

Interrogating Integrated Solid Waste Management Practices within Rural District Councils in Zimbabwe: A Case Study of Pfura Rural District Council, Mount Darwin (Zimbabwe)

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Abstract

This paper focused on integrated solid waste management practices within rural district councils. The management of solid wastes has become an increasingly important environmental issue due to population increase. Most urban municipalities are facing solid waste management challenges because waste generation exceeds the collection capacity. This paper focused on rural municipalities since waste management challenges are not experienced in urban cities only but in rural centres also. Not much has been documented for rural municipalities and this study sought to address this gap by conducting a case study in Pfura a Rural District Council in Mount Darwin, Zimbabwe. The objective of the study was to establish the Solid Waste Management system used by the Council. To achieve these structured questionnaires were administered to 200 randomly selected households in the four residential suburbs and 10 were administered to other service users such as shop owners and private companies. Focus group discussions and observations were also used for data collection. Findings showed that curbside collection of waste was the main waste disposal method used. Informal parallel systems involving open space dumping and uncontrolled burning of the waste were also noted. The study recommended that an Integrated Solid Waste Management system be adopted. ISWM promotes waste reduction, resource reuse and recycling.

Keywords: Solid Waste Management; Integrated Solid Waste Management; Disposal; Curbside collection; Reuse; Recycling; Rural District Council

Introduction

Humans have been producing solid waste since they first formed non-nomadic societies around 10,000 BC [1]. Worrell and Vesilind highlighted that for solid waste management some small communities buried their solid waste just outside their settlements or they disposed it off in nearby rivers or water bodies [2]. Wilson added that as population densities increased, these practices became more and more unsustainable resulting in diseases and foul odours spreading [1]. This resulted in disease outbreaks which then saw public health bylaws being enacted. Public health legislations became the major driver of waste management in many of these communities [1]. UNEP added that this enactment led to the creation of waste management systems and operations in response to the enacted legislations. Municipalities were mandated to provide waste management services in the interest of public health [3,4].

After sometime these municipal solid waste management systems (MSWM) began to fail due to increases in population and improved standards of living in the communities [1]. The UN-HABITAT adds that increases in financial challenges encountered by many municipalities also have become a major challenge in solid waste management [5]. There was therefore need for the improvement of these solid waste management practices to ensure sustainability. Because of the need for innovations that viewed the waste management processes in their entirety; as an interconnected system of components which depend on each other, integrated solid waste management (ISWM) was considered [1,5,6]. As a result the concept of ISWM evolved, thereby transforming waste management across the globe. Consequently, attendant policies and action plans have been developed in this regard.

The Agenda 21 plan of action in chapter 21 highlights that environmentally sound solid waste management must give priority to the safe disposal of waste [7]. It also highlighted in chapter 4 that focus actions which seek to change unsustainable patterns of production and consumption and waste minimisation strategies such as source reduction, waste recovery, reuse and recycling could possibly be adopted if development and environmental protection were to reconcile [7,8]. Despite the existence of such

conventions, sharp rises in solid waste management challenges are being experienced in both developed and developing countries most of which are signatories [1].

Waste management problems continue to grow and according to the World Bank, the problem is more acute in economically developing countries, where financial, human, and other critical resources generally are scarce. The World Bank estimates a 70% global increase in urban solid waste with developing countries facing the greatest challenges in solid waste management [9]. Even though waste generation rates available for select cities and regions in Africa shows lower waste generation rates as compared to most cities in developed countries, the disposal of this solid wastes still constitutes one of the most pressing challenges faced by urban authorities in most African Countries [6,10-12]. Nkonya E, *et al.* notes that in recent years there have been considerable increases in illegal waste dumping sites in most urban areas across most countries in Africa. This indicates that throughout the continent urban waste disposal systems are inefficient and environmentally unsafe [13].

In Sub-Saharan Africa the management of solid wastes has become an increasingly important environmental issue due to the escalating growth in populations and the changes in life styles which are giving rise to new trends of unsustainable consumption patterns coupled with increases in wastes production [14]. Sanyanga and Masundire brings out that in the SADC region solid waste generation exceeds collection capacity [14]. This is supported by other studies conducted in Botswana, South Africa, Tanzania, Zambia and Zimbabwe amongst others [5,15-19]. While the Department of Environmental Affairs in South Africa agrees to the fact that waste volumes have increased it also brings out that increased complexity of waste streams has further burdened waste management services which are already in short supply [20]. This is true because most countries in the SADC are grappling with the problems of high volumes of waste and high costs involved in the management. SADC highlights that these are exacerbated by lack of proper disposal technologies and methodologies, inadequate manpower and equipment and poor enforcement (SADC, 2012).

Likewise most major cities in Zimbabwe are also struggling with waste management issues [11,21-23]. To this effect there are numerous studies conducted which focused on solid waste management (SWM) in most of Zimbabwe's Cities. However the research has concentrated mostly on large cities especially Harare, Bulawayo, Gweru and Chitungwiza with small towns and rural centres being side lined [22]. Waste management challenges however are not peculiar to urban cities only but small towns and rural centres are also facing similar challenges [11,19,21,22]. Agenda 21 chapter 21 advocates for environmentally sound management of all solid wastes. Chapter 21 section 39c states that governments should by the year 2025 ensure that full urban waste service coverage is maintained and sanitation coverage is achieved in all rural areas [7]. This makes it important to also have research that focuses on SWM in small towns and rural centres.

In Zimbabwe, both urban and rural councils are mandated by the Environmental Management Act to ensure that solid wastes are disposed of in a manner that safeguards public health and minimises environmental pollution. They are mandated to put in place measures that seek to ensure that all solid wastes produced in their jurisdictions are collected, treated and disposed of in a safe manner (EMA 20:27; Urban Councils Act 29:15; Rural District Councils Act 29: 13; Public Health Act 15:09). Currently in urban areas, most solid wastes are crudely tipped in landfills, openly burnt and/or illegally dumped in undesignated areas such as open spaces and idle lands. Most council authorities are overwhelmed and they are failing to cope with SWM [11,19,21,22,24]. According to the UNEP, not much had been specifically written to provide the type of information that is required by developing countries [25]. Masocha also argues that in the developed world most solid wastes generated are recycled and recovered with the remaining waste being treated before disposal at secure landfills. In contrast most developing countries' cities such as Harare, Lusaka and Johannesburg face challenges of insufficient collection and improper disposal because of various challenges [22]. Zurbruegg argues that waste management solutions need to be developed locally and tailored specifically to meet local needs and conditions. He further states that urban centres throughout Africa collect less than half of the solid waste produced and that 95 percent of this amount is either indiscriminately thrown away at various dumping sites on the periphery of urban centres, or at a number of so-called temporary sites which are usually open spaces [12].

This study therefore sought to explore the waste management system currently adopted in the rural centre of Mount Darwin which is under Pfura Rural District Council, Mashonaland Central Province, Zimbabwe. In Mount Darwin the frequency of waste collection in most of the residential suburbs, town area and rural centres has since decreased. Waste is going for weeks without collection and removal. As a result illegal dumping sites have surfaced in most open spaces that surround the residential areas, shops, the vegetable market place as well as the commuter omnibus rank. It is fast becoming an eyesore. Poor disposal of solid wastes is of concern because the environment is being polluted and this undermines ecosystem stability. Poor waste disposal also poses threats to the health of the residents in the event of disease outbreaks like typhoid and cholera which were recently recorded in the area. Muranganwa noted that open waste dumps have become prime breeding sites for houseflies, rodents, mosquitoes and other vectors of communicable diseases such as fever, dysentery, diarrhoea, cholera and malaria [23]. Fumes from burning waste causes acute respiratory infections and the odours make the environment uninhabitable [22,23,26]. Tsivo also added that loose papers and plastics blown by wind resulted not only in an aesthetic intrusion of the surrounding environment but contributed to the blockages of the storm water drains leading to flooding in the cities [6]. The aesthetic value of the study area which is vying for town status also needs to be maintained if they are to court more capital investments for growth, expansion and development.

Pursuant to the above, this study sought then to identify the status of the present solid waste management system being utilised by the Pfura Rural District Council. According to Masocha in rural areas, waste management services are rare and, if they exist,

they are reduced to collection and disposal only. He further notes that these services in rural areas are inadequate with a significant portion of the population not having access to waste collection services. Sometimes only a fraction of the generated waste being actually collected [22]. The research therefore sought to also establish the existence of a SWM system and if present its status and the possibility of establishing an integrated approach as well as bringing to light some challenges, obstacles, loopholes in the existing system if any so as to effectively adopt an effective ISWM system. In light of the findings of the study some recommendations were given to assist the decision makers both at micro and macro levels to formulate an appropriate integrated solid management (ISWM) system for effective waste management.

Methodology

The study area, Mount Darwin is 157 km north of Harare the capital city of Zimbabwe. This is described as a rural business centre under the Pfura Rural District Council in ward 26 of the Mount Darwin South constituency in the Mashonaland Central Province of Zimbabwe. The parliamentary profile describes this constituency as an urban constituency whose livelihood is mainly depended on both commercial and subsistence farming small scale gold mining and formal and informal business activities around the centre [26].

The study area was Mount Darwin town business centre and the target population were the residents as well as the business owners in the central business centre. Mt. Darwin has 4 residential areas namely Camperdown; a low density residential area, Ridgeview; medium density and Kandeya and Pfura townships which are both high density residential areas. In the central business districts there are a number of supermarkets, pharmacies, banks, commuter omnibus rank, small scale informal traders and government offices' complex housing the district's administration (the D.A) and many governmental institutions [27].

The case study research design was chosen because the research questions that frame the study are closely connected to their phenomenon which is a rural council. The case study method allowed for the question of the current status of solid waste management system, constraints and potential options to be addressed whilst exploring opportunities for integrated solid waste management in the study area. However to make this research design more effective a mixed methods approach, also termed triangulation was adopted. This mixed methods approach helped in the generalisation of the findings to the population under study. It also helped develop a detailed view of the solid waste management system adopted in the study area. This triangulation method was adopted because it was simple to comprehend and it allowed the researcher to explore and use both qualitative and quantitative methods in a triangulation research process. This enabled the researchers to reap benefits from both qualitative and quantitative methods. It enabled the researchers to explain more fully the differences in human behaviour towards solid waste management by studying it using more than one study method. The triangulation approach also increased credibility of findings in this study by avoiding bias and distortion of perceptions during surveys. A number of qualitative and quantitative methods as research strategies of the mixed method approach were adopted in a bid to achieve triangulation. To this effect data from the study area was collected through administering various qualitative data collection instruments such as structured interviews, observations, focus group discussions, field surveys and questionnaires. The quantitative methods were mainly used during data analysis and this ensured that the study was systematic in that answers from interviewees and the data collected was not biased towards pre-existing ideas about waste management practices in rural districts.

The study had a mixture of probability and non probability sampling methods being used for data collection. There are several types of probability sampling methods used by researchers and these includes simple random, systematic, stratified, cluster, stage and multi phase sampling methods amongst others (Smith, 2008). Probability sampling techniques such as simple random sampling, stratified sampling, purposive sampling, convenience sampling and snowballing sampling methods were all used in this study to draw respondents from the wider population in this study. Non probability sampling techniques which involves the researcher targeting a specific and a particular group with the full intention that it might not present the whole population but in that it represents itself were also used [28]. In this study, focus group discussions, interviews with key informants and observations were adopted as the non-probability sampling techniques. The research design also adopted both qualitative and quantitative research methods in the study so as to achieve triangulation.

For primary data collection, this researcher used questionnaires, focus group discussions, direct observations and structured interviews as methods for gathering empirical evidence. Mt. Darwin business centre had 4 residential areas and data was collected from 200 randomly selected households. Fifty were collected from each of the four residential suburbs namely Camperdown low density suburb, Pfura high density township, Ridgeview middle density suburb and Kandeya high density township. Ten questionnaires and guided interviews were conducted with private companies, shop owners, employees at the government complex and other stakeholders. Employees and officials were interviewed at both the Mt. Darwin and Dotito offices. Structured questionnaires which contained definite and concrete questions were used, however at times non-structured questionnaires were used only as a guide during some interviews. This was necessitated by the fact that some of the respondents were illiterate and the researcher had to interview them so as to get information. In the structured questionnaires the questions were mixed. Open ended questions and closed questions in which respondents chose answers from a set of provided options. This tool was the most appropriate for households and other service users such as supermarkets and governmental institutions and private companies which were found in the study area. Focus group discussions were held in the council's hall and at a local church. Responses from the questionnaires, interviews and focus groups were pre-coded parameters. They were analysed using the SPSS package and various descriptive statistics generated. After analysis these parameters together with observations and documented evidence gave a reflection of the outcomes and the current status of solid waste management in the study area.

Results and Discussion

Statutory instrument 6 of 2007 for Environmental Management (Effluent and Solid Waste Disposal) highlights that responsible authority must develop waste management plans that guide their operation in waste management [29]. Pfura District Rural Council is the responsible authority for solid waste management in Mt Darwin. The council is mandated by the Rural District Council Act [29: 13] and the Environmental Management Act [20:27] to provide these services [30].

Solid waste collection and disposal services in Mt Darwin

Pfura Rural District Council had a formal solid waste management system that uses curbside collection services. Curbside waste collection involves the collection of wastes at sources where it is generated [31]. In most residential areas respondents indicated that they place their wastes in bins at the gate of their residence awaiting collection by refuse collection crews. Council officials indicated that the environmental health division is responsible for solid waste disposal and its management. During interviews with the officials it was established that waste is collected at least once per week in all the four residential suburbs. Respondents from the household survey confirmed that the council collects waste once a week using curbside waste collection method. The curbside method of collection involves service users having bins which they place at gates or by the roadside for collection by refuse collection teams. Results from the survey showed that despite the council using this curbside system some residents had no bins at all at their residences. The waste receptacles provided by the council were black bin liners which were not durable. Replacement took longer so much that the residents had to use alternatives such as sacks, broken buckets and plastic bags which were usually thrown off at the open space dumping areas. Respondents with no proper bins at their residences were recorded across all residential areas. Some respondents did not have bins at their residences. Explained that “because we do not have bins, we cannot keep waste at our households we look for areas to dump the waste. We at times openly dumped the waste in open areas and on street corners and if you are lucky and your yard allows; you dig a refuse pit at your house”. During the survey photographs were also taken which showed a variety of waste receptacles used by respondents. Below is a collage of photographs which shows the various types of waste receptacles used by residents (Figure 1).



(Source: Survey results, August 2015)

Figure 1: Waste receptacles used by residents for curbside collection

Some respondents indicated that they had pits instead, whilst others indicated that their liners were torn awaiting replacements. Others however agreed to illegally dumping paper bags full of wastes in street corners and open spaces. Sacks, bin liners and broken buckets were the most common types of bins available at most households. Across all residential areas sacks were the most common type of refuse bins used by most residents. This was despite the fact that council officials provided black bin liners used as bins to almost all the residents.

A disgruntled respondent complained that “the council officials do not change the liners soon enough and their waste collection is erratic so the liners get torn before we get replacements. We then use our sacks as alternatives. Sacks are much stronger, more durable and can be washed unlike their flimsy bins they give us.”

Another respondent noted that “the bin liners are not strong and we use them for storage of grains like sugar beans or maize after treatment. Sometimes if we receive many liners we sell them to the tobacco farmers who use them when grading their cured tobacco. Mount Darwin is surrounded by many farming settlements and rural communities and our bin liners are cheaper than those plastic rolls available in shops or at flea markets.”

It was noted that most residents preferred the more durable plastic and metal bins. One shop owner interviewed in the city centre commended the council for having such metal bins. He explained that “metal bins are durable than the bin liners they used to give us. These bins are better because they are durable can last longer. We need more of them because we produce high volumes of wastes.”

During interviews with council officials the researcher noted that some private companies and other stakeholders had provided the council with these durable waste receptacles. Some private companies donated these metal bins to the council and this showed the existence of some private stakeholders’ participation in solid waste management. Labelling of bins also proved to be some good form of advertisements for these companies. Partnerships are very important when establishing an effective ISWM since it is not the mandate and responsibility of the council alone, but all stakeholders must participate to ensure the sustainability of ISWM system [23]. Field surveys also confirmed the existence of such partnerships and below are photographs of some of the communal bins dotted around the town which bore company logos (Figure 2).



(Source: Survey results, August 2015)

Figure 2: Branded metal communal bins in the town area

Most of these communal bins were in the town centre and near the commuter omnibus taxi rank. However during the survey the researcher noted that some areas behind the flea markets, vegetable stalls and some restaurants had no bins so open dumping in open fields and pits was prevalent. Below are some photographs which showed these practices (Figure 3).





(Source: Survey results, August 2015)

Figure 3: Open dumping in fields and pits in the town centre

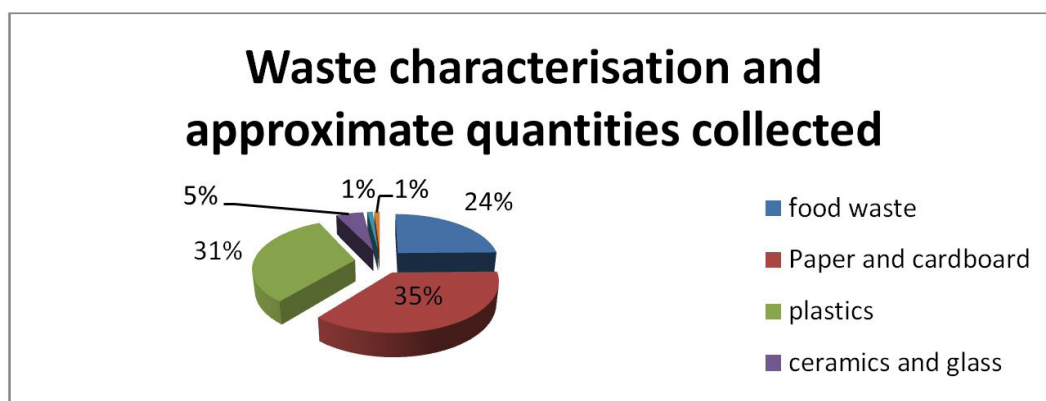
Household and other forms of wastes collected by the council were from residential areas, supermarkets and their warehouses, vegetables and the fruit market near the bus terminus and offices and institutions like the district attorney complex which house many government offices being the major sources of solid waste. However acquiring accurate waste quantities of the waste collected by the council was a challenge since both the council and service users do not quantify their waste. Council officials did not have an up to date waste quantification system in place therefore only estimates were given by the officials. Most of the respondents did not answer the section which asked for solid waste quantities produced at their households.

Respondent 153 [20 August (2015)] informed the researcher that people do not usually quantify our waste at households. Here we can only help you with the estimate number of sacks that we produce per week. In Mt. Darwin collection is weekly so quantities vary from half a sack to a full sack per week depending on our monthly provisions that I buy; but remember things are hard so not much is to be wasted. People do budget their meals in order to survive nowadays.”

The type of waste and the quantities produced can also be used to determine the lifestyle of the owner of the waste receptacle. Many people shun away from quantifying their waste for fear of being labelled as poor or struggling [32]. This together with the fact that others on the other hand are also afraid of being labelled as extravagant or wasteful most respondents therefore did not want to quantify their wastes.

During the survey the researcher noted that only a single tractor is responsible for all the solid waste collection. This shows that low quantities of waste are currently being collected by the council. Environmental health division officials who were part of the refuse collection team confirmed that only one vehicle currently services the whole area of Mt Darwin. During the interviews council officials indicated that there are plans to acquire a new state of the art refuse collection truck to replace the tractor which is old and always in constant need for repairs. Financial constraints and shortages of spares for repairs were cited as the major challenges that rocked the environmental division.

In as much as the council had a clear SWM system it was tarnished by inconsistencies and irregular collection which again contributed to open waste dumping and open uncontrolled burning of community bins in a bid to avoid litter. Inadequate waste services lead to unpleasant living conditions and a polluted and unhealthy environment. Given that a growing population trend and increased economic activity is expected once the study area achieves town status this means that increased volumes of waste are going to be generated. This puts more pressure on the already in short supply waste management services and facilities. Also there is increased complexity of the waste streams because of increased economic activities and urbanisation. This creates the need for waste to be segregated at the source hence the adoption of the ISWM system which focuses on stakeholders participation (Figure 4).



(Source: Survey results, August 2015)

Figure 4: Types of solid waste collected by the council

The type of waste collected in the study area was almost the same with that of established urban centres and communities. This showed that though the study area was a rural centre it also needed to have a developed solid waste management system just like those found in urban areas. The council strive to provide this using the curbside system. More than 50% of the respondents however indicated that the waste collection services offered by the council were not satisfactory. Residents indicated that they end up burying their waste or burning it to avoid litter. Residents were not the only ones affected by erratic waste collection but shop owners and other service users also in the town area complained that most of the community bins at their premises were not regularly collected. During the survey it was noted that most of the burning is done at night because during the day people usually complain about pollution. Shop owners also added that smoke from burning community bins affected their customers so they prefer burning the waste at night.

During interviews council officials acknowledged the existence of some illegal dumping areas but they maintained that the situation was not out of control. However survey results and field observations showed that the existence of illegal dumps is a wide spread phenomenon even in the central parts of the town area. Areas of concern were behind the vegetable markets, road catering spaces and behind most of the shops. Dumps in open spaces were also noted by the researcher across some street corners and intersections as well as in some open spaces behind some shops. Some wastes were dumped under the bridge just outside Mt Darwin on the Mt Darwin- Dotito main road (Figure 5) (Table 1).



(Source: Survey results, August 2015)

Figure 5: Some open space dumps in Mount Darwin

Residential area	Method of disposal if not collected			Total
	Burn	open space dumps	pits at household	
Pfura	20	11	18	49
Ridgeview	8	19	22	49
Kandeya	15	21	16	52
Camperdown	10	6	34	50
Total	53	57	90	200

Table 1: Preferred Method of Disposal for Uncollected Solid Waste

The results showed 50% of the respondents in the town area indicated that because the waste collection services offered by the council are not satisfactory they end up burning their waste in a bid to avoid litter. During the survey it was noted that most of the burning is done at night especially by business owners because during the day people usually complain about pollution and this can affect their customers so they prefer burning the waste at night. Respondents 119 [21 August (2015)] a restaurant owner highlighted that “*unlike our counterparts the supermarket and shop owners who can burn their waste organic waste is difficult to burn so we end up disposing our waste in pits or in the open spaces where the waste can decompose. However this has led to increases the challenges of mosquitoes, rodents, vermin and odours but we do not have a choice because the council is letting us down by not collecting the waste*”.

Below are some photographs which show some of the waste being openly burned in the community bins and in illegal dumps and open spaces in the business centre (Figure 6).



(Source: Survey results, August 2015)

Figure 6: Ashes in open spaces and burning of waste in the community bins

It was also noted that the council mostly preferred waste disposal over other options. The council had no recycling or resource recovery infrastructure. Availability of such equipment would have enabled the separation of waste at source before final disposal. The disposal system used by the council did not allow for the diversion of waste streams in a way that can aid material recovery during waste collection or during final waste disposal [4]. 41.5% of the respondents described the services offered by the council as very dissatisfactory 38% described the services as being fairly satisfactory. The waste collected was not segregated before collection. It was all mixed in the truck and compacted before disposal. Crude tipping and open burning were the most preferred methods they used in their solid waste management system. Crude tipping is a method in which waste collected is merely mechanically tipped or dumped. Since most of this waste is left in the open, this is the cheapest method for waste disposal [22].

Land filling is a better option that involves spreading waste into thin layers and then compacting the waste. The waste is compacted to reduce its volume. The compacted waste is periodically covered with soil at regular intervals. This method can successfully prevent odours whilst at the same time posing minimum environmental damage [22]. The head of the environmental health department however indicated that they have a designated area for a proposed landfill. Environmental Impact Assessments for the landfill area have already been done and the council is in the process of acquiring licensing from the Environmental Management Agency. He cited financial constraints to be hampering progress. He explained that they still have to meet some of the legal obligations and requirements that are needed to acquire the licence.

Prospects for ISWM

According to the United States Environmental Protection Agency (US-EPA), Integrated Solid Waste Management (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program. EPA describes ISWM as a system that considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment in a sustainable way (US-EPA, 2015). UNEP on the other hand identifies ISWM as a strategic approach to sustainable management of solid wastes covering all sources and all aspects, covering generation, segregation, transfer, sorting, treatment, recovery and disposal in an integrated manner, with an emphasis on maximizing resource use efficiency [3, 33-36].

Almost all of the respondents indicated that they do not have alternative uses for their wastes. Discussions during focus groups also showed that residents did not employ any alternative methods of solid waste disposal such as resource reuse and recycling. Apart from waiting for the council to collect all of their waste some respondents however indicated that they are eager to learn other waste management options such as recycling and proper composting since they have vegetable gardens at their residences. Less than 10% of the participants in focus group discussions indicated that they had tried composting but the composts ended up producing bad odours from the decaying materials. More than 35% indicated that they end up burying the waste when their pits fill up instead of making composts because they do not know how to properly compost their waste. Less than 3% indicated that they recycle. Most of those respondents who recycled explained that they mainly recycle plastic bags. They attributed this to the fact that most of the supermarkets are now selling plastic bags to consumers therefore to save money they reuse plastic bags. There were no respondents recorded who sold paper or plastics as alternative uses for waste. Most of the respondents were open to the idea of generating income from their waste through the sale of paper and plastics. They however expressed that they need to be linked to the market and the buyers and that the services need to be very efficient since keeping paper and plastics at their residences for long periods might be a challenge.

As a rural district council the challenges peculiar to them included inadequate skilled personnel, insufficient budgetary allocations, poor revenue collection strategies and shortages of appropriate equipment such as refuse trucks as well as spare parts to fix those which are grounded. Currently a refuse tractor is being used for waste collection and transportation. Few waste treatment options are also being employed to manage the collected waste. Compacting and open and uncontrolled burning without resource recovery

is currently being used by the council. Other options are more expensive and plans to construct a proper landfill are still a costly pipe dream for the rural district council which is struggling. Growing pressure on outdated infrastructure and refuse collection trucks is also a major challenge.

ISWM recommends environmental education, waste reduction and recycling, waste prevention and acceptable waste disposal methods. ISWM system's guiding principles that govern environmental management must place people and their needs at the forefront of its concerns so in line with ISWM Council officials indicated that they might consider partnerships with paper or plastic recycling companies or other stakeholders who will establish waste buy back facilities. They however insisted that these companies should be stationed in Mt Darwin with their processing plants so that the locals could get employment instead of sending delivery trucks which only collects the waste with the residents not benefitting much from such endeavours [36-38].

Conclusion and Recommendations

This study showed that the solid waste management system currently used by the council involves curbside collection of household waste as well as community bins in the town area. This system leans towards waste generation by service users, collection by the council refuse collection team, transportation and disposal in an open dumpsite which is not fenced. Compacting of the collected waste and open burning are the most common methods employed to manage the dumpsite. This system is effective if implemented correctly. However during the survey it was noted that the council is riddled with a number of challenges which are making the waste management system unreliable and unsustainable. This has given rise to an informal illegal parallel system which involves open space dumping and uncontrolled burning of the waste. The main shortcoming of this system is that it does not give much attention to solid waste management at the source. Waste reduction and recycling options can be made available to the consumers so much that they can make conscious decisions to reduce or segregate their waste at source before it is collected. All these waste management practices form the ISWM system. To address these challenges, the following recommendations could be adopted:

- An ISWM system should be adopted by the council. This system offers an integrated and holistic approach which can easily regularise the waste collection process. Councils are the primary providers of waste collection and disposal services, establishing an effective system of ISWM system at local level must be a priority. ISWM is effective and it favours waste avoidance, reduction, resource reuse and recycling as main objectives with little treatment and disposal. This not only can greatly reduce financial constraints for the council but can generate income for it through recycling.
- The ISWM system can be coupled with the adoption of local environmental action plans that have a specific time frame for achievement or life span. An example can be a "No more waste five year or ten year plan" which seeks to reduce waste by encouraging that all types of wastes should be recycled. Local environmental action plans are also recommended in the Environmental Management Act [20:27].
- Community and stakeholders' participation is also recommended. The council can conduct awareness campaigns as well as educational activities and initiatives that teach service users source segregation, waste reduction and the 3R practices (reduce, reuse and recycling). All solid waste services users need to see waste management as their responsibility as well not just the mandate of the council. Partnerships around effective waste management must be encouraged and strategies and initiatives to improve solid waste management adopted by all. Some cleanup campaigns should also be encouraged to promote the removal of litter as well as in fostering responsible behaviour in the community.
- The Pfura Rural District Council also requires adequate infrastructure to enable re-use, recycling and proper land filling. Material recovery facilities and buy-back centres can be established in different areas in Mount Darwin for example in front of all the major supermarkets, the people's vegetable market and at the commuter omnibus taxi rank. The Council can also provide spaces to sort waste into re-useable and recyclable waste or provide labelled community bins for recyclable materials like plastics, cans and paper. The council can also penalise consumers who put recyclable waste in their waste receptacles instead of depositing it into the labelled bins. Community based organisations (CBOs) can then be established for managing the bins. Charity shops managed by the CBOs or the council which sell reusable items or crafts from recycled materials can be established. These shops can also offer waste exchange services for recyclable materials. Examples can be exchanging an old tyre for crafted footwear made from recycled tyres. This can create employment for the community as well as generate revenue for the council through fines, rentals, taxes and service charges.
- Waste types that cannot be re-used or recycled, various options exist for energy recovery which can include biogas projects since the town is surrounded by communal areas, communal composting of organic wastes from restaurants and vegetable markets and methane gas recovery from landfills.
- Enforcement of existing bylaws locally by the council as well as at national level should be a must for better enforcement. The SWM plan of the council did not include measures to remediate contaminated land in the current dumpsite after they have finished constructing the new landfill. Remediation plans are a must for effective ISWM and compliance monitoring by EMA and other stakeholders is also very important for proper and reliable ISWM system. The formulation process of a national ISWM Policy should be expedited so that all stakeholders will have a blue print for action.

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