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AN ASSESSMENT OF THE IMPACT OF POLICY INTERVENTIONS FOR ORGANIC WASTE IN THE CITY OF CAPE TOWN

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ABSTRACT: Improved sustainable waste management systems goes beyond the waste sector and contributes to the reduction of greenhouse gases as well as overall sustainability. Estimates in South Africa suggest that the waste sector accounts for over 4.3 % of the total national GHG emissions. The City of Cape Town is one of eight metropolitan municipalities in South Africa. The Provincial Government of the Western Cape has included as part of the provincial integrated waste management plan, a mandate to divert all organic waste from entering landfills by 2027. Further targets set that will form the basis of this study are targets set by the Western Cape Government for overall waste diversion:
- 40% total waste diverted from landfill by 2025;
- 55% total waste diverted from landfill by 2030;
- >70% total waste diverted from landfill by 2035.

Where as the provincial integrated waste management plan for organic waste diversion targets for the Western Cape is:
- 50% diversion of organic waste from landfill by 2022
- 100% diversion of organic waste from landfill by 2027

The research aims to present detailed methane emissions and emission reduction options as well as waste diversion and landfill space savings that could occur should the targets be met according to the 4th generation integrated waste managemnet plan for the City of Cape Town. The outcomes of this study will be acheived through the application of the Waste to Resource Optimisation and Scenario Evaluation model (WROSE), that employs the Intergovernmental Panel for Climate Change's (IPCC) carbon emission factors. The WROSE model compares the emissions from the current landfill disposal (Business as usual – BAU) with other more optimised scenarios including aerobic composting and anaerobic digestion, to identify the most suitable waste diversion and carbon emission mitigation strategies to meet the provincial targets set by the Western Cape Government.

Keywords: Organic waste management, landfills, municipalities, GHG emissions mitigation

1. INTRODUCTION

The South African waste sector contributes an estimated 4.1% of the total greenhouse gas emissions in the country, with an estimated total methane contribution of 36.5% (DFFE, 2017). This is due the disposal of unsorted, untreated municipal solid waste as a primary mechanism for waste management in South Africa. This, combined with rapid urbanization and a gradually increasing total population, puts a strain on existing municipal infrastructure and services. In efforts to mitigate the impacts of these activities on both the environment as well as the municipal system, legislative instruments have been established at national and provincial level.

These legislative instruments underpin integrated waste management systems at it's core in order to achieve the best possible outcome. However, South African Municipalities lack necessary human resources and financial capital to implement these systems. One such instrument is the ban imposed by national government on liquid waste to landfill with a moisture content greater than 40%. Based on this, the Western Cape provincial government, has stipulated in their provincial integrated waste management plan a ban on organic waste from landfill with a short term target of 50% diversion of organic waste from landfill by 2022 and 100% diversion of organic waste from landfill in the province by 2027.

The purpose of this study is to determine the GHG emissions through the implementation of the policy requirements set out in the Western Cape Governments IWMP to achieve

- 50% diversion of organic waste from landfill by 2022
- 100% diversion of organic waste from landfill by 2027

The City of Cape Town is located in the Western Cape Province of South Africa. The study employs the use of the WROSE model, (Kissoon S and Trois C, 2022, Dell'Orto and Trois, 2022, S.Kissoon and C.Trois 2019, Sameera Kissoon, 2018, Trois and Jagath, 2011) which has been developed to assist municipal officials in the decision-making process for the implementation of appropriate waste management strategies.

2. STUDY AREA

The City of Cape Town Metropolitan Municipality (CoCT) is situated in the southern peninsula of the Western Cape Province and covers an area of approximately 2445 km². The CoCT is neighboured by the West Coast District to the north, Cape Winelands District to the east and Overberg District to the south-east. Cape Town currently has the second-largest population of all cities in South Africa, with an estimated 4.6 million residents in 2020. The city has seen steady population growth over the years, albeit at a slowing annual rate Population Projections and Growth Rates. In 2020, Cape Town's total estimated population was 4,604,986, making up 66% of the population in the Western Cape. From 2002 to 2020, the population of Cape Town had an average annual growth rate of 2,2%. As of 2016, City of Cape Town had a population of 4,004,793 which amounted to 1,264,849 households. Service delivery is measured at 99.997% for 2018/19 financial year. *Think Twice / Separation at Source (S@S)* covers 20-25% of the city's formal residential areas and increased roll out and the associated cost, revenue recovery and changing of operations within SWM need further investigation as these customers getting S@S have additional services at no additional costs. There are currently three main landfill sites in the City of Cape Town (Figure): Belville South, Vissershok and Coastal Park.

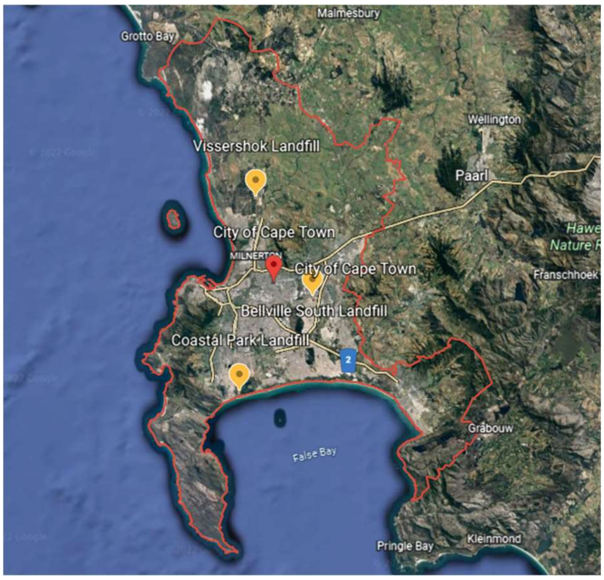

Figure 1. City of Cape Town and location of landfill facilities (Google Earth, 2022)

The figure below illustrates the waste composition witin the CoCT as per the 2021 IWMP.

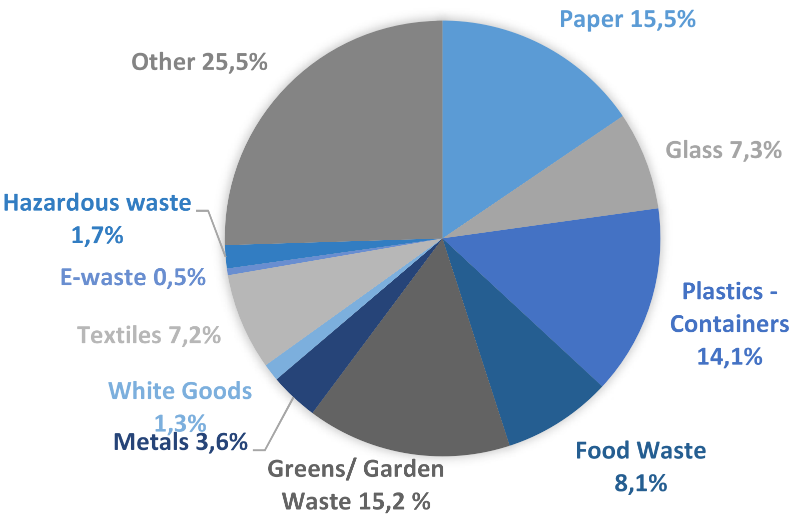

Figure 2.Waste profile of the household waste fraction in the CoCT (IWMP, 2021)

The waste profile of the CoCT was extracted from the 3rd Generation IWMP and is based on a waste characterisation study conducted in 2011. The figure above depicts a food waste quantity of 8.1% of the total waste stream and a garden greens portion of 15.2% of the total fraction. For the purpose of this study, these values will be utilised.

3. METHODOLOGY

The aim of the study is to determine, what are the potential emissions from the continuation of business as usual is in the City of Cape Town and therafater the emissions reductions acheiveable should the diversion targets set out by policy be implemented. In order to achieve the aim of the study the following methodological approach was utilised:

Firstly, Integrated Waste Management Plans (IWMPs) were analysed for the City of Cape Town. These were used to determine waste amounts. These were used as a first-phase data collection process from which waste generation quantities and qualities were extracted .

An assessment of the available data was conducted to determine if the waste values reported in the IWMPs are accurate for the study going forward. Thereafter, municipal Integrated Development Plans (IDP's) were examined to collect GDP and population data in order to try and fill the gaps identified in the data sets where necessary. In addition to the IDPs, the 2016 Community Survey was used to gather data on waste collection rates in order to determine waste generation per capita;

Annual reports from waste collection services and municipalities were consulted for the extraction of waste collection and disposal data. Finally, the 2001 and 2011 data from Stats SA was examined to verify collection rates and population figures.

This study employed the use of IPCC emission factors along with the WROSE model.The first set of analysis that was conducted for the CoCT was based on the assumption that no policy interventions were put in place to reduce the amount of waste sent to landfill or to reduce the GHG emissions.

The second set of assumptions considered the interventions of the Western Cape Government which assumes the GHG emissions reductions that could occur should the targets be met.

Figure 3 below, outlines the WROSE model employed for the purpose of scenario selection for this study.

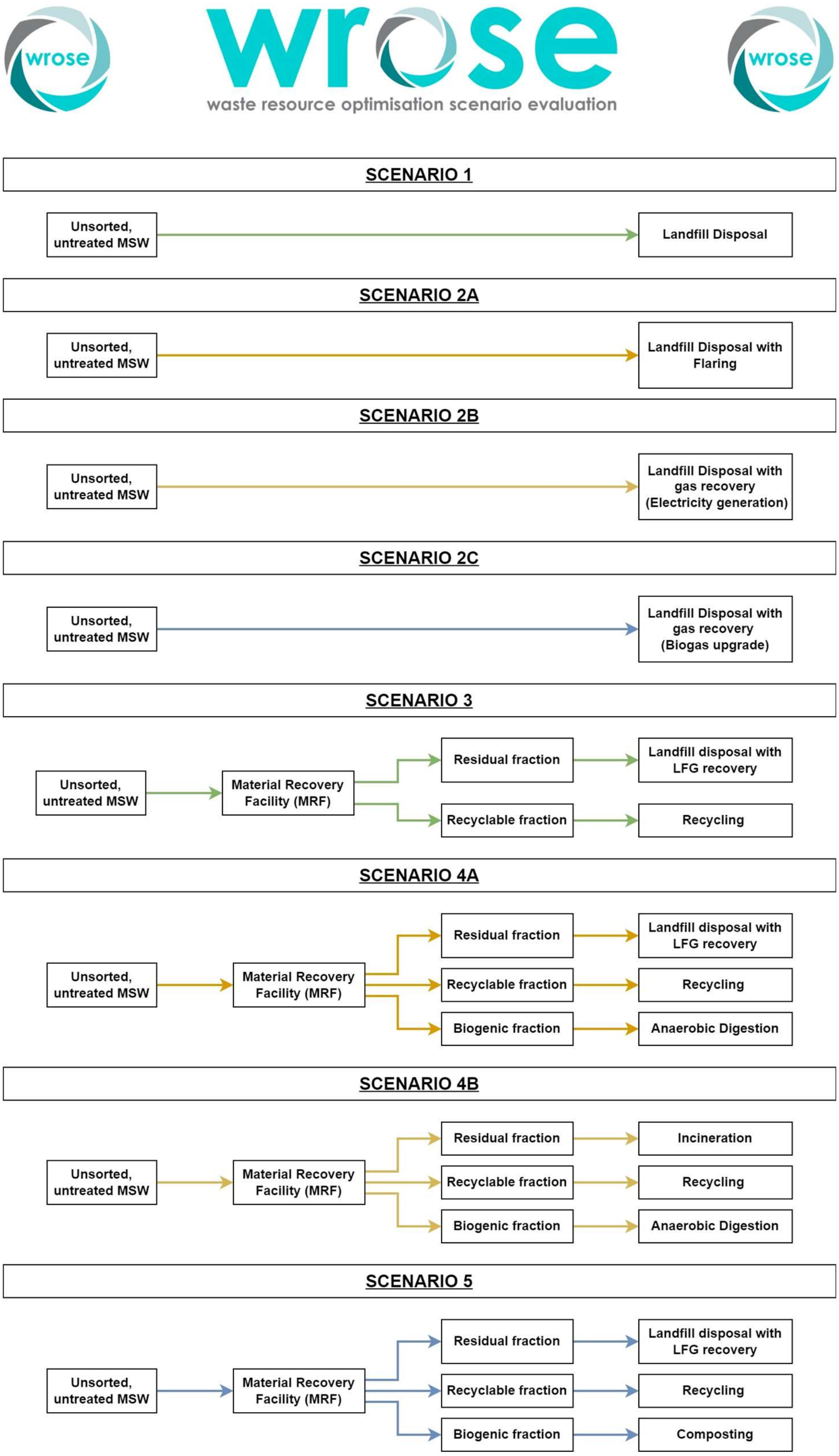

Figure 3: WROSE scenarios schematic (Dell'Orto and Trois, 2022, Trois and Jagath, 2011, Trois et al, 2023)

The WROSE model was developed in conjunction with the private sector for municipal officials looking to implement alternative waste management strategies. The model uses South African data and emission factors that makes it relevant to developing countries. It covers a range of waste management technology options such as landfilling, landfilling with gas extraction, recycling, anaerobic digestion and composting.

The WROSE model provides information such as GHG emission reduction potential, waste diversion rates and landfill airspace savings realised, associated capital and operational costs/revenues, job creation potential and associated health risks, of the assessed scenarios. It also provides information on the institutional framework (including possible “red tape”) pertaining to the implementation of the assessed technology options/scenarios.

4. RESULTS AND DISCUSSION

Figure 4 below depicts the total amount of food waste and garden produced in the CoCT over a 50 year period that will be disosed of into landfill.

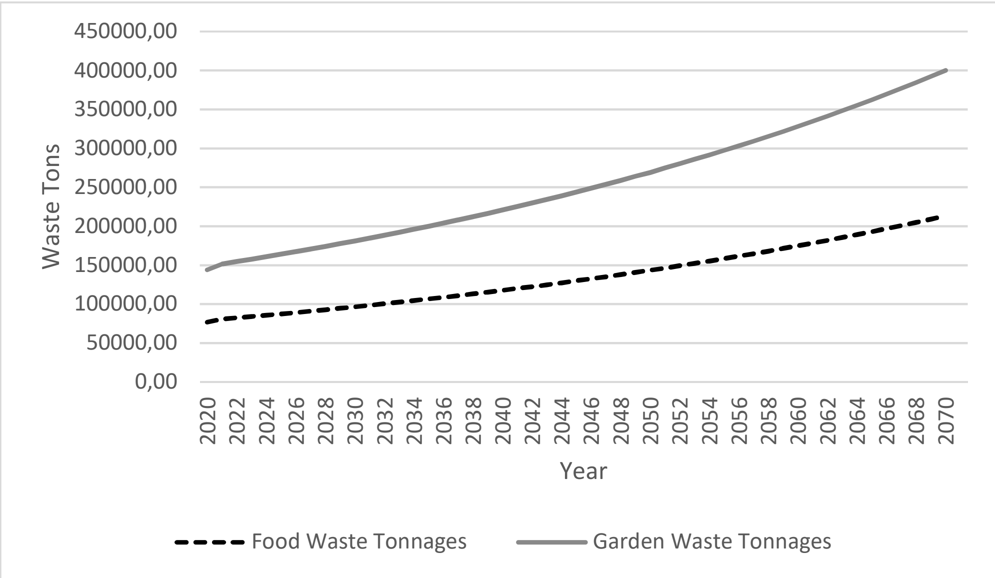

Figure 4. Projection of waste tons for food waste and garden refuse over 50 years in the City of Cape Town (Kissoon,2023)

As per figure 4 above, both the garden refuse fractions and the food waste fractions more than triple over the next 50 years without any interventions. The values projected through this will be used to detemine the emissions resulting in the continuation of business as usual.

Figure 5 below depicts the methane emissions in MTCO2eq resulting from the disposal of food waste and garden refuse into landfill as per the business as usual scenario.

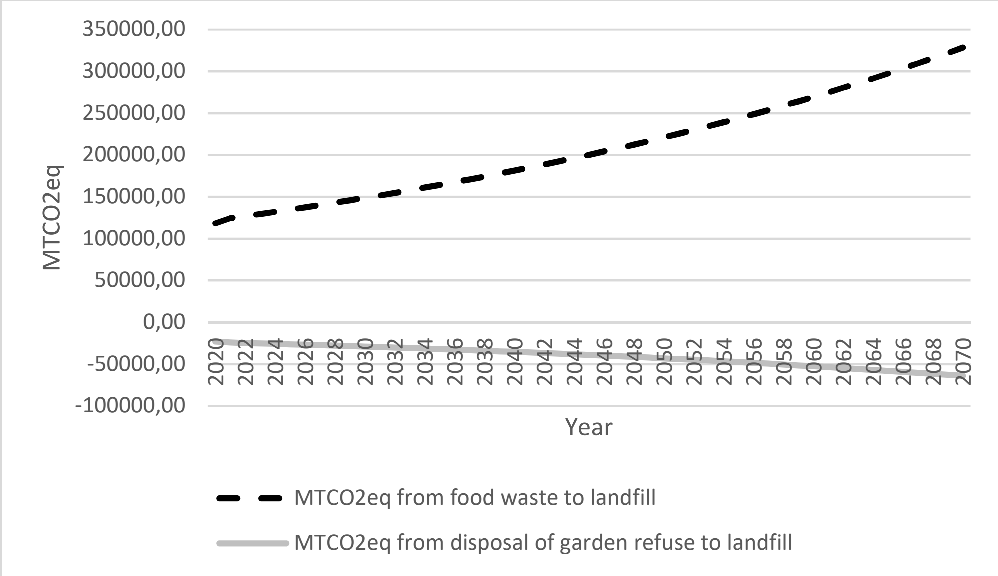

Figure 5. 50 Year projection of $MTCO_2eq$ emissions for the disposal of food waste and garden refuse to landfill for the CoCT. (Kissoon, 2023)

As seen in figure 5, in line with the increase in waste generation amounts over the next 50 years, methane generation also increases significantly should the diposal of organic waste continue as per business as usual. Methane levels increase from a predicted 118242.17 MTCO2eq in 2020 to a staggering 328354.98 MTCO2eq by 2070 for the food waste fraction. The garden refuse fraction however depicts a reduction in emissions, this is due to the emission factor being low at -0.16 (IPCC, 2006).

Figure 6 below depicts the potential methan reduction possible should the diversion rates set out by the Western Cape Government be acheived in the City of Cape Town.

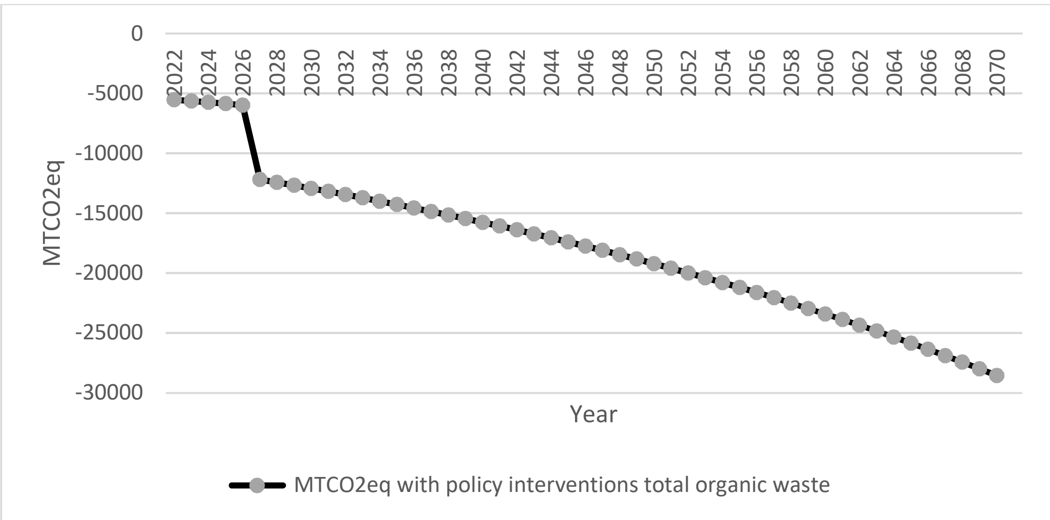

Figure 6. Methane emissions in MTCO2eq reduced from the implementation of policy targets in the City of Cape Town (Kissoon 2023).

The figure depicts a steady decrease in emissions from 2022 with by meeting the 50% diversion rate of the organic fraction from landfill. Thereafter a sharp decline is seen in 2026 should the 100% diversion rate be achieved. Although significante missions reductions are estimated through the implementation of policy targets, municipalities in South Africa currently lack the necessary infrastructure to fully implement the diversion targets set at provincial level. Therefore considerations should be given to the upgrade of existing infrastructure to manage the diverted waste fractions in order to prevent the filtration of the organic compoment back into landfill.

5. CONCLUSIONS

The purpose of this study was to determine the impact of meeting organic waste diversion targets set out by provincial government in the Western Cape. The key outcome of the study is that significant methane emissions occur should the disposal of organic waste continue as per business as usual. However, should diversion targets be met by 2022 and 2026, there will be a sharp decline in the amount of methane generated. Some of the challenges to this study include the fact that there is a big gap with respect to waste data availability and consistency. The waste characterisation study is outdated. There is not a standardized system to report waste generation and composition and, in many cases, the reported quantities represent only the amount of waste disposed of in landfills, situation that can lead to under estimation of total municipal solid waste generation quantities. Furthermore South African municiaplites currently lack the necessary infrastructure to manage diverted waste in large quantities which could result in the waste filtering back into landfills. Therefore this study recommends investment in infrastructural developments to capacitate municipalities to manage such policy interventions.

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