an environmental and health crisis, the need to assess the impact of waste use on the environment and on people's health is essential. The analysis of waste by [1] shows that it contained high levels of toxic heavy metals. These heavy metals can pass from the soil to plants and contaminate the entire food chain [2]. However, heavy metals are not the only hazards from waste. In western Burkina Faso, little research has been done on the environmental and health risks associated with waste treatment methods.

Hence the interest of this work on the theme: «Impact of waste treatment methods used in urban agriculture on environmental pollution risks and producer health ».

This study aims to assess the disadvantages of the different modes of urban waste treatment on the environment and the health of the producers. To do this, we first identified the different types of urban waste used at the Kuinima and Dogona sites, then we studied the different modes of solid urban waste treatment at these sites, and finally we assessed the environmental and health risks involved according to the mode of treatment.

2 MATERIAL AND METHODS

2.1 STUDY SITE

The study was conducted in the city of Bobo-Dioulasso with the following geographical coordinates: Longitude: 04°20' west; Latitude: 11°06' north; Altitude: 405 metres [3]. The climate is of the South Sudanese type characterised by a wooded savannah [4]. The study was conducted at two sites: the Kuinima site and the Dogona site. The selection of sites was based on the size of the site (at least a quarter of a hectare), the amount of waste used and the number of producers.

2.2 DEVICE FOR IDENTIFYING WASTE

For the identification of the different types of waste, the system used is that of [5]. The design of the system consisted realization of square plots of 2500 m² (50 m by 50 m). In each plot, five observation (identification) zones of 100 m² (10 m by 10 m) were delimited on the four sides and the centre of the plot. Depending on the configuration of the sites, each site visited will be subdivided into three zones (I, II, III), each of which receives a plot.

2.3 DATA COLLECT COLLECTE DES DONNÉES

2.3.1 SURVEY

The surveys are conducted using the individual questionnaire guide. When the interview, the producer expresses himself freely and the answers that are the subject of the study are noted. The producers surveyed were all heads of farm units who were available during the survey period.

2.3.2 IDENTIFYING THE DIFFERENT TYPES OF WASTE

After setting up the device, visual observations are made in the 100 m² plots to identify the different types of waste in each area and the type of waste treatment.

2.4 STATISTICAL ANALYSIS OF DATA

For data processing and analysis, the applications used are Excel spreadsheet and R software.

3 RESULTS

3.1 SOCIO-ECONOMIC CHARACTERISTICS OF SURVEYS

Table I shows the socio-economic situation of the producers surveyed. It reveals that the majority of producers were constituted by men (83.33%). All of them were mainly adults and oldie with an enrolment rate of 43.33%. Only 2 of the 30 producers were unmarried. The total number of children all the producers was 108, with only 24 helping them with their farming activities. For 63.33% of the surveyed, farming was their main activity, but only one surveyed claimed to have received support and advice from agricultural technicians.

Table 1. Socio-economic situation of producers surveyed

Sexe (%)		Level of education (%)					
Man	Woman	Uneducated	Primary	Secondary	University	Médersa	
83.33	16.37	56.67	26.67	10	0	3.33	
Number of children	Number of children active	Agriculture (%)		Technician support (%)		Practical advice	
		Main activity	Secondary activity	Yes	Non	Yes	Non
108	24	63.33	36.67	3.33	96.67	3.33	96.67

3.2 PERIOD FOR DEPOSITING WASTE ON THE PARCELS

The periods of waste disposal in the plots are shown in Figure 1. The majority of producers, 93.33%, were asserted that waste is deposited in their plots during the dry season. Only 3.33% said the opposite and as many said that deposits were made throughout the year.

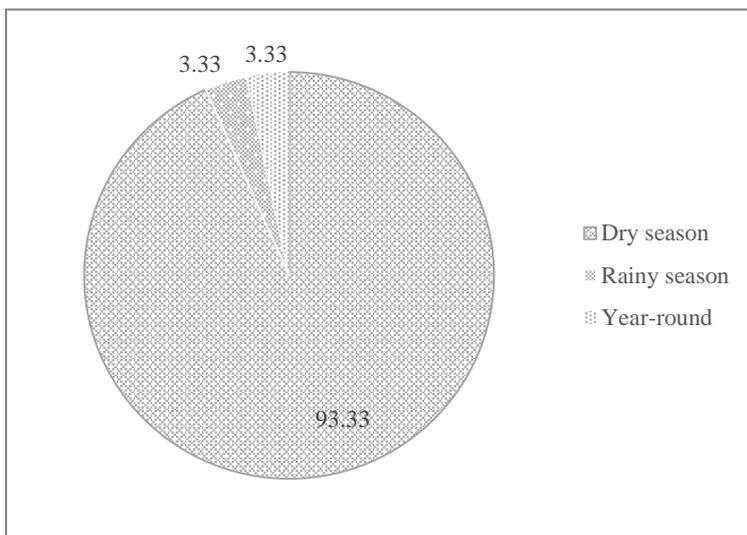


Fig. 1. Timing of waste disposal in the fields

3.3 WASTE COMPOSITION

The results of the waste composition surveys are presented in Figure 2. He spring that the waste deposited in the fields comes from concessions, industries, the city, hospitals, animal farms and agricultural residues. Thus, all the surveyed assert to receive household waste (HW) in their fields, respectively 80% and 70% of the producers accepted livestock waste and agricultural waste and 43.33% also received solid urban waste. As for industrial waste, excreta and biomedical waste, very few producers were accepted them in their fields.

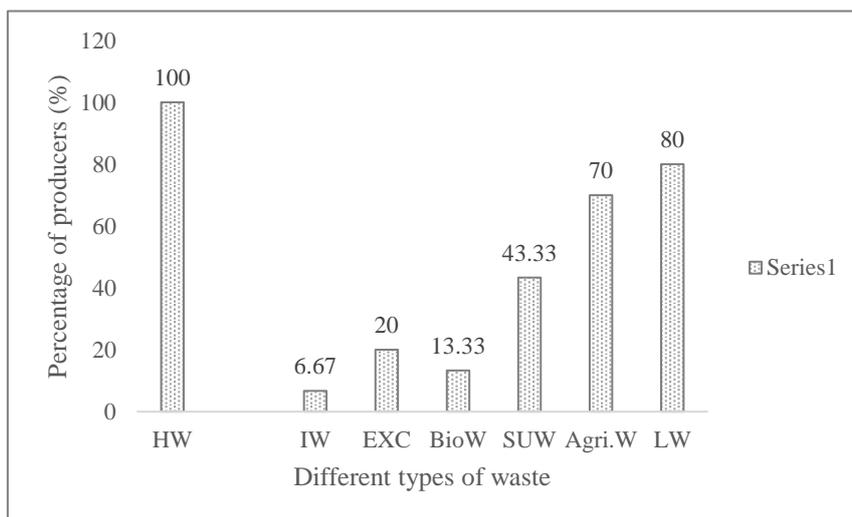


Fig. 2. Proportion of producers by waste type used

HW: Household waste; IW: Industrial waste; EXC: Excreta; BioW: Biomedical waste; Agri.W: Agricultural waste; LW: Livestock waste; SUW: Urban waste.

3.4 MODE DE TRAITEMENT

Figure 3 compares the practice rates of each waste treatment mode. Examination of this figure reveals that of the among treatments, namely sorting only and sorting followed by incineration, more than half of the producers practised sorting followed by incineration, i.e. 56.67%, and 20% sorted only. 23.33% did not perform any treatment.

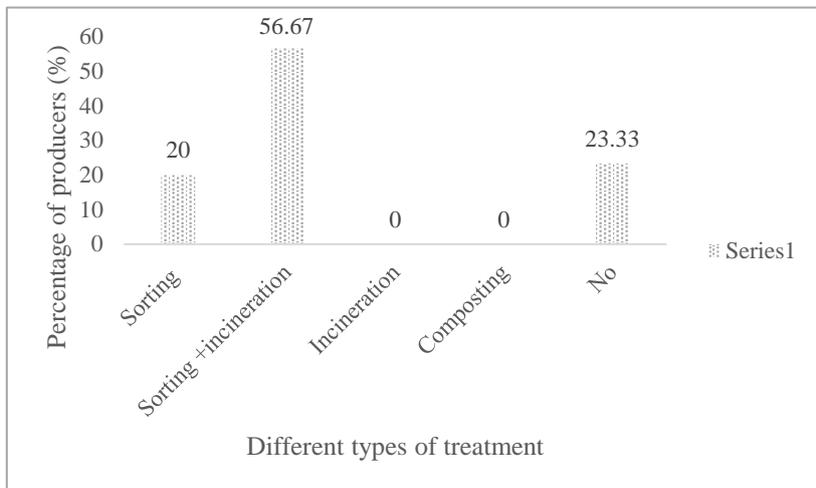


Fig. 3. Percentage of producers by treatment mode

3.5 USE OF PROTECTIVE TOOLS

The percentages of producers who were being used tools for protection in the field are given in Table II. The tools used for protection were gloves, boots and masks. However, only 53.33% of surveyed were being used protective tools during waste treatment. Of these, only 20% had all the protective tools, and 33.33% were missing at least one. Almost half, 46.67%, had none.

Table 2. I: Percentage of producers by protection tools used

Use of protection tools (%)		Protection tools used (%)						
yes	non	gloves	masks	bottes	masks + gloves	masks+ bottes	gloves + masks+ bottes	none
53.33	46.67	3.33	0	0	26.67	3.33	20	46.7

3.6 HEALTH IMPACTS OF TREATMENT MODES

Figure 4 below shows the impacts of waste treatment methods on the health of producers. According to the producers, several factors can influence their health when processing waste. The latter were asserted to be exposed to the risk of injuries, bites from dangerous animals and diseases. More than half of the producers who sorted their waste encountered dangerous animals, 33.33% had suffered injuries and 10% were asserted to be harassed daily by insects. For treatment by sorting followed by incineration, only 13.33% of producers encountered dangerous animals. However, no producer reported having contracted a respiratory, skin or digestive disease.

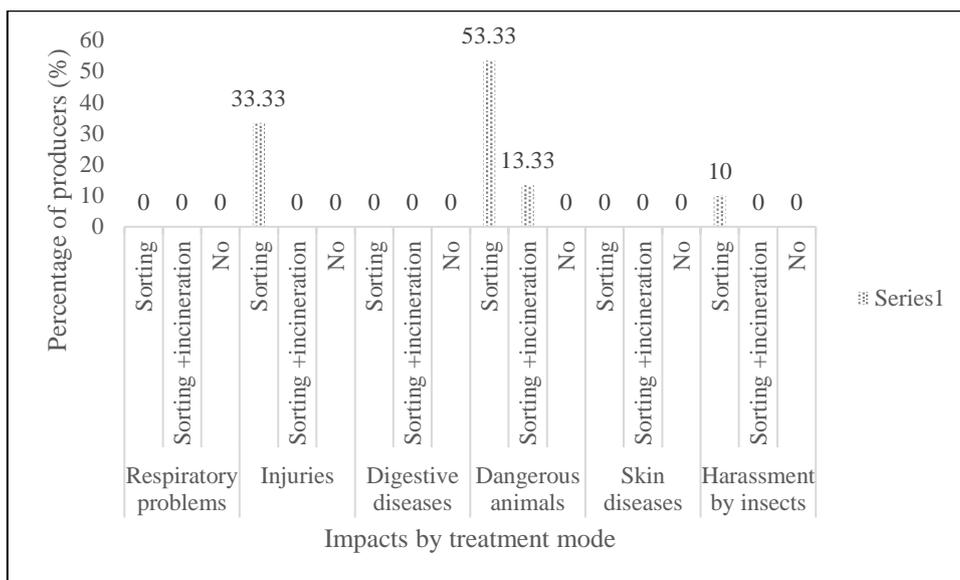


Fig. 4. Impacts of different treatment methods on producers' health

3.7 QUANTITY OF WASTE

Figure 5 shows the quantity of waste as a function of area. Examination of the results shows that the quantity of waste does not vary in proportion to the area farmed by the producers. The lowest quantity 11.67 tonnes is recorded by the 0.25 ha plots and the highest by the 3 ha plots. The maximum quantity of waste to be delivered per area is represented by the function line $Q(t) = \text{area (ha)} \times 30 \text{ (t/ha)}$. All those with plots of 0.25 ha, 1 ha, 1.5 ha, 2.5 ha and 3 ha used quantities of waste greater than the maximum allowed. Figure 6 shows the percentages of producers per dose of waste brought in per hectare. From these results, it appears that 40% of producers use wastes at doses higher than the maximum dose that can lead to crop poisoning problems. 56.67% of producers use waste within the range of recommended doses for yield optimisation. However, 13.33% of producers use the waste below the minimum rate for better yield.

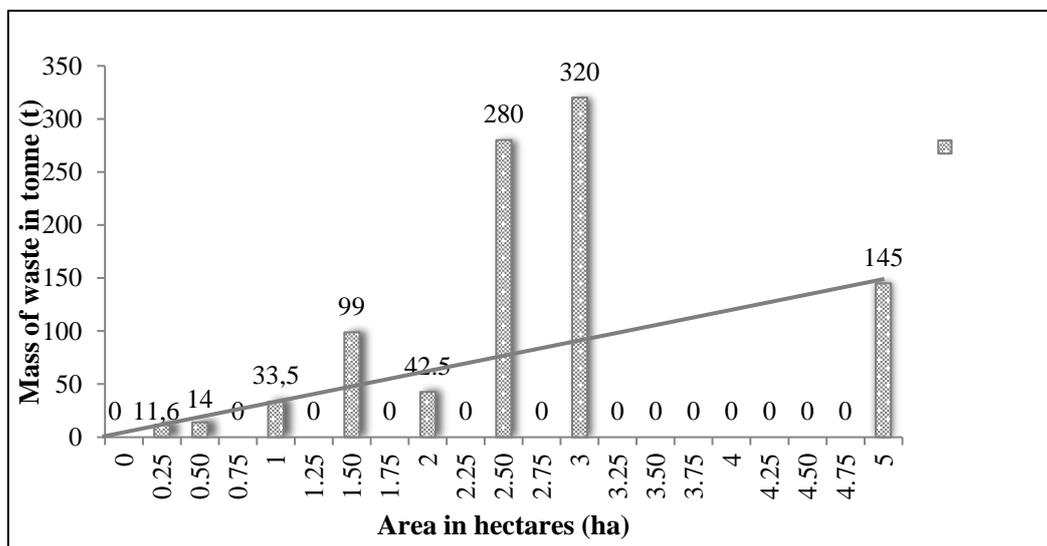


Fig. 5. Quantity of waste per area

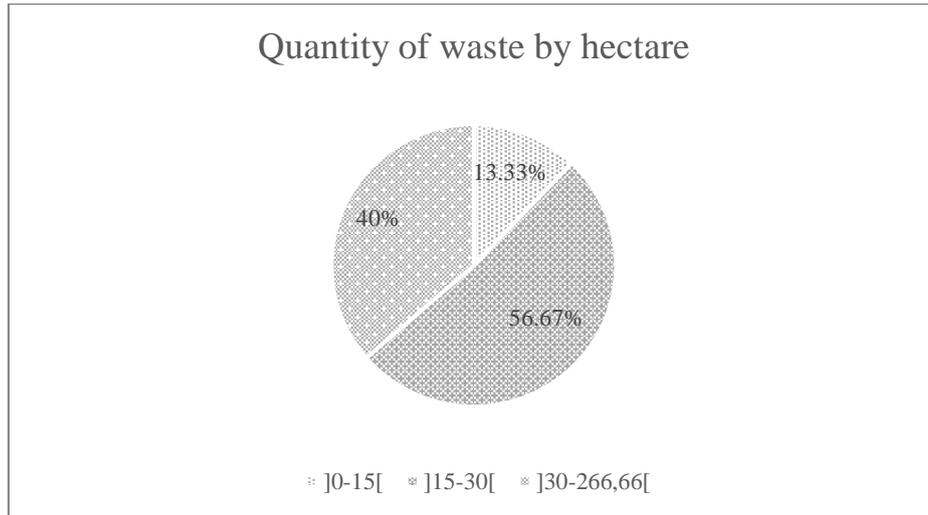


Fig. 6. Percentage of producers based on the quantity of waste brought in per hectare

3.8 IMPACTS OF WASTE TREATMENT METHODS ON THE ENVIRONMENT

The effect of different waste treatment methods is shown in Figure 7. The mode of waste treatment influences the production, intensity and specific diversity of bad plants. In terms of agricultural production, all producers are unanimous on the positive effect of waste on increasing yields. For 88.23% of the producers who sort and incinerate, the crop yield was good compared to 66.67% for those who only sort. For those who do not do any treatment 57.15% of them said that the yield was average. Regarding the specific diversity of weeds, the percentages are respectively 83.33%, 76.47% and 28.57% for sorting only, sorting followed by incineration and no treatment. Weed intensity is also high according to 82.35% of the producers who sort and burn. 50% of those who only sorted found that there were fewer weeds. Among those who did not apply any treatment, 28.57% said that there were more weeds.

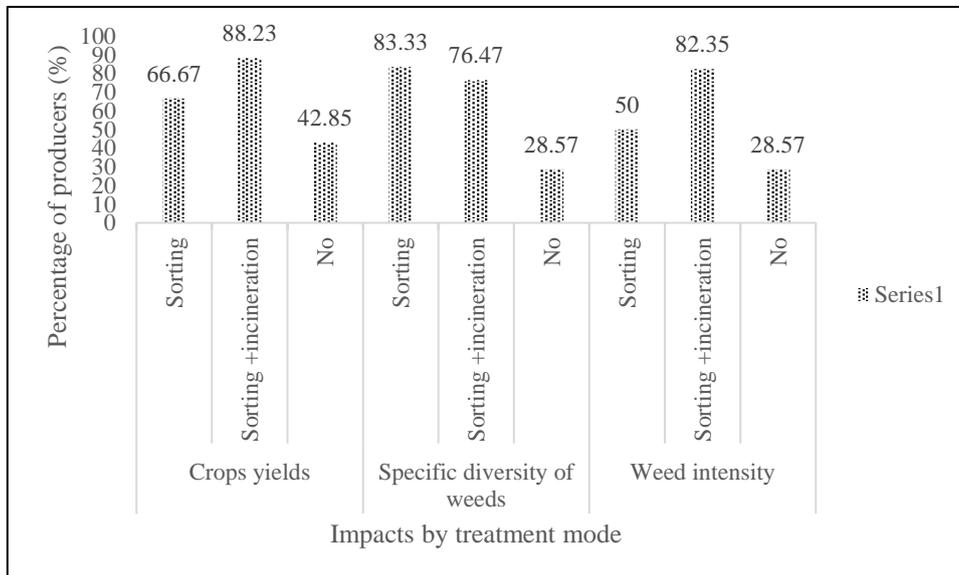


Fig. 7. Impacts of different treatment methods on the environment

4 DISCUSSION

4.1 IMPACTS OF DIFFERENT WASTE TREATMENT METHODS ON THE HEALTH OF PRODUCER

The results of the surveys showed that many producers are unaware the health risks involved in waste treatment. Indeed, treatment by sorting only presents more health impacts. 53.33% of the producers are at risk of being bitten by dangerous animals during sorting and 33.33% have been injured by sharp objects. Only 10% are harassed by mosquitoes and other insects. Our results corroborate those [6] which confirm the risk of injury when handling waste due to contact with sharp objects contained in the waste such as needles, syringes, bottle shards. Bites from animals such as snakes and scorpions, bites from disease-carrying insects and inhalation of toxic odours and gases are quite common [7].

The risks involved could be explained by the low level of education of producers. 56.67% are uneducated and use fewer protective tools during treatment. Also, few producers (3.33%) testify to having received support from state agents or other structures, which proves that they have no training in good agricultural practices, in this case in the prevention of health risks. Our results corroborate those of [8] who showed that in the town of Pouytenga in Burkina Faso, 58.3% of producers were unaware of the risks involved during waste treatment. Surveyed were being carried out the treatment without body protection, which exposes people to toxic elements and sharp objects. Also [9] revealed in a study in Ghana that only 16% of producers wore protective tools (boots and gloves) not because of health risks, but to protect themselves from cold and physical injury. In addition, producers testified that they had been injured several times in the field by sharp objects hidden under the waste.

Furthermore, the analysis of our results shows that none of farmers reported having contracted a respiratory, skin or digestive disease a few hours or days after returning from the fields. These results are not in agreement with those of [10] who showed that the producers had diseases such as malaria, diarrhoea, respiratory diseases (mainly colds and coughs), skin infections (itching) and tetanus. The difference in our results could be explained by the absence of a health study on producers. In contrast to [10], our results are mainly based on the respondents' answers.

4.2 IMPACTS OF DIFFERENT WASTE TREATMENT METHODS ON THE ENVIRONMENT

The analysis of our results shows that 65.92% of the producers claim to have good yields with the use of waste. In fact, the majority of producers no use that very little or no chemical fertiliser. Our results corroborate those of [11] who state that waste has high levels of organic matter and nutrients (N, P, K) that contribute to plant nutrition and thus increase crop yields.

In addition, some producers use waste in excess. For areas of 0.25, 1.5 and 3 ha, they use 11.67, 99 and 320 tonnes of urban waste respectively. According to [12] excess waste increases the heavy metal content of the soil. In this way, heavy metals can lead to groundwater pollution and impact agricultural production. Excessive use of waste by producers could be due to lack of training and advice on good agricultural practices by technical agricultural officers. According to [13] these heavy metals have harmful impacts on the plant and its environment. They are among the toxic elements that pass from the fields to the waters of ecosystems and from the soil to the plants [2].

Weed species diversity increases with the use of waste treated by sorting. 83.33% of producers who sorted said they noticed an increase in weed species. This could be due to the sorting treatment which does not allow the destruction of weed seeds in the waste as opposed to sorting followed by incineration. Although weed species diversity was lower in the fields that were sorted and burned than in the fields where the producers sorted only, weed intensity was higher. This could be explained by the regenerative power of some herbaceous species after the fire. According to [14] after a fire, most herbaceous and perennial species regenerate in a mixed way, by both shoot and seed. Fields that have not been treated have a low intensity of disease. This is because unburned plastic bags bury themselves in the soil and prevent grass from growing or block root development.

The latter justification also explains the better agricultural yield in plots where the waste was treated by sorting followed by incineration compared to plots with only sorting or no treatment.

According to 93.33% of the producers, waste is deposited in the plots during the dry season after the harvest. Exposed to the sun and wind, the waste and the pathogens it contains are dispersed into the environment, polluting it.

According to the work of [15], composting treatment allows good hygienisation of the initial materials by destroying pathogens and weed seeds.

5 CONCLUSION

From the different results obtained from the study, it appears that all the surveyed use household waste (HW) in their fields. 80% of them also used livestock waste and 70% used agricultural waste. As for industrial waste, excreta and biomedical waste, very few producers accepted them in their fields. Among the different waste treatment methods, more than half of producers practised sorting followed by incineration, i.e. 56.67%, and 20% practised sorting only. 23.33% did not carry out any treatment. The impact of waste treatment methods is much more felt at the level of sorting only. More than half of producers who were sorted their waste by sorting were being encountered dangerous animals, 33.33% had suffered injuries and 10% claimed to be harassed daily by insects.

Regarding the impact of waste treatment methods on the environment, the results showed that for 88.23% of producers who sort and incinerate, crop yields were good compared to 66.67% for those who only sort. As for the specific diversity of weeds, the percentages are respectively 83.33%, 76.47% and 28.57% for sorting only, sorting followed by incineration and no treatment.

These results call on decision-makers to take action to prevent or reduce the risks associated with the use and treatment of waste.

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