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Evaluation of the community participation in solid waste management: case of the city of Bulawayo, Zimbabwe

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Abstract

The collection of municipal solid waste is an operational problem faced by local authorities in most cities of the developing world. A solid waste collection program was run in several residential areas of the Bulawayo city with the involvement of communities in order to improve solid waste management services. This study sought to evaluate the effectiveness of community participation in solid waste management. The research question of this study was as follows: is community participation effective in improving solid waste management services in the City of Bulawayo? A mixed research approach was used to determine the performance of the community-solid waste collection program. Significant findings were that collection of solid waste improved from to weekly and the number of active solid waste dumps had reduced. The economic impact was that for solid waste collection from each suburb; the average costs for fuel, repairs, and maintenance dropped by 28%, and the average costs for labour reduced by 30%. Residents that were involved in the program were economically empowered, with the monthly income for truckers increased by 203% and for street sweepers by 680%. Women, the elderly, and youths were involved in the program, but no disabled persons were involved.). Overall, the community-solid waste collection program performed well, although there was need for the City of Bulawayo to clear all active and non-active dumps. The findings of this study are applicable to urban areas in Zimbabwe which are facing challenges in solid waste collection.

Keywords Solid waste collection · Solid waste management · Performance · Community participation · Bulawayo City

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Introduction

Ideally, waste is supposed to be managed by separating the industrial and household unwanted materials and placing them in sanitary landfills, incineration, or recycling to prevent impacts on human health and the environment (Vergara and Tchobanoglous 2012). Solid waste management (SWM) continues to be a challenge in urban areas throughout the world, as the generation of waste has increased, resulting in an increase in budgets to clear the waste from households to disposal sites due to the high costs involved (Sharholy et al. 2009). This happens mainly in the rapidly growing cities and towns of the developing countries (Mohsin and Chinyama 2016). Rapid urbanization caused by the massive movement of people to cities has caused some municipals to strain their budgets on waste management (Mudzengerere and Chigwenya 2012). Solid waste management involves control of generation, storage, collection, transportation, processing, and disposal of solid waste in a manner that is in accordance with the best principles of public health, economic, engineering, and other environmental concerns

(Afroz et al. 2010). The most difficult operational problem faced by local authorities in any city is the collection of municipal solid waste (Nuortio et al. 2006), because the collection of municipal solid waste may account for more than 70% of the total waste management budget. To reduce the expenditure in the collection of solid waste, it is therefore vital to optimize the routing network used for waste collection and transportation (Tavares et al. 2009).

Although the collection and disposal of solid waste are done by the local authorities in many developing countries' urban areas, the process has not been efficient; for example, about 40% of the solid waste was collected in the Bahawalpur City, Pakistan, much to the dissatisfaction of the residents (Mohsin et al. 2016). In most urban cities of Zimbabwe, solid waste management, especially solid waste collection and disposal has, been an issue of concern, as waste has been seen along highways and in many urban communities (Mudzengerere and Chigwenya 2012; Muzenda and Nhubu 2019). According to Muzenda and Nhubu (2019), rapid urbanization of cities in Zimbabwe has led to an increase in solid waste generation and the local authorities have failed to cope. The inefficient collection system has led to disorganized and uncontrolled waste dumping in the environment, exposing residents to health risks (Makwara and Magudu, 2013). For example, in Pakistan, inappropriate dumping of solid waste created informal dumping points near the streets and roads resulting in land pollution and proliferation of disease-carrying vectors such as rodents and house flies (Mohsin et al. 2016). Cities in developing countries lack adequate funding to procure standard and appropriate equipment for solid waste collection, leading to the inefficiencies in the collection of solid waste (Khan et al. 2020; Mudzengerere and Chigwenya 2012). In the quest to solve solid waste management challenges faced by many urban settings, community participation as a development approach has been envisaged to be a solution. The emergence of participation as an approach to development was in part a response to the collapse of the credibility of 'grand theories' of development in the 1970s and 1980s (McPherson and McGarry 1987). Several studies have shown that community participation can help alleviate the challenges of solid waste collection faced by the local authorities if communities are involved in the planning and implementation of solid waste management programmes (Shukor et al. 2011; Ike et al. 2018; Sinthumule and Mkumbuzi 2019; Basu and Punjabi 2020; Serge Kubanza and Simatele 2020).

Ednah and Luo (2010) found that the involvement of volunteers from the community in the solid waste management program in Botswana known as 'Clean Up Botswana', was effective in anti-litter campaigns by changing consumer waste disposal behaviour in the country. Another study by Zahra et al. (2012) concluded that there was a great change both in the behaviour of society as well as the cleanliness of the area in Faisalabad City, Pakistan, where a solid waste management project was initiated with the inclusion of the community. Community participation in solid waste management encourages members of the community to be accountable to each other, and hence, behaviours such as illegal dumping and backyard burning of solid waste are reduced as community members keep watch over each other (Marello and Helwege 2018). The plethora of evidence on how community participation in waste management can solve waste management problems calls for local authorities to collaborate with communities in waste management.

In Zimbabwe, the city of Bulawayo faces challenges of solid waste collection, due to an out dated and inadequate fleet of solid waste removal vehicles. In response to the challenges, the city initiated a solid waste collection project involving the participation of the community in some of its residential areas. Against this background, this study seeks to evaluate the effectiveness of community participation in improving solid waste management services.

The evaluation of the effectiveness of community participation in improving solid waste management services was premised on the theories of reasoned action and of social capital. According to Vineeshiya and Mahees (2019), the theory of reasoned action states that the members of the community decide to participate in a project because of expectations of a positive outcome such as a reward. In this study, participants in the solid waste collection program were paid for their services which influenced their participation. The expectation of a reward enabled the local community to offer their resources such as their trucks and their labour towards the improvement of solid waste collection services. This is in line with the social capital theory which according to Coleman (1990) cited in Mpanje et al. (2018) relates to personal relationships that bond a community to pool their resources and work together to deliver services for the common good. Studies have shown that community participation has a positive impact on the sustainability of development programmes (Kleeimer 2000; Prokopy 2005; Sinthumule and Mkumbuzim 2019; Jomehpour and Behzad 2020; Serge Kubanza and Simatele 2020), especially when the community brings in their own resources as in the case of this study.

This study is significant in that it explores the dynamics of community participation in solid waste management that influences how much resources the community brings to the project to improve the services. Previous studies, for example Zahra et al. (2012) and Marello and Helwege (2018), concentrate on the aspect of mere community participation without analyzing the resources the community bring to the project to improve the effectiveness and sustainability of the project. This study evaluates the contribution of the community resources of time, labour, and vehicles to the effectiveness of the solid waste collection services.

Study area

The study was carried out in Bulawayo the second-largest city in Zimbabwe in Southern Africa. The city is divided into three districts for ease of administration, namely, Nkulumane, Emakhandeni, and Northern Suburbs Districts and one high-density suburb where the program was piloted was selected from each district for the study as follows: the Entumbane suburb (Northern Suburbs District), Nkulumane Suburb (Nkulumane District), and Pumula South suburb (Emakhandeni District) as shown in Fig. 1.

The general solid waste generated in the study area is domestic waste, typically food waste, plastics, and papers from packaging of household grocery items. Food waste is separated from the rest of the waste at source where residents have domestic animals such as dogs and rabbits that they would feed with food leftovers. Some food waste is composted for use in the garden at household level. Some households indiscriminately throw away all

waste into the garbage bag without sorting and removing food waste. Plastics especially plastic bottles are usually collected from the garbage bins by groups of informal collectors who sell the plastics to recycling companies. These behavioural patterns are indicative of the traditional linear economy of consuming and generating waste and throwing away the waste, resulting from lack of a deliberate policy to educate residents on the importance of sorting solid waste and recycling or composting at source. This is contrary to the circular economy practices; for example, in Germany, citizens are encouraged to reduce the waste generated as well as sort and prepare the generated waste for re-use, recycling or recovery of energy, or other useful resource (Nelles et al. 2016).

The waste was once collected by the local authority from the residential areas to the sanitary landfill. However, over time, the fleet of solid waste removal vehicles aged and could not cope with the demands of solid waste collection in the city. It was against this background that the local authority resolved to involve the community in the collection
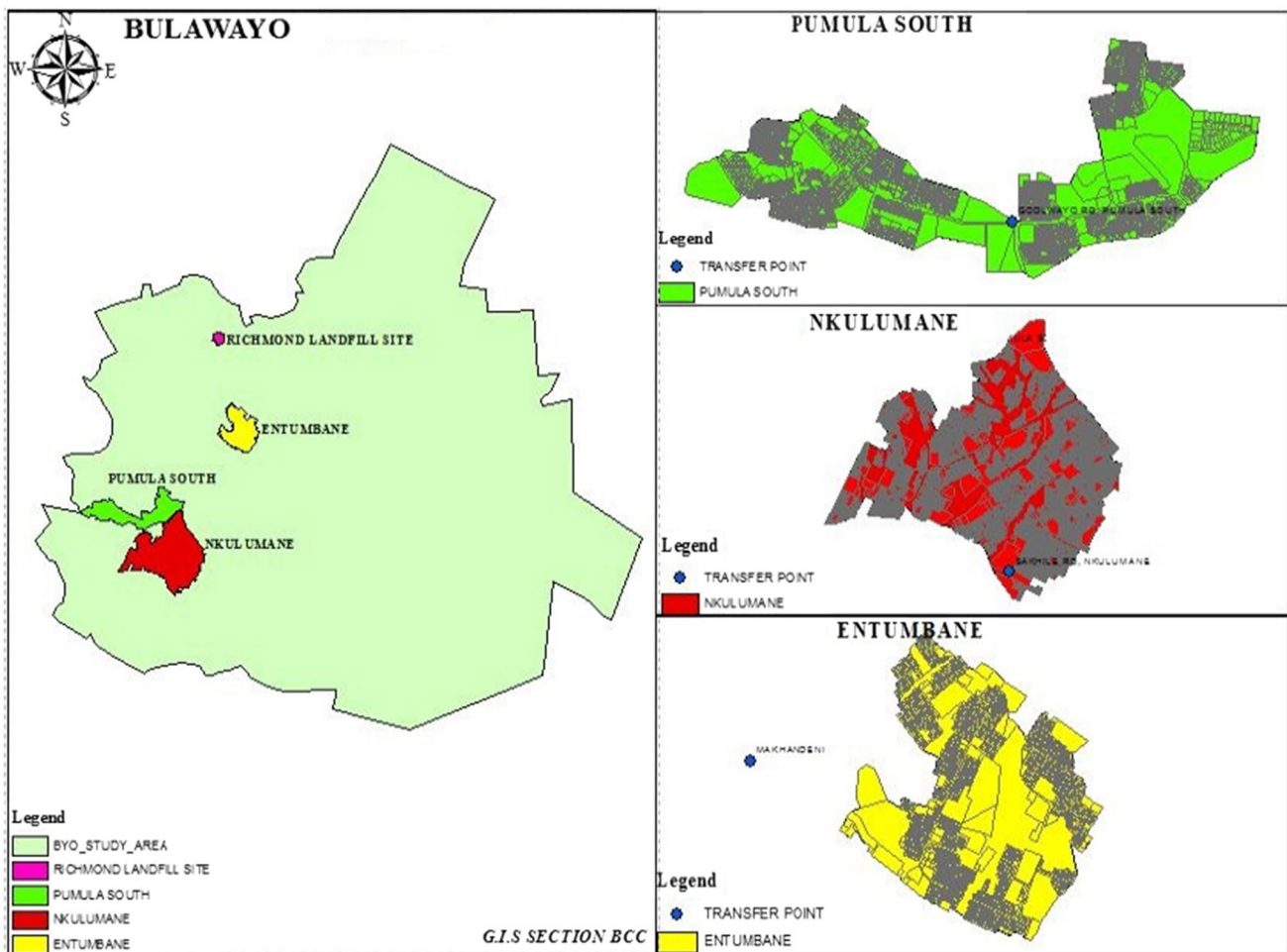

Fig. 1 Map of Bulawayo City showing the three study area suburbs

of the solid waste. Flyers were distributed to residents and multimedia platforms were utilised to bring awareness to the residents before the program was implemented. Meetings with local leaders of the communities were held in order to organize the members of the community for participation. The community solid waste collection program was then piloted at Emganwini, Nketa, Nkulumane, and Pumula South from 28 June 2015 and ended on 31 December 2015. It was rolled out into other 19 high-density suburbs in January 2016 (City of Bulawayo, 2015).

Materials and methods

Data collection procedure

A mixed research method approach which is a combination of qualitative and quantitative methods was used to evaluate the effectiveness of community participation in improving solid waste collection services. In order to answer the research question that is community participation effective in improving solid waste management services in the City of Bulawayo, an investigation of the improvements in solid waste collection services which took place after the implementation of the program was done. The improvement of the solid waste collection services was measured based on the following indicators of the service: the frequency of solid waste collection, improvement in terms of cleanliness, the period taken to clear each suburb in the study area, and the distribution of active and non-active open dumps. These indicators were selected for this study based on the norm of selecting the most appropriate indicators that are measurable and are able to show the difference between the before and after project implementation periods as used Rai et al. (2019) in his study. The collection of data to evaluate the indicators of improvement of the solid waste collection services was done through the desktop study of solid waste collection schedules at the Cleansing Section offices of the Bulawayo City Council.

Sources of data

Data on the frequency of solid waste collection and clearance of bagged solid waste from street sweepings were collected through observations, key informant interviews (KIIs), and focus group discussions (FGDs), which were held differently with truckers and sweepers. Purposive sampling was used to obtain a representative sample of key informants. The key informants were councilors of Nkulumane, Pumula South, and Entumbane suburbs; nurses in charge of the clinics in the suburbs; cleansing supervisors; cleansing officer; senior administration officer; and cleansing superintendent. Convenience sampling was used at the

solid waste transfer point to get participants for FGDs from the truckers and sweeping groups.

Information on the distribution of open dumps was obtained from area cleansing overseers and located by Geographic Information Systems (GIS) using a GPS device. The differentiation of active and non-active open dumps during data collection was guided by the fact that the non-active open dump had old solid waste, an indication that no recent dumping activities had taken place there, whereas the active dump had fresh solid waste, a sign that residents were dumping solid waste on it.

Instrumentation, samples, and sampling

Residents were interviewed using structured questionnaires about their awareness and their perception of the solid waste collection service. Simple random sampling was used to obtain a representative sample of households, where the eldest available person was interviewed. Raosoft sample size calculator was used to get the sample size; it was calculated at a margin of error of eight (8%), the confidence level of ninety (90%), and response distribution of fifty (50%). The recommended sample size for Nkulumane suburb was 105 out of 13,270 households, Pumula South suburb was 105 out of 6797 households, and Entumbane suburb 103 out of 3805 households.

Data analysis

The expected positive outcome participating in the community-solid waste collection program was measured as differences in the monthly income of the community members participating in the program as truckers and sweepers. The calculations were in US Dollar which at the time of the study was at a rate of 1US Dollar: 1 Zimbabwean currency. Measurement of the indicators of improvement of the solid waste collection services was done by analyzing the questionnaires using the SPSS 22 software and Microsoft Excel. Comparison of collection frequency in the program with the recommended frequency from literature as well as comparing the solid waste collection schedule with the actual collection of solid waste was done to measure the level of improvement of the service. Analysis of the cleanliness of the surroundings was done qualitatively from the observations. The analysis of the period taken to clear each suburb in the study area was done by comparison of days that were taken to clear each suburb before and after the implementation of the program. The distribution of open dumps was analysed using GIS software, QGIS from the data obtained using the GPS.

Results and discussion

Performance of community solid waste collection program

The performance indicators of the community solid waste collection program were identified as the frequency of solid waste collection and improvement in terms of cleanliness; the period is taken to clear each suburb in the study area, and the distribution of active and non-active dumps. The frequency of solid waste collection as reported by the residents of the study areas, 78% of respondents attested to the weekly collection of solid waste, 6% claimed it was collected fortnightly, and 2% monthly, 6% rarely, and 8% of the respondents did not know about the frequency of solid waste collection at all.

Since most of the residents (78%) attested to the weekly collection of the solid waste, the performance indicator of the solid waste collection frequency for the community solid waste collection program was satisfactory as it met the program's set target of weekly solid waste collection. This showed a great improvement in the solid waste collection frequency in the studied suburbs since it was between fortnightly and monthly before the introduction of the community-solid waste program.

A high percentage of the respondents expressed satisfaction on the cleanliness of the surroundings (63% of the respondents), while 37% did not see any improvement in the cleanliness of the surroundings. From observations in the study areas, there was evidence of general cleanliness of the surroundings as shown in Fig. 2 which shows solid waste bags waiting for collection by the truckers in neatly swept and clean surroundings.

Fig. 2 Solid waste bags collected by a community trucker put by the roadside by households

The performance of the community-solid waste collection program was also measured by the time required to collect all solid waste bags in an area. According to the desktop studies of Bulawayo City Council records on solid waste collection schedules, it was found that before the implementation of the program, it took more than 1 day to collect all the solid waste in each suburb. It was noted that it took 7 days to clear all the solid waste in Nkulumane suburb as it has 13,270 houses and is the furthest of the three from the land fill site, while Pumula South suburb has 6797 houses and Entumbane suburb 3805; thus, it took more time to clear the solid waste from Nkulumane, while clearing Pumula South and Entumbane was taking 3 days in each suburb. This is against the one-day time that is taken by community truckers to clear each suburb. This shows a significant difference in the time taken to clear each suburb before and after the implementation of the community-solid waste collection program in Bulawayo.

The performance of the community-solid waste collection program which was once per week meets the frequency recommended by literature. For example, Meine (2014) found that residential waste collection frequency in Addis Ababa (Ethiopia) was once or twice a week and the community was content with the service. Yusof et al. (2019) established that in Malacca, Malaysia, organic and unrecyclable wastes were collected twice a week, whereas recyclable waste such as plastic was collected once a week; all premises were required to separate waste at the source. Removing waste from public areas helps reduce risks to overall health, decreases exposure to biohazards, and reduces infestation of pest. The distribution of active dumps was also used to indicate the level of performance of the community-solid waste collection program. Figure 3 shows solid waste dump sites that were mapped during the study period in the Nkulumane suburb, out of the 124 dumps which were mapped 21 dumps (17%) were active and 103 dumps (83%) were non-active (Figs 4 and 5). The non-active dump had old solid waste, an indication that no recent dumping activities had taken place there. Whereas the active dump had fresh solid waste, a sign that residents were dumping refuse on it.

Figure 6 shows the solid waste dump sites that were mapped during the study period in the Entumbane suburb, out of the 38 dumps which were mapped as 13 dumps (34%) sites were active and 25 dumps (66%) sites were non-active.

Figure 7 shows solid waste dump sites that were mapped during the study period in the Pumula South suburb, out of the 64 dumps which were mapped 17 dumps (27%) sites were active and 47 dumps (73%) sites were non-active. The dumpsites are illegal as all solid waste should be transported to the Richmond controlled tipping landfill Site. The illegal non active dump sites were a sign that the program has reduced illegal dumping. The active

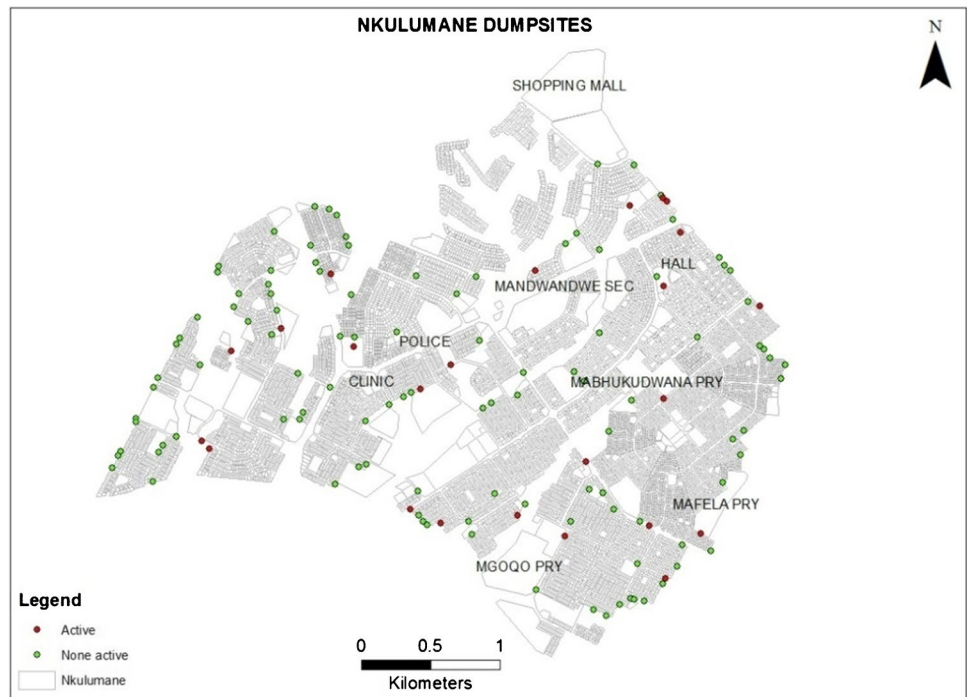**Fig. 3** Nkulumane active and non-active dump sites

Fig. 4 A non-active solid waste dump site

Fig. 5 An active solid waste dump site

illegal dumpsites had fresh solid waste while the none-active illegal dump sites had dry old solid waste.

Maps on dumps showed that the percentage of active dumps was lower than the percentage of non-active dumps; this revealed the effectiveness of the program, as it meant that residents were no longer dumping solid waste as they used to do before the implementation of the community-solid waste collection program. Nkulumane and Pumula South piloted the program; it was then rolled out to the other suburbs including Entumbane. The uniformity in the performance results of the three suburbs show that the rolling out of the program was properly done.

Socio-economic impact of the community-solid waste collection program

The economic impact of the community-solid waste collection program was measured as the differences in operational cost for the Bulawayo City Council and as differences in monthly income of the community members participating in the program as truckers and sweepers. Operational costs for Bulawayo

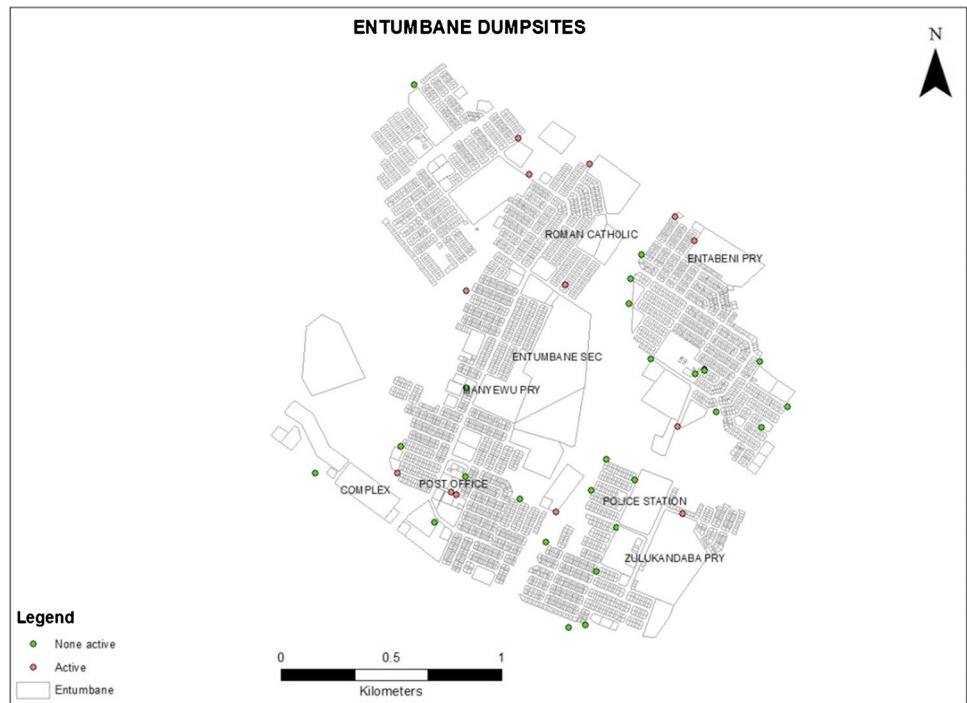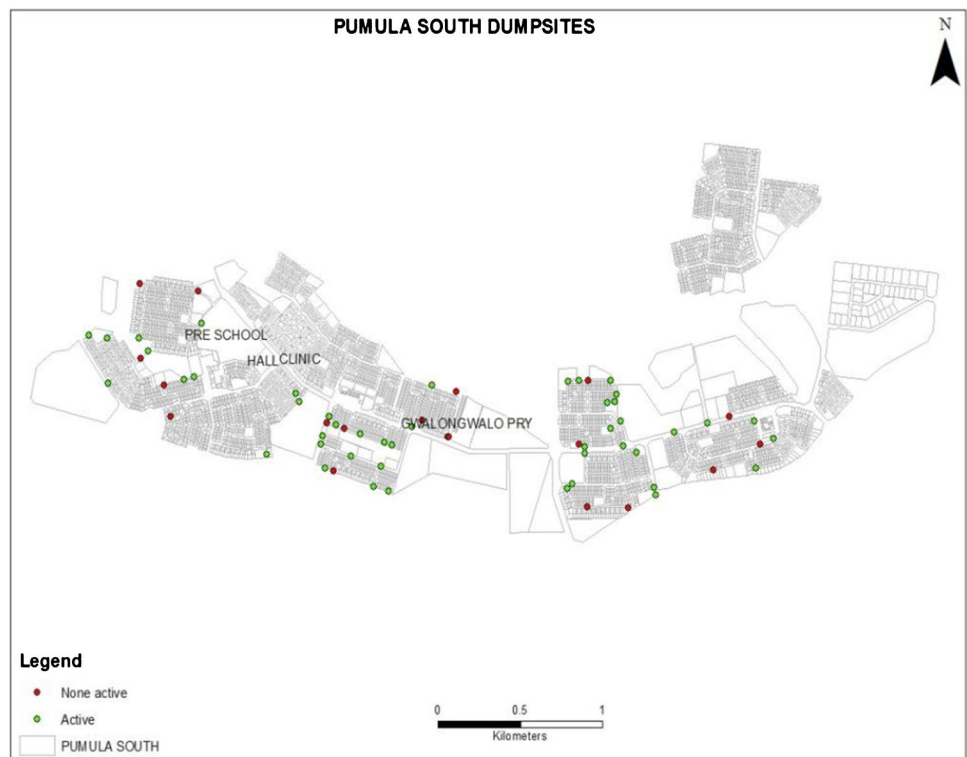**Fig. 6** Entumbane active and non-active dumpsites

Fig. 7 Pumula South active and non-active dumpsites

City Council in terms of the number of council trucks used to collect solid waste, it was found that before the implementation of the program thirteen council trucks were used to collect solid waste from house to house and only three trucks were used to collect the solid waste from the collection points after the implementation of the program. The Bulawayo City Council recorded a saving in operational costs as the fuel, maintenance and labour costs of thirteen trucks is much higher than that of three trucks. Table 1 shows the average costs for fuel, repairs, and maintenance to clear solid waste in each suburb

Table 1 Average costs for fuel, repairs, and maintenance to clear solid waste in each suburb

Name of suburb	Before implementation	After implementation	Decrease
Nkulumane	$ 4474.99	$ 3204.81	$1270.18 (**28%**)
Pumula South	$ 2409.62	$ 1725.67	$ 683.95 (**28%**)
Entumbane	$ 2065.38	$ 1479.15	$ 586.23 (**28%**)

Table 2 Average costs for labour and general costs to clear solid waste in each suburb

Name of Suburb	Before implementation	After implementation	Decrease
Nkulumane	$ 4174.54	$ 2904.25	$ 1270.29 (**30%**)
Pumula South	$ 1669.79	$ 1176.17	$ 493.62 (**30%**)
Entumbane	$ 2504.71	$ 1764.27	$ 740.44 (**30%**)

before the implementation of the community solid waste collection program in 2014 when the collection was twice per month and after the implementation in 2016. Reduced collection frequency resulted in uncollected wastes often ending up in drains, causing blockages which resulted in flooding and unsanitary conditions, breeding of rats flies, and mosquitoes, furthermore dumps of waste and abandoned vehicles block streets and other access ways.

From Table 1, when the collection was weekly scheduled after the implementation of the program, the costs were decreased by 28%. For labour and other costs, Table 2 shows differences for each suburb before the implementation of the community solid waste collection program in 2014 and after the implementation in 2016.

The labour and other general costs decreased by 30% after the implementation of the program. For the members of the community who were directly participating as truckers or sweepers, there was a change in monthly income as shown in Table 3.

The income increment percentage for truckers was 203%, and for sweepers, it was 680%.

It was clear that the members of the community who participated as truckers and sweepers derived substantial economic benefits from the program. Guggsa (2012) and Omar et al. (2017) also concurred that substantial income can be realized by community members that participate in

community solid waste collection programs. These results suggest that the community-solid waste collection program performed well in terms of providing a substantial saving for the Bulawayo City Council as well as an income benefit for the communities participating in the program. On the social inclusion of all members of the community in the program, it was found that out of a total of 26 community truckers who were recruited, 20 (77%) were males and 6 (23%) were females. Out of a total of 60 street sweepers who were recruited, 9 (15%) were males and 51 (85%) were females. There were fewer females than males that were engaged as truckers, and there were more females than males that were engaged as street sweepers, and none of them was disabled. The results of the assessment of community members having equal chances to economically benefit from the program showed that the chances were there since the contracts for the truckers were 12 months and for street sweepers, 3 months long and this promoted in rotation so that each community member got an employment opportunity. This provided equal chances to community members to economically benefit from the program as truckers and street sweepers. Community empowerment and social inclusion to address the needs and potentials of the most vulnerable and marginalized groups of society existed in the program in form of inclusivity, which was incorporated at the recruitment stage of community truckers and street sweepers.

The percentage of women was higher in the sweeping groups and very low in truckers; this shows that few females owned trucks, youths were well represented, but there were no disabled persons in the community solid waste collection program. Carrabba (2007) stated that a community should be inclusive; however, respondents claimed that the tasks involved were physically demanding, such that the disabled could not manage to carry the tasks involved in solid waste collection. Cleansing and solid waste services are services that require physical strength and youth, especially the solid waste collection section, and by having a good understanding of the age profile of staff, certain operational adjustments can be planned and made timely (Ethekwini Municipality 2004). On the issue of health and safety, the results revealed that the truckers and sweepers had personal protective equipment (PPE) which prevented exposure to anything that could be detrimental to health, and cleansing officers made spot checks on the truckers' crews and sweeping groups to see if they used PPE. The crews understood the benefit of using the PPE, and furthermore, it is mandatory.

Table 3 Community economic status

Type of involvement	Monthly average income before involvement	Monthly average income after involvement	Increment
Truckers	$ 500.00	$ 1515.68	$ 1.015.68(**203%**)
Sweepers	$ 50.00	$ 390.00	$ 340.00(**680%**)

Conclusion and recommendations

In this study, the performance of the community-solid waste collection program was assessed to evaluate the effectiveness of the program. From the findings, it can be concluded that the program was effective in improving solid waste management in the three suburbs as solid waste was collected more frequently, reducing the tendency to use unofficial dumpsites, and the residents perceived that their surroundings were cleaner. The socio-economic analysis revealed that both the local authority and the community derived economic benefits from the program in the sense of cost-saving for the City of Bulawayo and improved livelihoods for the community members who participated in the program. The social impact of the community participation in solid waste management was the proper management of waste at the household level, community empowerment through rotation of participation and inclusivity, and health and safety of the truckers and street sweepers.

It was recommended that the City of Bulawayo should maintain the community-solid waste program and roll it out to other suburbs as well as clear all the active and non-active dumpsites to discourage uncontrolled dumping of solid waste. The participation of all members of the community must be encouraged by increasing the frequency of community consultations and awareness meetings as well as provide incentives such as payment for services rendered. Members with disabilities should be given the opportunity to choose roles they are comfortable with physically and materially such as doing administrative duties and other chores depending on the type of disability. Further study is recommended on community participation in other aspects of solid waste management (SWM) such as disposal and recycling.

Author contribution Mutemani, J.: originate the idea, data collection, and write-up of the paper. Chinyama, A.: supervise the work, data analysis. Mohsin, M.: revise and review the manuscript, discussed the results. Kativhu, T.: assist the whole manuscript with useful remarks and suggested revision.

Declarations

Conflict of interest The authors declare no competing interests.

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