Perceptions of Populations and Technicians in Waste Management in Nampula, Mozambique

A. Tocoloa
Department of Sciences and Technology, Universidade Aberta, Rua da Escola Politécnica, 141, 1269-001 Lisboa, Portugal
Universidade Católica de Moçambique – Nampula

A. P. Martinho
Department of Sciences and Technology, Universidade Aberta, Rua da Escola Politécnica, 141, 1269-001 Lisboa, Portugal
CAPP, Center for Public Administration & Public Policies, University of Lisbon, Rua Almerindo Lessa, 1300-663 Lisboa, Portugal
CEG-UAb, Center for Global Studies, Universidade Aberta, Portugal

P. Vaz-Fernandes
Department of Sciences and Technology, Universidade Aberta, Rua da Escola Politécnica, 141, 1269-001 Lisboa, Portugal
CAPP, Center for Public Administration & Public Policies, University of Lisbon, Rua Almerindo Lessa, 1300-663 Lisboa, Portugal
CEG-UAb, Center for Global Studies, Universidade Aberta, Portugal

ABSTRACT: Urban solid waste management systems (MSW) in developing countries are characterized by inadequate service delivery, low waste recovery, operational inefficiencies and inadequate waste disposal. The presence of urban solid waste poses a threat to public health and the environment if not managed properly. In Nampula city, in Mozambique, peri-urban populations live near open dumps with open burning. The present study aims to analyze the implications and perceptions about the effects on health and on the environment of these populations that lives close to MSW dumps in the city of Nampula. A mixed survey was used with data collection instruments: an epidemiological questionnaire and interview guides. The common questions of these two tolls were analyzed and compare the perception of the population with the perception of health and environmental technicians of the municipality of Nampula.

1 INTRODUCTION

The presence of MSW poses a threat to public health and to the environment if not managed properly from separation, collection, transfer, treatment, and disposal or recycling and reuse (Vinti et al., 2021). The World Health Organization (WHO) has highlighted the risks associated with the inadequate disposal of solid waste with respect to soil, water, and air pollution and the associated health effects for populations surrounding the involved areas (WHO, 2015). Indiscriminate disposal of solid waste in dumpsites located within urban areas has proved to be a problem to nearby residents in most developing cities of the world. Nampula, in Mozambique, is no exception.

All waste disposed in the dumpsite will end up causing health risks to the inhabitants and environmental disaster such as large floods during the rains. These areas become sources of contamination mainly to children due to the incubation and proliferation of flies, mosquitoes, and rodents. All these inadequate waste leads to environmental and public health risks, including air and water pollution from indiscriminate dumping, and reduced quality of life, particularly for the most vulnerable and is related to environmental justice and unequal exposure to the environmentally detrimental impact of a MSW dominated by the informal sector (Vaccari et al., 2019; Perteghella et al., 2020).

Lack of (appropriate) technologies, poor infrastructure, institutionalized failure to implement and enforce urban policies and regulations, and financial capacity have been shown to be key reasons for inadequate management of MSW (Perteghella and Vaccari, 2017; Kazuva and Zhang, 2019; Kubanza and Simatele, 2020).

Due to limited solid waste separation, solid waste composition is complex and may contain industrial, medical, electronic, and human waste dumped on the same open grounds where all the other municipal waste is dumped (Vaccari et al., 2019; Perteghella et al., 2020). In developing countries, solid waste characteristically has a high content of organic matter compared to that in developed countries. The high organic content has implications for waste management including recycling, but also a potential source of ill-health if mismanaged (Perteghella and Vaccari, 2017).

Residents, especially those who are closer to dumpsites, are not satisfied about the location. They complain that the dumpsite is too close to their houses causing a lot of sicknesses and argue that their surroundings are smelly and filthy causing environmental pollution near their houses (Ndukwe et al., 2019). Several papers were found that reported the health effects on populations living near the dumpsites (Sankoh et al., 2013; Njoku et al., 2019; Norsa'adah et al., 2020; Tomita et al., 2020; Etea et al., 2021).

The present study aims to analyze and compare the perceptions about the effects on health and on the environment of populations that live close to MSW dumps in the city of Nampula, in Mozambique and the perceptions of the Health and Environmental Technicians from the Nampula Municipality. It is important to understand whether the perceptions of these two groups are similar to be able to move forward with concrete measures to protect these populations.

2 METHODS

The participants of this study were Health Technicians (one physician and five nurses) and Municipality Environment Technicians (two engineers and four operational technicians. It was applied a semi-structured interview script for each group that contained eight questions. Four of which questions were common to both groups. The interviews took place at their workplaces.

The questions regarding the population were taken from the epidemiological questionnaire previously published in (Tocoloa et al, 2022).

An epidemiological questionnaire, mostly with closed questions, was applied to a selected sample of 300 individuals from populations residing in the two studied areas: cases and controls. 139 individuals were female (46.3%) and 161 were male (53.7%), the average age of the interviewees was 32.9 ± 6.53 years, educational level were 188 individuals (62.7%) had completed secondary education. About the employment 201 individuals (67%) are self-employed.

The case population resided in the administrative post of Carrupeia (n=40), the administrative post of Muhala expansão (n=50), and the administrative post of Namicopo (n=110). The control population resided in the administrative post of Marrere (n=100). In Peri-urban areas of cases, the municipality use these areas to dump the waste collected in Nampula city. In the cases populations they live very close to the waste, the houses are in 100 m away. In the control population, this area is not used by the municipality to dump the waste, but as the waste collection in these places is very deficient, there is an accumulation of waste by the population, which means that the control population is also very close to waste, about 500 m away.

The questionnaire used here was based on the epidemiological questionnaire developed by Machado et al. (2017) and was adapted to the realities of Nampula (more precisely, to reflect the foods most typically consumed by the population of Nampula). It aimed to ascertain the risks associated with the level of health of the survey populations and the environment and how these related to living close to open dumps.

We selected five questions related to the perception of health status, the most frequent diseases and the perception of the place where they live, poor quality factors in where they live, factors in the good quality of the place where they live and selection of measures for improvement to be implemented in the places. A content analysis was conducted to standardize the information and thus be able to compare these three groups.

3 RESULTS AND DISCUSSION

Table 1 summarises the comparative content analysis between the health and environmental technician groups and the populations that living near open dumps.

Regarding the perception of their health status, it was found that the populations studied considered their health status to be good or reasonable. According to the information obtained in the interviews with health technicians, they considered the health status of the populations to be reasonable, despite highlighting the fact that the medical tests carried out were very superficial and focused on identifying malaria, not allowing a more in-depth assessment of the health status. A study conducted in Ethiopia showed different results, i.e., the populations living near the dumpsites were very concerned about the effects on their health, present and future, and on the health of their children (Etea et al., 2021).

In a study carried out in South Africa, with a representative sample of 32255 people, it was possible to establish a causal relationship between populations living less than 5 km from dumpsites and the consequences on their health, obtaining a higher prevalence of the following diseases: asthma, diabetes, tuberculosis and depression (Tomita et al., 2020).

These results obtained from the questionnaires are corroborated by the analysis of the interviews with the technical staff from the health centers, and it was possible to associate the treatments for injuries and being sick with several more serious diseases including respiratory diseases, skin diseases, diarrheal diseases and chronic diseases. Other studies have also found a link to injuries in the populations living near the dumpsites who usually only go to hospitals when the situation is very serious (Asampong et al., 2015; Cunningham et al., 2012; Kubanza & Simatele, 2020).

Several studies were found that reported health effects on populations living near the open dumps (Sankoh et al., 2013; Njoku et al., 2019; Norsa'adah et al., 2020; Tomita et al., 2020; Etea et al., 2021). A study in Sierra Leone found health effects in exposed populations living within 50 metres of the open dumps, with the following diseases recorded: malaria, chest pain, diarrhoea and cholera (Sankoh et al., 2013).

When asked about the quality of the place where they live, most participants considered it to be "normal" and the most negative option "poor quality" received the least responses. This may indicate that the population considers the place where they live to be adequate. One of the possible explanations for this response may relate to the ease of finding space for the house and farm without having to buy these properties. Another justification could be the good neighbourhood relations. Other studies have verified results that disagree with those obtained in this study, where the populations most affected by the proximity of the dumps considered the place where they lived inadequate.

For Ndukwe et al. (2019) and Sankoh et al. (2013) households living near the open dumps, are not happy with the location of the dump. They complained that it is too close to their houses, causing many diseases.

In another study developed by Etea et al. (2021), the results obtained were more in agreement with those obtained in this study, that is, although they had the perception of the risks of living near dumps, overall they considered a reasonable quality of the place where they lived. In other words, the perception of risk of the populations studied was more influenced by good neighbourly relations than by the quality of the environment. Similar results were also found in another study that examined the perception of air quality (Bickerstaff & Walker, 2001).

Several researchers have proposed a set of essential basic measures that should be implemented in populations living near open dumps. These measures include: replacing waste dumps with landfills (which should be properly located and managed to reduce impacts on the environment), resettling people who live too close to waste dumps, and providing populations with the necessary education to be aware of the effect of waste dumps on their health (Ndukwe et al., 2019; Etea et al., 2021).

The education of populations is also essential to promote good management of MSW. Implement simple measures to understand the local situation such as the characterization of MSW, adaptation of good MSW management practices and promote the use of locally adapted technologies, using examples successfully applied in municipalities with similar characteristics. Another very important aspect is the need to realise that waste can also be a resource and to build infrastructures for composting and multi-material recycling. This set of measures can be implemented in municipalities in developing countries (Wang et al., 2015; Ziraba et al., 2016).

Another study identified recycling and landfilling as the most suitable technologies to be implemented in developing countries. The methodology used analysed in a set of scenarios with a multi-criteria analysis, where the interests of several key actors and a set of economic, social, environmental and technical criteria are also included (Coban et al., 2018).

With the implementation of Agenda 2030 and the Sustainable Development Goals (SDGs), the need for a holistic and sustainable approach to MSW management has been confirmed, which should consider environmental, socio-economic and health factors, especially in developing countries. The socio-productive inclusion of waste collectors in cooperatives, associations, non-governmental organizations, or even recycling factories, with improved working conditions, decreased accidents and health problems represents an example of such a holistic and sustainable approach (Fedelis et al., 2020; Ikhlayel, 2018; Langa, 2014; Vaccari et al., 2019; Wang et al., 2015; Yoon et al., 2013).

Table 1. Comparing the perception of populations and health and environment technicians on common questions about health conditions, risks and environment.

Questions	Health technicians (HT)	Environmental technicians (ET)	Populations
Perception of population's state of health	Health status is reasonable		Health is good (50,7%) and reasonable (48%)
Most frequent disease caused by living near open dumps	Most common diseases: Malaria, Tungiasis, Cholera, and Typhoid fever Main reason for medical consultation: i) cuts and injuries (accidents at work); ii) serious illnesses (respiratory, skin, diarrhoeal and chronic) Main reasons for hospitalisation: Malaria, Cholera, Tungiasis, Bilharziosis, Tetanus and Anaemia.	Malaria, Tungiasis, Cholera, Bilharziosis, Scabies and Astma, Diarrhoea and Fever.	Malaria, Tungiasis, Bilharziosis, Filaria, Cholera and Yellow fever (>24%); Main reasons for using health services are “treatments” or “being sick”
Which urban waste has caused the most diseases to the population?	i) Sharp objects (needles, rusty iron, pieces of glass, blades); ii) Batteries, fertilizers, pesticides, leftover food (cause serious illnesses); iii) Oils and liquid waste (cooking oil, motor oil, contaminated water).	Organic waste, sharp objects, batteries, chemical products, medicines, metals, industrial waste.	
How to avoid diseases caused by urban waste?	Appropriate waste management: i)Better environmental behaviour; ii)Health rules; iii)Water protection	i)Resettling families; ii)Raising awareness and mobilizing populations; iii)Correct environmental behaviours regarding waste; iv)Municipality surveys risk places and environmental pollution foci and raises awareness of these populations; v)In the rainy season, the municipality intensifies actions; vi)Negotiations for moving families from one point to another from the markets; vii)Call for moving families to the homes of their relatives that are out of danger; viii)Distribution of mosquito nets.	The population identified the following measures (> 70%): i)Construction of landfills; ii)Construction of the fence wall; iii)Construction of dumps far from the population; iv)Resettlement of people living near the open dumps in other areas.
Protective measures that the ET uses for the populations living near the open dumps		i)Community meetings to inform about the problems caused by the dumpsites if the population enters without protection material; ii)Prohibit the population from entering inside the dumpsites; iii)Prohibit the population from making cultivation fields inside the dumpsites.	Identifies (> 90%) the compensation of people living near the dumps as improvement measures to be implemented at the sites.
Consequences of living near open dumps	Populations often get sick and the places where they live are polluted.	It leaves people with polluted air, respiratory diseases and other pathologies: malaria, diarrhoea, bronchitis, bilharziosis, tungiasis. The populations living near open dumps have poor health and are considered as beggars, landless, poor, people without hygiene.”	They consider that the place where they live is normal (71.3%) and Good (19.3%); More than 80% identifies 4 factors that are responsible for the poor quality of the place where they live: i)There is no treatment of MSW; ii)There are no medical services; iii)There is no canal drainage; iv)There are no constructions of

		ditches More than 90% identify factors responsible for the good quality of the place where they live: i)There is ease of food; and ii)There are activities to do.
What is the main reason why people live near open dumps?	i)easy occupation of the space; ii)space where they make a living for their families; iii)lack of financial funds to live in other areas; iv)lack of employment.	
What is ET doing to rectify this situation?	Responses to the problem: lectures for people to leave the area; Other suggestions: i)better solution would be to resettle families in other areas (no resources); ii)formation of associations of MSW collectors	
What are good practices in waste management?	The ET identify: i) Prevention; ii) Deposition; iii) Recycling; iv) Final destination: to place MSW with watertight and hygienic conditions to avoid its dispersion in a sanitary landfill.	

4 CONCLUSIONS

In this paper it was presented that the perceptions of populations living near open air dumpsites are very similar to the perceptions of technicians, with both groups identifying a set of measures that should be implemented. Although the technicians, by having more in-depth information on these themes (health and environment), can develop their reflection in greater depth and identify in detail the action measures to be implemented, for example: identify the good practices in waste management and formation of associations of MSW collectors. They also identify that these populations are in risk because they often get sick and the places that they live are polluted. The populations had some contradictory perceptions, as they considered the place they live are normal and good, and identify factors responsible for the good quality of the places they live. They also identify compensations for the people who live in this areas and improvement measures to be implemented.

Among these measures are the need for resettlement of families and adequate waste management. This provides a basis of understanding that can lead to action.

It is necessary to implement a set of measures to protect the populations living near open dumps. Among these measures we can highlight the following:

- Education of the populations, in an effective and continuous manner, on measures they can implement to protect themselves from these identified risks;
- Involvement of these populations in the decision and participation processes on MSW management to ensure that their points of view are considered;
- Consider the possibility of resettling the populations most exposed to the risks of the open dumps;
- Improve the living conditions and habitability of these populations;
- As some individuals from these populations also work informally in the recycling of products, they should be protected to reduce the risks they are exposed to by using protective materials provided by the municipality or MSW management companies and avoid the habit of burning waste in an uncontrolled manner.

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