Wrestling with Data: Establishing a National Waste Information Baseline for South Africa

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ABSTRACT

Developing a waste information baseline for South Africa, without doing primary data collection, proved to be an enormous task. The project team had to ensure that all available data, whether being reported or not, were collected. This process involved contacting custodians of data and reports, meeting with relevant people and extracting data from a host of different sources. Sourcing waste data in South Africa proved to be a difficult task due to the relative unavailability of documents specifically IWMPs. The perseverance of the project team sourcing reports, reviewing close to 500 documents and furthermore making sense of the data collected, is noteworthy. A total number of 2 358 general waste data points and 810 hazardous waste data points spread over the period 1990 to 2011 were captured. This paper reports on some of the challenges experienced during the data collection and interpretation phase as well as the sources and quality of data collected.

1. INTRODUCTION

The Council for Scientific and Industrial Research (CSIR) was contracted by the Department of Environmental Affairs (DEA) to develop a national waste information baseline for South Africa. The project was commissioned to establish a baseline, representing a snapshot in time, against which progress with the implementation of the National Environmental Management: Waste Act, 2008 could be measured. In addition, the information collected will also inform policy decisions going forward. Since no primary data collection was included in the scope of the project, it was important to ensure that all available data, whether being reported or not, are collected.

The need for the development of a national waste information system (SAWIS) was identified in the White Paper on Integrated Pollution and Waste Management (DEAT 2000). The SAWIS was consequently developed and piloted between 2004 and 2006 (DEAT, 2006). However, accurate data and information on waste generation, storage, treatment, reduction, re-use, recycling, recovery and disposal in South Africa remain difficult to find, despite the establishment of the SAWIS and other provincial waste information systems (Godfrey 2004). Only 46 activities reported data to SAWIS in 2010 while there are known to be more than 2000 waste handling facilities (Godfrey et al. In press). This low level of reporting could be ascribed to the fact that regulations requiring reporting of data to the SAWIS are not yet in force. In addition, a study conducted in South African municipalities revealed that only 69% of municipalities were collecting some form of data on waste management in 2005 (Godfrey 2008). This lack of accurate data has resulted in the setting of unrealistic targets i.e. the Polokwane Declaration, 2001 as well as municipal planning being based on '*obvious problems*', '*perceived problems*' and '*educated guesses*' (DEAT 2001; Godfrey 2008).

Given the lack of waste data, the slow implementation of SAWIS, and the need for reliable waste data to inform government planning, the Department of Environmental Affairs set out to establish a national waste information baseline on the quantities and types of waste that is generated, stored, treated, reduced, re-used, recycled, recovered and disposed of, to enable tracking of waste from generation through to final disposal.

The aim of this paper is to highlight some of the difficulties experienced by the project team during the data collection process in terms of data interpretation, data sources, data availability and data collection.

2. METHOD

To keep the project within an affordable budget, no primary data was collected. The project team relied on available data that could be used as a platform for extrapolations and estimations in order to generate a preliminary baseline. Existing waste data was collected from all relevant stakeholders in the South African waste sector, including the public and private sector. This was done through interviews and extracting data from available reports and databases.

A thorough literature search of available waste related information was undertaken. This included a search of official websites such as:

- National Department of Environmental Affairs (SAWIS and SAWIC);
- National Department of Water Affairs (WARMS);
- Department of Trade and Industry;
- Water Research Commission (WRC);
- Provincial Departments responsible for Environmental Affairs;
- Municipalities (Metropolitan, District and Local Municipalities);
- Municipal Demarcation Board;
- Statistics South Africa;
- Industry Associations; and
- Specific industries i.e. Sasol, Eskom etc.

Where information was not readily available on the internet; specific documents were sourced from government departments (national and provincial), municipalities, consulting firms that are known to do work for municipalities, industry associations, research organisations and direct interactions with key players in the waste sector that act as custodians for waste information. The literature search was also expanded to cover research findings published in reports and papers in peer reviewed scientific journals.

The project team focussed their efforts on obtaining as many as possible of the following reports:

- Integrated Waste Management Plans (Provincial, District, Metropolitan and Local municipality), but more importantly Status Quo Reports feeding into these plans;
- Industry Waste Management Plans
- Hazardous Waste Management Plans;
- Integrated Development Plans;
- State of the Environment Reports;
- Previous National Baseline Studies;
- Waste surveys conducted at various levels;
- National Government Databases (WARMS, Inventories, SAWIS etc.);
- Industry and waste stream guidelines;
- Sustainability Reports;
- Audit reports; and
- Annual Reports.

The reports were reviewed for relevant data as well as information on how the data was derived and recorded. Waste data extracted from the reports was entered into one of two spreadsheets: one covering general waste and the other hazardous waste. The spreadsheets were designed to allow for data to be recorded in line with the new waste categories as outlined in Schedule 1 of the draft SAWIS regulations and as updated by DEA, as shown in Table 5 (RSA 2010).

3. RESULTS

Approximately 486 different sources were consulted for waste data. The documents included IWMPs (or status quo reports) from 133 municipalities (including 24 district and 6 metropolitan municipalities) and 7 provinces. Other sources of data included 38 government reports, 22 Integrated Development Plans (IDPs),

28 research reports from the Water Research Commission (WRC), and 18 State of the Environment (SoE) reports. The IDPs and SoE reports contained very little to no waste data while WRC reports, on the other hand, were sources of good quality data on selected waste streams i.e. brines and sewage sludge (Herselmann et al. 2005; Van der Merwe et al. 2009). Landfill records from the metros and data provided by specific industries and industry associations were regarded as being of good quality.

A total number of 2 358 general waste data points and 810 hazardous waste data points spread over the period 1990 to 2011 were captured in the two spreadsheets. These figures include self reported data (results from survey questionnaires), actual measured data (by means of waste analysis, weighbridge measurements, etc), calculated estimates (based on population data, census data, statistics, etc) as well as forecast data (future estimates via modelling of historical data, etc).

4. DISCUSSION

Examples highlighted in the discussion are not intended to implicate any municipality or service provider as these are examples of common problems experienced. Actual examples from reports are included in this paper strictly for illustrative purposes and therefore references to specific municipalities have been omitted.

4.1. Data Accuracy

Since no primary data was collected for the national waste baseline, it is important to make a few statements on the accuracy of the data collected from available sources.

At an early stage it became apparent that reported data is derived in one of four ways:

- Through actual accurate measurement e.g. weighbridge data;
- Extrapolations based on conducted surveys;
- Estimates based on counted volumes; and
- Estimates based on national and international experiences.

While data within SAWIS is currently incomplete, reviewing the SAWIS data suggests that there are also inaccuracies within the system which will need to be corrected. These include order of magnitude changes in waste tonnages from one month to the next, suggesting a data capturing error in the placing of the decimal figure, or order of magnitude differences in data for landfills of similar size, suggesting lack of consistency in units, i.e. tonnages versus kilograms.

While it was expected that IWMPs would be based on fairly accurate data, most IWMPs indicated uncertainties about the information provided e.g. '*not accurate'*, '*theoretical'* or '*assumed to be typical'* (DEADP 2011). It is acknowledged that accurate data collection is impaired by the absence of weighbridges at the majority of general waste landfills in South Africa. The majority of landfill data is therefore estimated by counting truck loads or bags. Municipalities collecting waste data, often do so at landfills. Thus, only waste disposed of at municipal landfills, and not waste generated within the municipality, are accounted for. Waste generation data on the other hand is often calculated based on population statistics., When comparing service delivery data from the Community Survey, 2007 with the annual service delivery survey for the same year, the service backlog figures differs significantly (StatsSA 2007; National Treasury 2011). It is therefore difficult to comment on the accuracy of waste generation estimates as compared to disposal figures in the same municipality in the absence on accurate service backlog estimates.

Provincial hazardous waste management plans also indicated some reservations about the accuracy of the waste data (GDACE 2007; NWDACE 2006; LEDET 2006). Service providers typically collect hazardous waste data through surveys characterised by poor response rates i.e. 5.3% response rate for the Gauteng hazardous waste management plan survey (GDACE 2007). In addition, "*the majority of those interviewed do not fully comprehend what constitutes hazardous waste and do not (as a rule) record volumes generated"* (NWDACE 2006; LDEDET 2006). The data collected through surveys are generally statistically insignificant and therefore not suitable to use in extrapolations for hazardous waste generation.

4.2. Availability of IWMPs

The promulgation of the National Environmental Management: Waste Act, 2008 placed a legal requirement on municipalities and industry to develop IWMPs (RSA 2010). The Department of Environmental Affairs developed a guideline in support of the compilation of IWMPs to assist municipalities in this regard (DEAT 2000b). Municipal IWMPs are public documents which should, in theory, be easily obtainable from municipalities. The South African Waste Information Centre (SAWIC), for example, was designed to allow

municipalities to upload and share their IWMPs. However, to date only 4 of 284 municipalities have a presence on SAWIC, only one IWMP and an executive summary of another IWMP could be sourced from there. The results of internet searches covering municipal websites were equally disappointing with only a few municipalities making IWMPs available through their websites. Service providers to municipalities i.e. consultants, proved to be the best source of municipal IWMPs and/or status quo reports.

The percentage of municipalities for which the project team could source IWMPs (final or draft IWMPs or Status Quo Reports) are summarised in Table 1. These include all IWMPs (and Status Quo Reports) developed since 2000.

Table 1: Percentage of municipalities for which at least first generation IWMPs (Draft, final or Status Quo Reports) could be sourced by May 2012.

Province	Local Municipalities			District Municipalities			Metropolitan Municipalities		
	IWMP	Total	% IWMP available	IWMP	Total	% IWMP available	IWMP	Total	% IWMP available
Eastern Cape	8	38	21	2	6	33	1	1	100
Free State	5	20	25	0	5	0	-	-	-
Gauteng	2	9	22	2	3	67	3	3	100
KwaZulu-Natal	19	50	38	6	10	60	1	1	100
Limpopo	16	26	62	4	6	67	-	-	-
Mpumalanga	7	17	41	1	3	33	-	-	-
North West	4	21	19	0	4	0	-	-	-
Northern Cape	18	26	69	4	5	80		-	-
Western Cape	24	24	100	5	5	100	1	1	100
Total	103	231	45	24	47	51	6	6	100

From Table 1 it is clear that a large number of municipal IWMPs could not be soured. In total, only 103 of 231 (44.6%) local municipality IWMPs were found and 24 of potentially 47 (51.1%) of the district municipality IWMPs were found. All of the metropolitan municipality IWMPs were obtained (6 of 6).

North West province and Western Cape are the only two provincial IWMPs which could be sourced. The Western Cape is the only province where 100% of municipalities had IWMPs which could be sourced for the project.

Some important observations were made while reviewing these IWMPs. It was found that where the same service provider compiled plans for different municipalities, the level of detail in the reports were comparable. However, the authenticity of these plans and their applicability to local conditions in each local municipality is questionable as many of the reports appears to be identical in many respects with only the waste figures adapted to the local conditions. This observation raised questions on the involvement and participation of the local stakeholders in the development of the plan as well as the level of ownership taken for these plans at municipal level. This in turn raised concerns over the implementation of these plans. Another observation was that many of the IWMPs did not provide more than status quo information. These IWMPs can hardly be called plans. Also, many of the IWMPs did not follow the guidelines issued by DEA in support of the compilation of IWMPs (DEAT 200b). Although an audit of the implementation of the plans is beyond the scope of this project, it may be something that government should consider.

4.3. Inconsistencies in Data

Apparent inconsistencies in data were found while reviewing the documents. A few instances are discussed here.

4.3.1. Inconsistencies in Estimated Data

In the same report, two separate tables reporting waste generation figures for 2004 and 2009 in four different municipalities in the same district municipality were encountered. Both these tables used Census 2001 demographic data to estimate domestic waste generation quantities. The percentage differences between the data for these two years are summarised in Table 2. The problem with this situation is that the reasons for and basis of the adjustments in estimated figures are not explained or obvious. When utilising population figures to estimate waste generation, the population is multiplied by a factor for waste generation per income group. If the same population figures were used for 2004 and 2009, the factor must have changed, or the consultant calculated the 2004 and 2009 population in those municipalities by a percentage population growth rate. Without detail of the method used, assumptions must be made, and potential errors overlooked. Inconsistencies like these without supporting explanations made it difficult to interpret the data and impossible to assess the accuracy of both estimates.

Table 2: Inconsistencies in data estimations found in four municipalities within the same district municipality

	% of which 2009 data are greater than 2004 (in tpa generation in Urban areas)	**% of which 2004 data is greater than 2009 (in tpa generation in Rural areas)**
Municipality 1	79.0	48.3
Municipality 2	64.4	34.6
Municipality 3	58.7	55.7
Municipality 4	63.7	30.9

4.3.2. Inconsistencies between Actual and Estimated Data

In comparison, some instances of estimated data varied considerably from the actual data when compared for a specific year, Table 3 is a case in point. The team developing the provincial IWMP also found it difficult to obtaining information. Therefore they estimated the quantity of waste that was expected to be generated by considering waste generators, together with the amount of generated waste identified and reported during a survey. Most of the times, these figures did not correlate with each other. Again, a possible explanation for the difference between actual and estimated data is not provided, making it impossible to gauge the accuracy of the estimate and the reported data and therefore rendering the data questionable for use in the baseline.

Table 3: Quantities of Selected Hazardous Wastes Generated in Limpopo Province 2005 (Adapted from LDEDET 2005)

Waste Type	**Identified Quantity**	**Estimated Quantity**	**% error between identified and estimated quantity**
Medical Waste	125 tons/month	205 tons/month	61.0
Oil/Grease Wastes	160 tons/month	400 tons/month	40.0
Used Oil	0.79 million litres/year	9 million litres/year	8.8

In other instances, discrepancies between actual and calculated data are reported i.e. waste generation estimates based on population and actual landfill weighbridge data is reported. However, no attempt to explain the discrepancies or comment on the accuracy of the data is provided.

4.3.3. Incomplete Data

A number of reports created the impression that data was available, but in actual fact no, or very limited data were reported. Tables describing the type of data that could be found in tables elsewhere in the report were provided, but when those tables were consulted, it was not populated with data. In a single document, 17 such tables were found. In another instance, a total of 27 tables populated with '*no information'* inscriptions were found in one document.

4.4. Aggregated Data

In some reports aggregated data is reported as average annual quantities. Although this way of reporting is useful for planning purposes, it limits the usability of the data for predicting trends and reporting year-on-year

progress with implementation. It would have been useful if maximum and minimum levels as well as the standard deviation could have been provided in such instances.

4.5. Change in Waste Classification System

Traditionally hazardous waste in South Africa has been classified into different hazard classes according to their properties (DWAF 1998). The hazardous waste classification as outlined in the minimum requirements consisted of 9 hazardous classes (according to SABS Code 0228) as shown in Table 4 (DWAF 1998). A new waste classification system (for general and hazardous waste) consisting of 21 hazardous waste categories, as, shown in Table 5, is however proposed through the draft Waste Information Standards as updated by DEA (DEA 2010). General waste was previously informally classified as domestic, commercial or industrial, but has now been classified into 17 categories (NWMS 1999, DEA 2010), as shown in Table 5.

Table 4: Hazardous waste classification categories according to the minimum requirements (DWAF 1998)

Hazardous waste class	**Hazardous waste type**
Class 1	Explosives
Class 2	Gases
Class 3	Flammable liquids
Class 4	Flammable solids
Class 5	Oxidising substances and organic peroxides
Class 6	Toxic and infectious substance
Class 7	Radioactive substances
Class 8	Corrosives
Class 9	Other miscellaneous substances

Table 5: Waste classification categories according to the proposed draft waste information standards (DEA 2010) as updated by DEA.

GENERAL WASTE	GW 01	Municipal waste	HAZARDOUS WASTE	HW 01	Gaseous waste
	GW10	Commercial and industrial waste		HW 02	Mercury containing waste
	GW13	Brine		HW 03	Batteries
	GW14	Fly ash and dust from miscellaneous filter sources		HW 04	POP Waste
	GW15	Bottom ash		HW 05	Inorganic waste
	GW16	Slag		HW 06	Asbestos containing waste
	GW 17	Mineral waste		HW 07	Waste Oils
	GW 18	Waste of Electric and Electronic Equipment (WEEE)		HW 08	Organic halogenated and /or sulphur containing solvents
	GW 20	Organic waste		HW 09	Organic halogenated and/or sulphur containing waste
	GW 21	Sewage sludge		HW 10	Organic solvents without halogens and sulphur
	GW30	Construction and demolition waste		HW 11	Other organic waste without halogen or sulphur
	GW50	Paper		HW 12	Tarry and Bituminous waste
	GW51	Plastic		HW 13	Brine
	GW52	Glass		HW 14	Fly ash and dust from miscellaneous filter sources
	GW53	Metals		HW 15	Bottom ash
	GW54	Tyres		HW 16	Slag
	GW99	Other		HW 17	Mineral waste
				HW 18	Waste of Electric and Electronic Equipment (WEEE)
				HW 19	Health Care Risk Waste
				HW 20	Sewage sludge
				HW 99	Miscellaneous

From the available reports, etc, hazardous waste data has been reported according to the old hazardous waste classification as contained in the minimum requirements (DWAF 1998). However, the national waste information baseline is required to report waste based on the new hazardous waste categories in order to align the findings with the SAWIS. This situation resulted in some difficulty in matching categories or re-assigning waste to new categories (including splitting/aggregating wastes). In such situations it is close to impossible to decide in which new category the available data based on the old categories should be allocated. For instance a flammable liquid (old hazardous waste class 3) can consist out of many components including inorganic waste (new class HW 05), waste oils (new class HW 07), organic halogenated and/or sulphur containing solvents (new class HW 08), organic halogenated and/or sulphur containing waste (new class HW09), organic solvents without halogens and sulphur (new class HW 10), other organic waste without halogen or sulphur (new class HW 11) and mineral waste (new class HW 17). Even to differentiate between organic halogenated and/or sulphur containing solvents (HW 08) and organic halogenated and/or sulphur containing waste (HW 09), or between organic halogenated and/or sulphur containing solvents (HW 08) and organic solvents without halogens and sulphur (HW 10) are challenging, especially in the absence of analytical data. More thorough analyses are required to be able to say with certainty in which waste category to place the waste.

4.6. Literature Findings Pertaining to Specific Waste Streams

According to the new waste categories a number of waste streams can be listed either as general or hazardous waste such as brine (GW 13 and HW 13), mineral waste (GW 17 and HW 17), sewage sludge (GW 21 and HW 20) and waste of electric and electronic equipment (WEEE) (GW 18 and HW 18) in Table 5.

Since no primary data was collected in this study it was not possible to split the general and hazardous portions of the reported waste figures. Therefore, following a precautionary approach, all the data on these waste streams are reported under the hazardous waste categories.

5. CONCLUSIONS

Sourcing waste data in South Africa proved to be a difficult task due to the relative unavailability and inaccessibility of documents and specifically IWMPs. Despite the creation of the SAWIC to facilitate easy access to waste related information, this facility is not being used to its full potential especially by municipalities. However, it is acknowledged that reporting into the SAWIS is still voluntary and that increased reporting is to be expected following the planned promulgation of Waste Information Regulations.

Accuracy of data is a second concern that requires urgent attention. Implementation of the SAWIS and reaping the benefit of such a system is highly dependent on the availability of accurate data. It is however envisaged that accuracy of waste data will improve over time. Compulsory reporting into the SAWIS will allow for benchmarking and cross checking of data for verification purposes. It will however require dedication and attention to detail by both system administrators and those who report data into the system.

Estimated waste data, in the absence of actual data is permissible, provided that sufficient detail on the assumptions and methods of calculation are provided. The absence of the required level of detail on assumptions and methods of calculations make it impossible to gauge the accuracy of reported data. This was identified as a fatal flaw in current waste data.

The change in reporting categories for general and hazardous waste proved to be problematic from a data interpretation and comparison perspective. The current situation with certain waste streams being categorised as either general or hazardous waste made it impossible for the project team to split those waste streams into hazardous and non-hazardous portions. It is impossible to classify certain waste streams without proper laboratory analysis. The differences between the 1998 waste classification (DWAF, 1998) and the proposed new classification system (RSA, 2011) may also result in waste streams that were previously viewed as non-hazardous to now classify as hazardous and vice versa. As such, comparison of the 2011 waste baseline with previous waste baseline studies may be prohibitive.

The review of large numbers of IWMPs and IDPs clearly indicated that IDPs are not informed by IWMPs as expected by law and that the level of detail expected to be included in both reports are largely lacking. Measures must therefore be put in place to ensure that the development of IDPs and IWMPs does not become yet another tick in the box. IWMPs must be practical, implementable and inform IDPs in order to leverage funding from national treasury for municipal waste management.

ACKNOWLEDGEMENTS

The authors would like to express our heartfelt gratitude to all those stakeholders whom provided data and information. We would also like to thank Aubrey Muswema, Linda Godfrey, Lulama Wakaba, Jeremia Sibande and Musa Maringa for their assistance in sourcing data and extracting data from numerous reports and databases. The project was funded by the Department of Environmental Affairs.

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