CTCN Technical Assistance

Development of a technical and economic feasibility study for anaerobic digestion of the organic fraction of solid waste from households, hotels and markets in Mauritius

Output 2: Status quo and baseline analysis of organic waste

Deliverable 2 (2.2 & 2.3)

Submitted to:

- Climate Technology Centre and Network
- Department of Environment, Ministry of Environment, Solid Waste Management & Climate Change, Republic of Mauritius
- Solid Waste Management Division, Ministry of Environment, Solid Waste Management & Climate Change, Republic of Mauritius

Submitted by:

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Acronyms

AD	Anaerobic Digestion
C:N	Carbon : Nitrogen
CTCN	Climate Technology Centre & Network
EIA	Environmental Impact Assessment
GCV	Gross Calorific Value
GHG	Greenhouse Gas
MIE	Mauritius Institute of Education
MSW	Municipal Solid Waste
NGO	Non-Governmental Organisations
NIMBY	Not In My Back Yard
OFMSW	Organic Fraction of Municipal Solid Waste
RE	Renewable Energy
SIDS	Small Islands Developing States
STEM	Science Technology Engineering Mathematics
SWMD	Solid Waste Management Division
SWOT	Strengths Weaknesses Opportunities Threats
TS	Total Solids
UoM	University of Mauritius
VS	Volatile Solids
WTE	Waste-to-Energy

Overview of Deliverable 2

Deliverable 2 consists of three components namely:

- Kick-off meeting for the presentation of the technical assistance with the different stakeholders;
- Analysis of the current organic waste value chain across collection, transport, treatment and disposal;
- Baseline analysis of the organic waste from fresh produce markets, household and hotels including waste composition, characterization, and quantification.

The meeting report (Deliverable 2.1) comprises the main discussions held during the kick-off meeting between the different stakeholders and was submitted as to the CTCN as part of immediate deliverables. This report presents Deliverables 2.2 and 2.3. The analysis of the current value chain for organic waste provides a situational analysis of the value chain for organic wastes from collection, transportation, treatment to ultimate disposal. An in-depth analysis of the source of organic waste generation is made while the collection, transportation, treatment and disposal systems existent in Mauritius are also reviewed. This report also includes a gender and youth perspective in the analysis of the current value chain for organic wastes in Mauritius.

1. Introduction

Mauritius is a small island developing state (SIDS) of total surface area 1868 km^2 located to the east of Madagascar in the south-west Indian Ocean, with a total population of 1,221,759 as at end of 2020 (Statistics Mauritius, 2021). The island is well-known as a tourist destination owing to its pristine waters and white sand and has a quite diversified economy based on the textile and sugar industries, financial services sector and tourism industry, amongst others. Owing to the diversification of its economy, the island has evolved from a low-income economy to an upper-middle income economy. The downside of this economic growth coupled with higher standard of living, population growth and an increase in the number of tourists visiting the island yearly has resulted in a continuous increase in solid waste generation over the years. Solid waste generation in Mauritius, as in other SIDS, is a major issue considering land scarcity in these small islands states, often exacerbated by the NIMBY syndrome, and the high investment costs associated with waste management infrastructures. However, as opposed to other SIDS, Mauritius has been able to set-up a proper solid waste management system where a single sanitary landfill located at Mare Chicose ensures that most of the solid waste generated is properly disposed in an environmentally safe and sound manner. Nonetheless, while the Mare Chicose landfill has been guaranteeing the safe disposal of solid wastes since 1997, this is no longer a sustainable approach and is the least preferred option in the waste management hierarchy. Furthermore, the Solid Waste Management Division (SWMD) has fixed a highly ambitious target of 70% diversion of solid wastes from the landfill by 2030 (Beerachee, 2019), implying that alternative waste management technologies will need to be studied and implemented in the short to medium term.

Coupled with the issue of increasing solid waste generation, Mauritius faces another concern pertaining to its heavy dependence on fossil fuels to meet its electricity/energy requirements. In 2019, fossil fuels contributed to 87% of the total primary energy requirements of the island (Statistics Mauritius, 2020a). The electricity mix is highly carbonised as shown in Figure 1, where renewable energy (RE) represents only 24% of the energy mix. In 2009, the Mauritian Government fixed a target of 28% of electricity to be produced from renewable sources by 2020 and 35% of electricity generation from renewable sources by 2025 (Ministry of Energy & Public Utilities, 2009). Out of these, electricity from waste-to-energy (WTE) technologies would contribute to 4% by 2020 and 2025 (Ministry of Energy & Public Utilities, 2009). However, as at end 2019, renewable energy sources contributed to only 21.7% of electricity production in Mauritius while energy from solid wastes (through a landfill gas to energy project at the Mare Chicose landfill) contributed to 0.6% of total electricity produced (Statistics Mauritius, 2020a), both much less than the targets fixed. In its renewable energy roadmap 2030

for the electricity sector, the Ministry of Energy and Public Utilities maintained the target of 35% of electricity generation from renewable sources for 2025 while the contribution of electricity from WTE projects has been revised to 4.2% for 2025 (excluding electricity produced from landfill gas) (Ministry of Energy and Public Utilities, 2019). In view of the above, there is much to be done for tapping into the energy recovery potential of solid wastes (and in particular organic waste streams) to meet these targets.

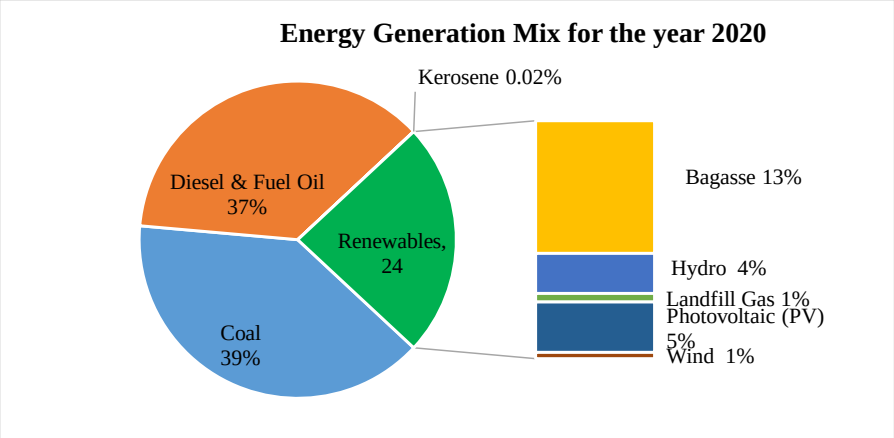

Figure 1 – Electricity mix in Mauritius (Statistics Mauritius, 2021)

In an attempt to alleviate the issues of solid waste generation and heavy dependency on fossil fuels to meet its total primary energy requirements, anaerobic digestion (AD) of the organic fraction of MSW emerges as one of the potential solutions. Anaerobic digestion can be defined as the biological degradation of organic wastes in the absence of oxygen in a controlled environment to produce biogas (mainly methane and carbon dioxide) and a digestate. The methane can be effectively combusted to produce renewable electricity while the digestate can be used as an organic fertiliser. With the anaerobic digestion project, the issue of solid wastes generation is alleviated through the diversion of wastes from landfilling while the electricity produced will contribute to reaching the target fixed for renewable electricity production from wastes and at the same time reducing greenhouse gases (GHG) emissions.

However, prior to implementation of such a project on large scale, a technical and economic feasibility is essential to assess the viability of the project. In this context, this CTCN technical assistance will comprise the development of a technical and economic feasibility study for AD of the organic fraction of solid waste from households, hotels and fresh produce markets in Mauritius. It is expected that this feasibility study will give Mauritius enough materials to take

an informed decision about the eventual implementation of anaerobic digestion of organic wastes on a large scale on the island.

2. Organic Waste Value Chain Report (Deliverable 2.2)

2.1 Analysis of the current value chain for organic waste

Solid wastes generated in Mauritius emanate from the domestic, commercial, institutional, and industrial sectors. The compositions of the different components constituting these waste streams are highly variable with some waste streams higher in organic wastes while others possessing higher recyclable components. There are around 12 recycling companies while others are mostly involved in the exportation of recyclable waste. The recycling companies are involved in the recycling of e-wastes, glass, plastics, textile, waste oil, used tyres and wood wastes.

There are some financial incentives provided by the Government to recyclers where they get an incentive of Rs. 15/kg of PET bottles recycled locally or exported for recycling, Rs. 2000/tonne of used tyres recycled or exported for recycling, Rs. 25/unit of used tyres re-treaded, Rs. 300/tonne of waste taken from transfer stations to be recycled

The scope of the current feasibility study is on organic wastes and particular focus will be made on organic fraction of the wastes generated from households, hotels and fresh produce markets.

2.1.1 Generation

Organic wastes are generated from the domestic sector, the hospitality sector, institutional sector, the agricultural sector, the forestry sector, the industrial sector and from fresh produce markets. The major types of organic solid wastes generated from these different sectors in Mauritius are illustrated in Figure 2. The highlighted blocks refer to the focus of the current study which is on organic wastes from households, hotels and fresh produce markets.

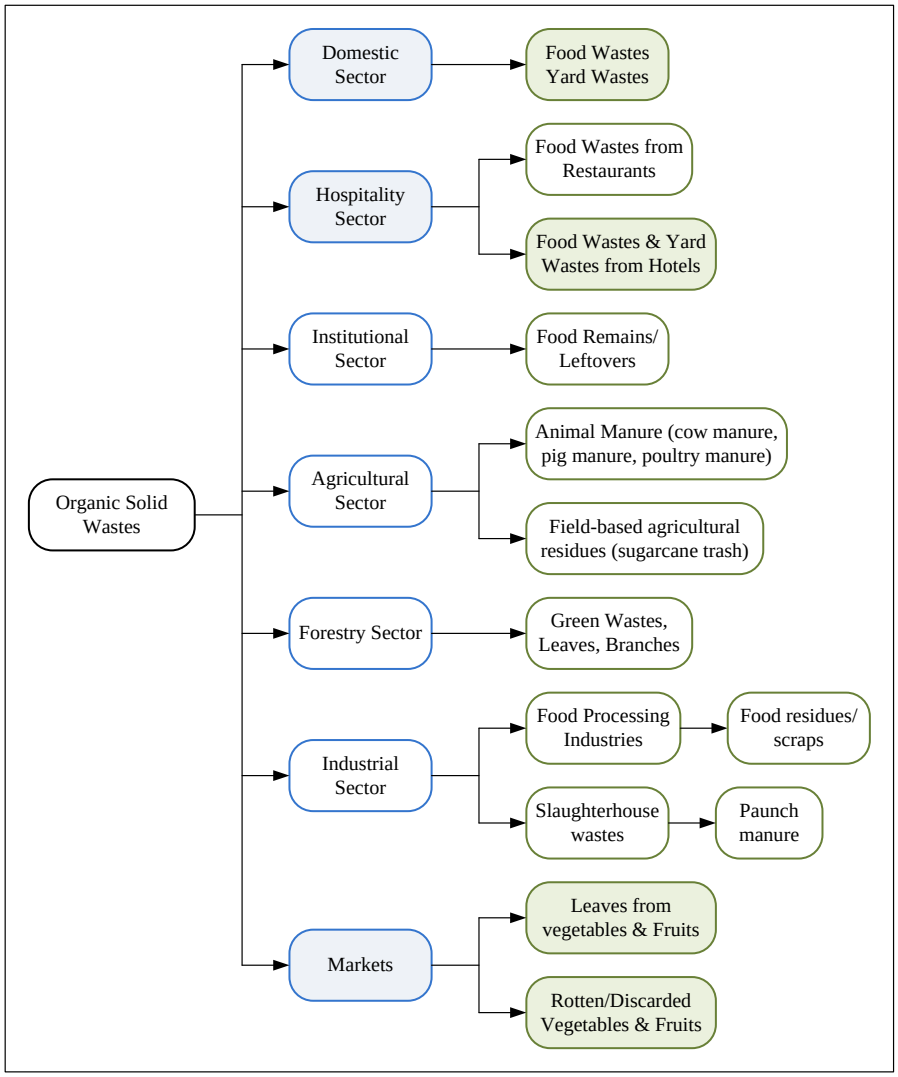

Figure 2 – Major sources of solid organic wastes generation in Mauritius

- **Organic solid wastes from households**

Among the three sources of solid organic wastes generation being analysed in this study (households, hotels and fresh produce markets), the domestic sector, representing an estimated 381,500 households in Mauritius (Statistics Mauritius, 2019), is the major generator of solid wastes. Out of the household solid waste stream, organic wastes consisting of food and yard wastes (or also known as garden waste) represent the major fraction, with the remaining comprising recyclable materials such as paper, plastics, glass and metals. Food wastes from

households are mainly generated during preparation and cooking as peels of fruits and vegetables or unutilised parts of meat while some food wastes may also be generated as leftovers, as stale food and as plate waste, although the latter is not significant. As for yard wastes, these are generated from the garden cleaning, maintenance and embellishment and include mainly grass clippings, fallen green and dry leaves and small branches. The food waste and yard waste from domestic represents 50% of the waste. Once generated at source (household), all the domestic wastes (food wastes, yard wastes, recyclables and any other residual wastes) are commingled and stored temporarily in storage containers such as 75-L bins, plastic bags or concrete boxes/enclosures fixed in boundary walls prior to these being collected by the collection services.

- **Organic solid wastes from hotels**There are around 111 hotels in Mauritius with more than 13,000 hotel rooms, catering for 1.35 million tourists visiting Mauritius in 2019 (AHRIM, 2020). The majority of hotels in Mauritius are located in the north/north-west of the island followed by the eastern and western parts of the island while the south and central part possesses only a few hotels. Similar to organic solid wastes from households, organic solid wastes from hotels can also be divided into food wastes and yard wastes. Food wastes from hotels are generated as part of the storage process (stale food), during meals preparation (peels or unutilised parts of meat), as leftovers particularly during buffets or as plate wastes (not insignificant as opposed to that from households) (Driver et al., 2020). As for yard wastes from hotels, these consist primarily of grass clippings.
- **Organic solid wastes from** fresh produce **markets**

There are 31 fresh produce markets in Mauritius, all widely dispersed around the island. Each market is serviced by its responsible Local Authority and the waste collection service is also ensured by the Local Authority. As opposed to organic wastes from households and hotels, organic solid wastes from fresh produce markets generally consist of leaves of fruits and vegetables as well as rotten vegetables or fruits and the amount generated annually in Mauritius is insignificant as opposed to the organic solid wastes generated from households.

2.1.2 Collection

Following generation, the next key function in an integrated solid waste management system is collection. In Mauritius, waste collection is ensured by the 12 Local Authorities (5 Municipal Councils and 7 District Councils) across the whole island as a door-to-door service. Waste collection takes place at least once weekly for the domestic sector and at least twice weekly for

the commercial sector, with a collection coverage of 100% (SWMD, Personal Communication, May 10, 2021). All wastes from households are collected commingled with the absence of separate bins for source segregation. Local Authorities may either provide the waste collection service in-house or they may contract out the collection service to a private waste contractor. The waste collection vehicles that are typically used in Mauritius are illustrated in Figure 3 and comprise either compactor trucks or non-compactor trucks. In some cases, the non-compactor open trucks are covered with a tarpaulin to prevent rainwater from infiltrating the waste mass. Once collected, the commingled household wastes are sent to one of the five transfer stations located across the island depending on the catchment area. Only wastes collected in the south and south-east of Mauritius are directly sent to the Mare Chicose landfill without being staged at a transfer station.

Figure 3 – Types of trucks used for waste collection in Mauritius: (a) Non-compactor truck with tarpaulin cover, (b) Non-compactor truck without tarpaulin cover, (c) Non-compactor closed truck and (d) Compactor truck

There exist some instances where the waste collection service is ensured by private contractors. This takes place in some regions (gated community) whereby households segregate their wastes in compartmentalised bins and pay for the collection of these wastes to be sent to recyclers. However, this practice is very minimal in Mauritius.

With regards to solid organic wastes emanating from hotels, there exist varying practices. As part of the conditions attached to their Environmental Impact Assessment (EIA) licence, hotels must ensure that their yard wastes are composted on-site. As for the food wastes generated, these are generally collected by private contractors and sent to the transfer stations or the landfill (depending on the catchment areas) due to the absence of a facility treating organic wastes. Small hotels may avail themselves of the private services offered through the Local Authorities. There are some hotels that work with some non-governmental organisations (NGOs) and give these NGOs their fresh food surplus to feed the needy people (Mazery, 2019). In this case, the surplus fresh food is not waste and is not collected as such. Furthermore, some hotels are also involved in the provision of food waste as animal feed and a dedicated lorry for that purpose collects the food wastes (Maudarbux, 2019).

As for fresh produce market wastes, these are collected by the Local Authorities or their contractors and sent to the transfer stations or the landfill (for markets in the south and south east) similar to wastes emanating from the domestic sector.

2.1.3 Transfer and Transportation

Once collected, most of the solid wastes from households, hotels and fresh produce markets are sent to one of the five transfer stations across the island. Exception is made for solid wastes from households, hotels and fresh produce markets in the south and south-east of Mauritius whereby the wastes are directly sent to the Mare Chicose landfill. The transfer stations and the landfill are the property of Government and fall under the responsibility of the SWMD. In addition to devising policies and strategies pertaining to solid waste management, the SWMD also ensures that the transfer stations are properly operated and maintained by contracting the maintenance and operational aspects of the transfer stations to the private sector.

The five transfer stations in Mauritius are located at La Chaumiere (west), Roche Bois (north-west), Poudre d'Or (north-east), La Laura (east) and La Brasserie (centre) while the Mare Chicose landfill is located in the south east of Mauritius, as illustrated in Figure 4. Over 84% of the solid wastes generated from households transit through one of the five transfer stations prior to be sent to the landfill (SWMD, Personal Communication, May 10, 2021). Once received

at the transfer stations, the solid wastes are placed in large truck trailers of capacity 20-25 tonnes that then transport the wastes to the Mare Chicose landfill. Similar to the operation and maintenance of the transfer stations, the waste transportation from the transfer stations to the landfill is also undertaken by the private sector contracted out by the SWMD.

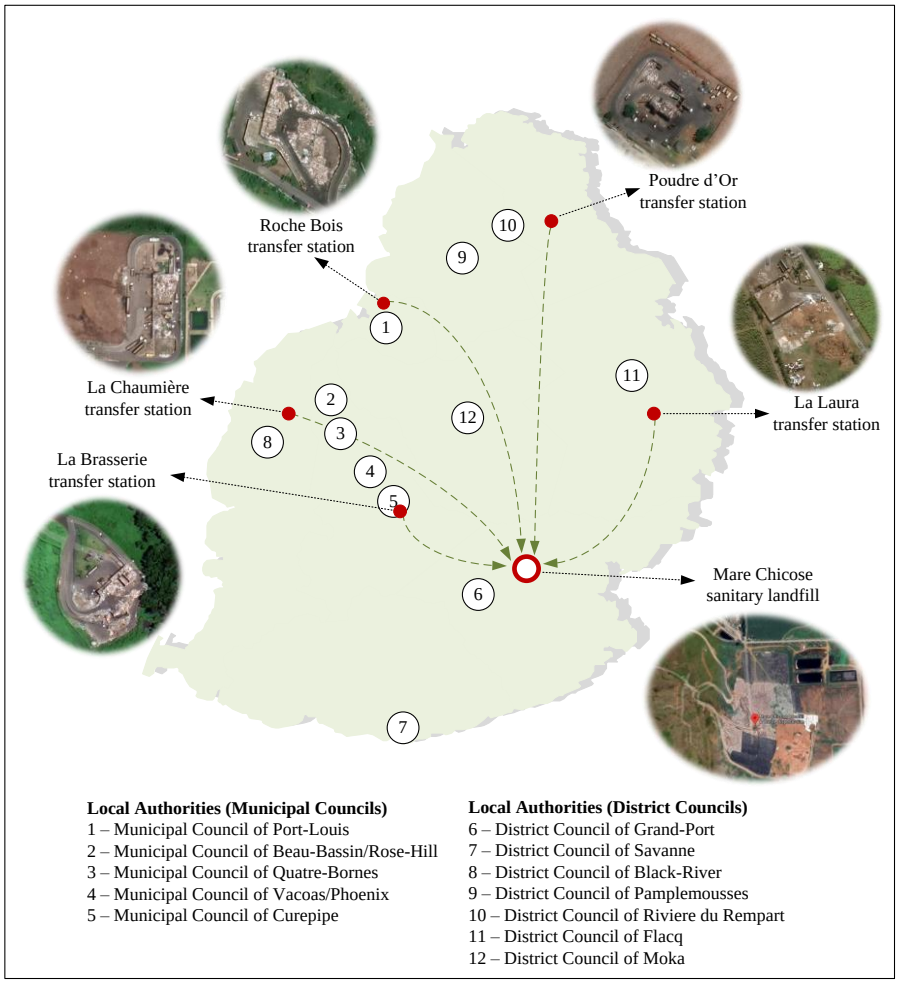

Figure 4 – Location of transfer stations, Mare Chicose landfill and 12 Local Authorities in Mauritius (Aerial views of transfer stations and landfill reproduced from Google Maps)

Each of the five transfer stations across the island serve as catchment areas for their neighbouring regions. La Chaumière transfer station serves the regions of Black-River, Quatre-Bornes, Beau-Bassin/Rose-Hill and part of Vacoas/Phoenix and the nearby regions. Roche Bois transfer station is responsible for the regions of Port-Louis and part of Pamplemousses and

other regions in the vicinity. Poudre d'Or transfer station caters for the regions of Rivière du Rempart and part of Pamplemousses and the surrounding regions. La Laura transfer station serves the regions of Moka and Flacq and the neighbouring regions while La Brasserie transfer station serves part of Vacoas/Phoenix and Curepipe and the nearby regions. The details of the five transfer stations are provided in Table 1.

Table 1 – Details of the five transfer stations in Mauritius (Adapted from: Solid Waste Management Division, 2020)

Transfer Station	Year of Operation	Design Capacity (tonnes/day)
La Chaumière	2011	350-450
Roche Bois	1992	300-400
Poudre d'Or	2000	150-180
La Laura	2005	100-150
La Brasserie	1991	150-300

2.1.4 Treatment

As at current status, no solid organic wastes are subjected to any treatment such as composting or anaerobic digestion except in some hotels that are required to do composting as per the condition of their EIA license. A household composting scheme was initiated by the then Ministry of Environment and Sustainable Development in 2011 whereby household composters were delivered to households for the composting of organic wastes. In total, 26,058 household composters were delivered from 2013 to 2016 and training was also imparted to the beneficiaries (SWMD, Personal Communication, May 10, 2021). However, no follow-up was made on the efficiency of this measure on organic wastes diversion from the landfill. This scheme has not been active since 2016 but was re-introduced in the budget for financial year 2021/2022 wherein an amount of MUR 10 M (USD 232,000) has been provided for composting of green wastes from households..

In 2011, as a private initiative of the company Solid Waste Recycling Ltd., a national composting plant became operational at La Chaumière to process solid organic wastes. The

composting plant processed unsorted municipal solid wastes and waste diversion from the landfill through the composting plant are summarised in Table 2.

Table 2 – Waste diversion from landfill through composting plant at La Chaumière (Source: Statistics Mauritius, 2020b)

Year of Operation	Solid Wastes processed by composting plant (tonnes/year)
2011	5,154
2012	34,785
2013	19,257
2014	41,032
2015	37,979
2026	38,308
2017	14,533

However, since 2017, the composting plant ceased operation following an Enforcement Notice issued to the company by the Department of Environment due to numerous fire outbreaks at the facility (SWMD, Personal Communication, May 10, 2021). In addition, the composting plant had some technical and operational issues which resulted in the cessation of its activities (Kowlesser, 2020). Subsequent to these mishaps, the company 'Solid Waste Recycling Ltd.' has gone into receivership in 2018 and the composting facility is still not operational.

With regards to organic solid waste from hotels, there are several avenues for its management as aforementioned. Yard wastes should normally be treated through composting by the hotels as part of the conditions attached to their EIA licence. However, this is sometimes not the case as the yard wastes are disposed with food wastes through the contracted private services. Food wastes are not treated but are mostly disposed of as part of the normal waste collection services provided by Local Authorities or through contracted private contractors. As for fresh surplus food, these are delivered to NGOs for feeding the needy people (Mazery, 2019). Some hotels also provide their food wastes as animal feed and a dedicated lorry collects the food wastes on a daily basis (Maudarbux, 2019).

Market wastes have a similar fate as solid wastes from households. These do not undergo any treatment and are collected by the Local Authorities for disposal at the landfill.

2.1.5 Disposal

There is only one disposal site in Mauritius: a sanitary landfill located at Mare Chicose. Similar to the 5 transfer stations, the landfill is also the property of the Government but is operated and maintained by a private contractor through a contract with the SWMD. The Mare Chicose landfill with a footprint of 48 Ha has been operational since 1997 and has ensured the environmentally sound management of solid wastes over the years while also protecting human health (Solid Waste Management Division, 2020). The Mare Chicose landfill receives wastes from the 5 transfer stations across the island and from the southern and south-eastern parts of Mauritius. In addition, other wastes such as municipal sludge, construction and demolition wastes, used tyres, condemned goods and poultry wastes, amongst others, are also disposed at the landfill (Statistics Mauritius, 2020a). In 2020 (from January - December), the total amount of solid wastes disposed at the Mare Chicose landfill reached 509,085 tonnes (SWMD, Personal Communication, May 10, 2021).

Due to the significant amount of organic wastes disposed at the landfill annually, the biodegradation process results in the production of leachate and landfill gas (comprising mainly methane and carbon dioxide). The leachate is collected and sent to a pumping station located at Roche Bois prior to disposal to sea outfall while the landfill gas, after collection is combusted in 3 X 1.1 MW (3.3 MW) capacity engines for the production of electricity (Kowlesser, 2020). In 2019, 19.8 GWh of electricity was generated from landfill gas combustion and fed to the grid network (Statistics Mauritius, 2020a).

Considering the amount of solid wastes landfilled annually, the lifetime of the landfill has considerably reduced. In view to ensure a continuity in waste disposal, the SWMD came forward with a project comprising of erecting walls around the perimeter of the landfill so that wastes placement could be extended vertically (Kowlesser, 2020). This measure will increase the landfill lifespan and provide for sufficient time for the SWMD to establish other waste management diversion techniques such as composting and anaerobic digestion.

2.2 SWOT Analysis of Organic Waste Value Chain

A SWOT analysis is a structured planning method that evaluates the four elements namely Strengths, Weaknesses, Opportunities, and Threats of a system. A SWOT analysis helps with both strategic planning and decision-making

2.2.1 Strengths

- 100% waste collection coverage in Mauritius.
- No illegal or negligible dumping of solid organic wastes.
- No backyard burning of solid organic wastes as there is proper regulation.
- Proper solid waste management framework with a network of 5 transfer stations and a sanitary landfill.
- Proper landfill gas management and leachate collection system.
- Landfill gas abstracted converted to renewable electricity.

2.2.2 Weaknesses

- Low to non-existent source segregation of solid organic wastes.
- Solid organic wastes collected are commingled with other wastes.
- Low to non-existent recovery of solid organic wastes.
- Lack of efficient technologies to recycle solid organic waste
- Low or inadequate incentive to recycling companies.
- Lack of waste annual characterisation data (tracking this data over a number of seasons rather than a single season adds additional confidence provided that the methodology can be replicated).

2.2.3 Opportunities

- Implementation of source segregation of solid organic wastes through provision of separate bins for households. This could result in relatively homogenous organic waste streams for exploitation.
- Set-up solid waste management technologies for treatment of organic wastes such as composting and anaerobic digestion processes.
- Renewable energy production from anaerobic digestion of organic wastes.
- Reduction of GHG emission through green energy.
- Creation of specialised and green jobs in composting and biogas plants.

- Conduct was characterisation exercise annually (this will assist to track any improvements in efficiency, for instance to gauge how successful targeted separation at source initiatives are working).
- Develop a clear methodology for waste characterisation.

2.2.4 Threats

- Loss of high valuable solid organic wastes having potential for composting or anaerobic digestion processes.
- Further GHG emissions from decomposition of solid organic wastes.
- Saturation of the Mare Chicose sanitary landfill.
- Solutions for organic waste utilization such as anaerobic digestion not economically viable.
- Solid waste disposal emergency situation in the future.

2.3 Gender and Youth Perspective

2.3.1 Gender Analysis

Solid waste management is often perceived as a job restricted to the male gender. However, it is often forgotten that the first person to handle wastes at household level is either a mother or a wife, that is, the female gender (ISWA/UNEP, 2015). But moving from waste generation to waste collection, transfer, treatment and disposal, it is often observed that the waste management system then becomes dominated by men. As per a survey carried out by the SWMD (results summarised in Figure 5), it is observed that at the level of the Local Authorities, 96% of the employees from the health department responsible for waste collection are men. The highest positions in the health department (chief, principal and senior health inspectors) are predominantly of male gender while at the health inspector level, 43% constitute the female gender. At the level of waste collection (supervisors, drivers and refuse collectors), this is again dominated by the male gender with only 1 female refuse collector out of 1419 refuse collectors employed by the 9 Local Authorities that have responded to the survey.

At the level of private waste private contractors, while the sector is predominantly of male gender, the disparity between male and female is less than that at the level of the Local Authorities. From the 4, based on information gathered from waste private contractors, it is observed that at managerial level, an average of 80% is controlled by the male sector. However, at the level of on-site operators/workers, 57% of this cadre is of female gender while 31% of the refuse collectors also consist of women.

However, when moving up the waste management institutional hierarchy, it is observed that the SWMD, the entity responsible for solid waste management in Mauritius, has a more balanced distribution of the genders. The SWMD can be categorised into an administrative section, a technical section and a non-technical section. 53% of the staffs at the SWMD are men while 47% are women. The technical cadre, headed by a Director of male gender, comprises 56% of personnel from the male gender while the non-technical cadre consists of 54% of officers from the male gender. The administrative cadre is headed by a Permanent Secretary of the female gender and has one female deputy permanent secretary and one male assistant permanent secretary.

Based on the above, it can be inferred that the disparity between the two genders is decreasing particularly at the central level (SWMD) and at the level of the private waste private contractors. However, at the level of the Local Authorities, it is observed that the waste sector is still predominantly of male gender: be it at the level of the chief, principal or senior health inspectors or at the level of refuse collection. As such, there needs to be a shift at the level of the Local Authorities to recognise that the waste sector is no more reserved for the male gender but can be serviced by both genders.

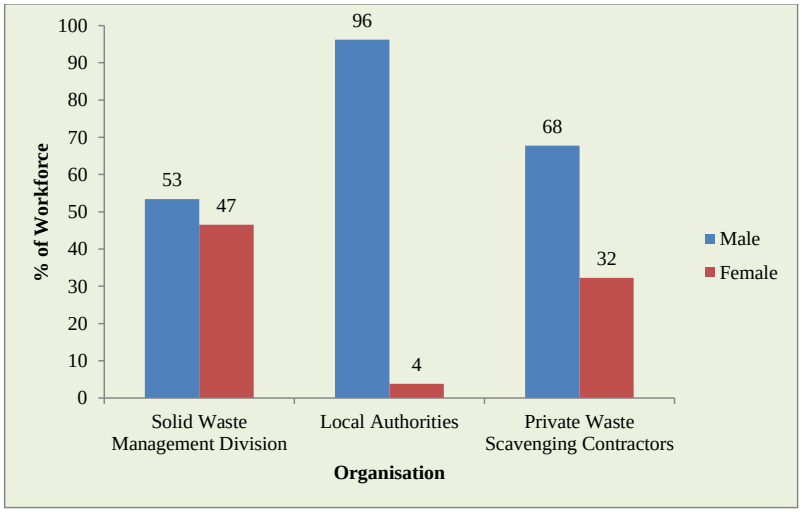

Figure 5 – Gender perspective across the solid waste management chain chain (Drawn based on data provided by SWMD)

2.3.2 Youth Perspective

Sustainable waste management is a topic that needs to be inculcated in national youth programmes from a very early age so that the upcoming generations already possesses this mindset towards waste prevention, reduction, reuse and recycling. In Mauritius, children at the age of 11 years old (grade 6 of primary school teaching) are introduced to the topic of waste management in the curriculum of the science subject wherein an initiation is made on the aspect of source segregation of wastes into different bins for recycling while composting of green wastes is briefly introduced (MIE, 2018a). At the level of grade 9 (14 years old), focus is again made on the "4Rs principle of waste management" namely Refuse, Reduce, Reuse and Recycle (MIE, 2020). Furthermore, a composting project was initiated in 44 schools in 2006 while waste segregation has been implemented in schools since 2010 for the separate storage of paper, plastic, green wastes and others (MIE, 2018b). At the School Certificate level, there is one subject "environmental management" that includes some aspects of waste management. However, only 0.6% of the total candidates sitting for the School Certificate examinations opted for that subject in 2019 and it is also worth noting that only 8 girls out of 115 candidates opted for this subject (Mauritius Examinations Syndicate, 2019a). At the Higher School Certificate level, this ratio was even more insignificant and stood at 0.1% in 2019 (Mauritius Examinations Syndicate, 2019b). It would be tempted to think that there is a lack of interest from the youth in Mauritius towards the environment and even less concern towards waste management. However, the education system in Mauritius is framed as such that STEM subjects and accounting and economics are often privileged.

At the tertiary education level, the Chemical and Environmental Engineering Department of the University of Mauritius offers a programme on Chemical Engineering (with an option of Environmental Engineering in the 4th year of study) wherein a module is dedicated to solid waste management. Furthermore, many of the final year students under this programme opt for final year projects focussing on solid waste management technologies such as composting, anaerobic digestion, bio-ethanol production and thermal treatment techniques such as torrefaction and pyrolysis. The Chemical and Environmental Engineering Department also boasts several PhD students (current and past) having done research on solid waste management including on vermi-composting, anaerobic digestion, industrial symbiosis, bio-ethanol production, pyrolysis and torrefaction. The Department also offers a course at Masters level on Sustainable Energy Engineering with Environmental Management that also includes a component on solid waste management technologies. Around 30 students registered for the undergraduate in Chemical Engineering and 15 students for the Masters in Sustainable Energy Engineering with Environmental Management

Besides the inclusion of solid waste management in the curriculum at primary, secondary or tertiary levels, the Government has recently set-up a National Youth Environment Council comprising young environmentalists with an age group of 18 to 35 years old (Prime Minister's Office, 2020). This Council will provide the youth with the opportunity to interact with policy makers on policies, strategies and action plans related to the environment (Prime Minister's Office, 2020). It can thus be inferred that solid waste management will be one of the themes that the National Youth Environment Council will look to engage in and sensitise the young generation on the issue of solid wastes and the best environmental practices to adopt.

At the level of the Local Authorities, the majority of the workforce (54%) falls within the age group of 40-54 years old while only 0.4% falls within the youngest age group of 18-24 years old. A similar trend is observed for the private waste private contractors whereby 43% of the workforce falls within the age group of 40-54 years while 5% falls within the age group of 18-24 years old. At the level of the SWMD, the majority of the workforce (50%) falls within the age group of 25-39 years old while 2% falls within the age group of 18-24 years old. Further details are summarised in Figure 6.

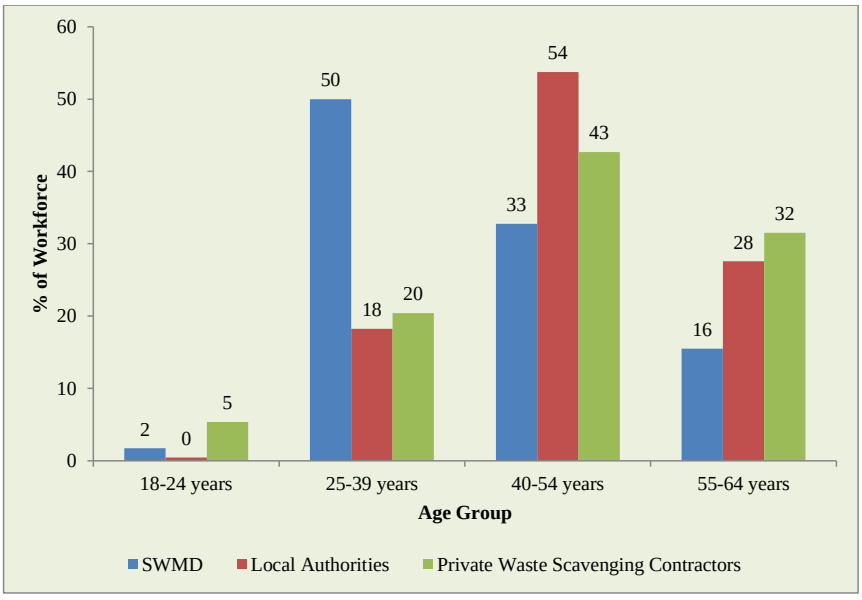

Figure 6 – Youth perspective across the solid waste management chain (Drawn based on data provided by SWMD)

2.4 Conclusions

Deliverable 2.2 provided an analysis of the current value chain for organic wastes from households, hotels and fresh produce markets across generation, collection, transport, treatment and disposal. Through this analysis, it was concluded that all the organic solid wastes collected from these three sources of waste generation ultimately end up at the transfer stations for final disposal at the Mare Chicose landfill. The next deliverable (deliverable 2.3) will focus on waste quantification, composition and characterisation at the different transfer stations and the Mare Chicose landfill. While deliverable 2.3 will provide estimated quantities of solid organic wastes from hotels and fresh produce markets, the official figures from the transfer stations and the landfill will be used as the basis for this feasibility study as these figures include the aggregated quantities for both households, hotels and fresh produce markets.

3. Baseline Analysis of Organic Waste including Composition, Characterisation and Quantification (Deliverable 2.3)

3.1 Solid Waste Characterization

The data on characterization was taken from the study conducted by the University of Mauritius (UoM) and Solid Waste Management Division (SWMD). The characterization was conducted as per ASTM D5231 - 92(2016) through the selection and manual sorting of waste samples to determine waste quantities and waste characteristics. The procedures for the collection and classification of a representative sorting sample of municipal solid waste generated in Mauritius were as follows:

- Timing of waste analysis
- Sample selection: Size and Number
- Site and truck selections
- Sample size reduction
- Sample classification

The waste was characterised at each Transfer Station and landfill once monthly over a period of 12 months. It started in November 2019 and completed in October 2020. However, characterisation was not done during April and May 2020 due to the national lockdown with respect to COVID-19 pandemic. As such the characterisation was conducted for the same month, that is April and May, during 2021 to ensure that characterisation was conducted once each month.

During the process of characterisation solid waste was separated into different components namely food waste, yard waste, paper, PET, HDPE, LDPE, Polystyrene, textile waste, meta1 and glass. After sorting, samples of the different waste components and sub components were collected and transported to the laboratory for analysis such as the moisture content, total solids, ash content, volatile solids, gross calorific value, CHNS content.

3.2 Solid organic wastes composition

Solid organic wastes that will be investigated in this study will comprise food wastes and yard wastes. Based on a national solid waste characterisation study carried out by the University of Mauritius in collaboration with the SWMD from November 2019 to May 2021, the results pertaining to the composition of food wastes and yard wastes for the domestic and commercial sectors (henceforth referred as municipal solid waste (MSW) stream) were obtained and used for the current feasibility study. *In the absence of actual data for November, December 2020*

given that the characterisation study was for the period November 2019 to October 2020 and April and May 2020 due to national lockdown, data on composition of waste for November and December 2019 and April and May 2021 have instead been used as the characterisation study was conducted for these months.

3.2.1 Food Waste

As observed in Figure 7, the compositions of food waste in MSW stream for the different transfer stations and that disposed directly at the landfill do not show a uniform trend. The food waste composition is lowest at 3% for Roche Bois transfer station in January 2020 and highest for food in MSW disposed directly at the landfill at 47% in August 2020. For the whole island, the food waste composition varies from 11% to 26% across a year, with the yearly average being 17%.

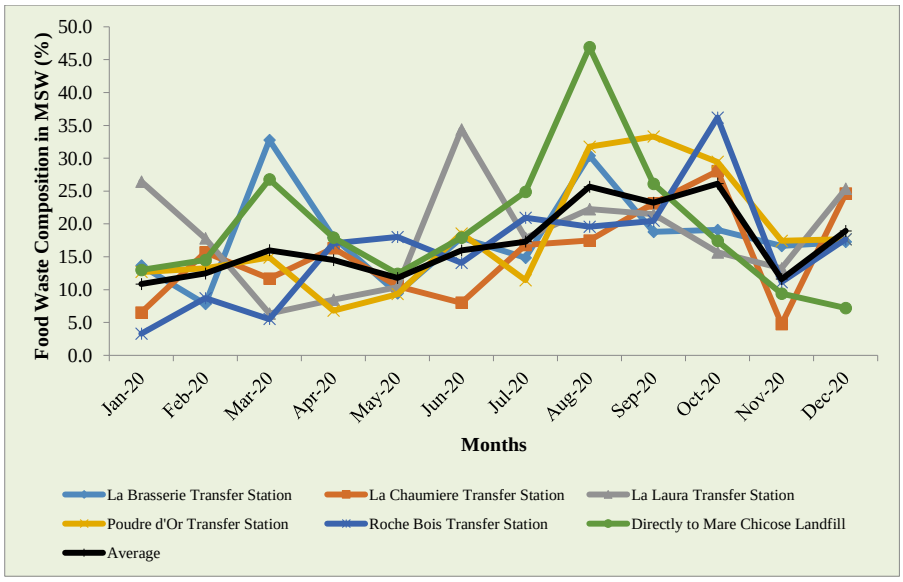

Figure 7 – Food wastes composition in MSW stream for different disposal sites (Source: SWMD and UOM, 2021). **Note:** Wastes disposed directly to Mare Chicose landfill come from Grand Port and Savanne district councils.

It should also be noted that 2020 was a bad year given that there no tourists since March 2020. Many people were working from home during April to even August. At some point of time during July – Oct, students (primary, secondary and tertiary) were also on vacation. This may have accounted for the increase in organic food waste towards the beginning of the last quarter of the year.

3.2.2 Yard Waste

Similar to food wastes, the compositions of yard wastes in the MSW stream for the different disposal sites show a rather erratic tendency, as depicted in Figure 8. The lowest yard waste composition stands at 3% for La Brasserie transfer station in November 2020 while the highest yard waste composition is 61% in November 2020 for wastes directly disposed at the landfill. For the whole of Mauritius, the composition of yard wastes varies from 22% to 36% throughout the year, with the yearly average being 29%. Based on the food waste and yard waste compositions, solid organic waste represents, on a yearly average, 46% of the total MSW landfilled in Mauritius.

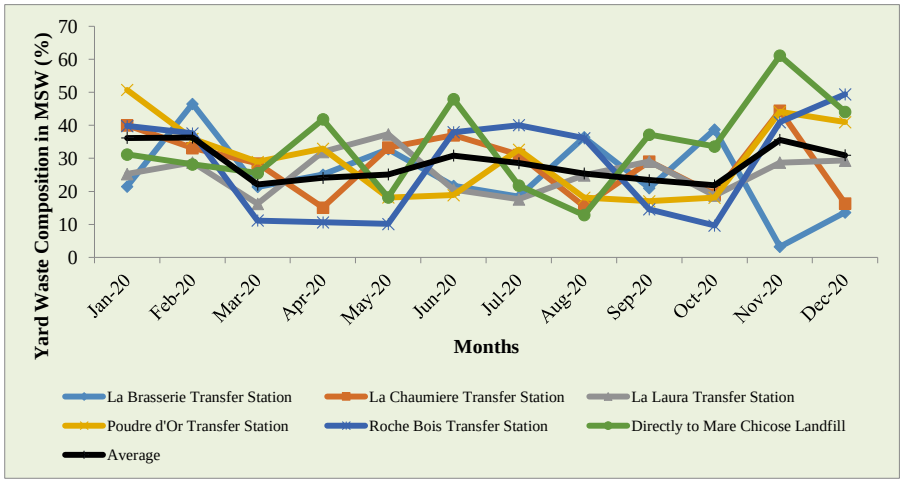

Figure 8 – Yard wastes composition in MSW stream for different disposal sites (Source: SWMD and UOM, 2021)

3.3 Solid organic wastes characterisation

Solid organic wastes characterisation comprises the determination of the total solids (TS) content (and moisture content), the volatile solids (VS) content (and ash content) and the carbon (C), hydrogen (H), nitrogen (N) and sulphur (S) content of the food waste and yard waste samples through ultimate analysis. All the results were obtained from the national solid waste characterisation study carried out by the University of Mauritius in collaboration with the SWMD and the average values were determined as weighted means using the waste quantification data.

The following laboratory analysis were conducted:

- Moisture content and Total Solid

The moisture content of each sample was determined by weighing 1 kg of the samples into a pre-weighed dish and drying the samples in an oven at 105°C to a constant weight (ASTM D3173). The moisture content was calculated as a percentage loss in weight before and after drying. The dry sample represented the total solids.

- Ash content and Volatile solids

  Ash content of waste is the non-combustible residue left after waste is burnt. The dried samples were burnt at 550°C for 3 hour (ASTM D3174) and then was weighed to determine the ash dry weight. The volatile solids are the difference between the dried solids and the ash.

- Gross Calorific Value

  The gross calorific value (GCV) is the total heat released by a fuel during its complete combustion with the assumption that the water vapour in the products condenses. Hence it takes into accounnt the latent heat of vaporization of the water vapour in the products. The calorific value is obtained experimentally using a calorimetric bomb as per ASTM D 5865. Approximately 1 g of each waste sample was crushed and inserted into a bomb calorimeter for GCV determination.

- CHNS

  An elemental analysis was performed to determine the carbon, hydrogen, oxygen and nitrogen percent present in the sample. It was carried out as per ASTM D5373. The samples were made into powdered form. They were then weighted (between 0.5 – 0.8 mg) and placed in tin capsules. The tin capsules were then combusted at a temperature of 900 ºC inside the CHNS analyser.

3.3.1 Total solids content

The TS contents of the food waste and yard waste samples determine the type of anaerobic digestion system that will be more suitable for implementation (e.g. low solids vs. high solids anaerobic digestion systems). This also assists the operator of a future biogas plant to determine the amount of water that needs to be added to the feedstock so as to reach the desired TS content. As observed in Figure 9, the TS contents of the food waste samples at the various disposal sites are highly variable with values ranging from 18% (Poudre d'Or transfer station) to as high as

83% (La Laura transfer station). For the whole island, the TS content averages 47% for the whole year.

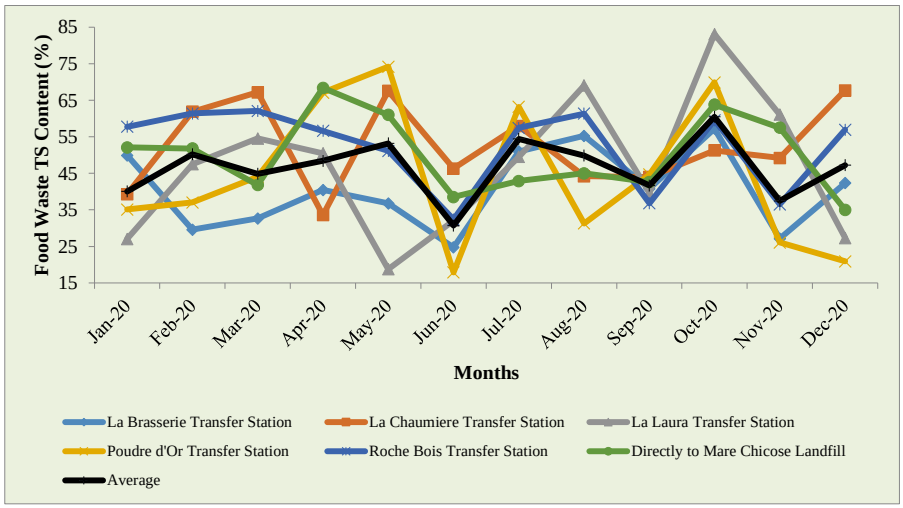

Figure 9 – TS content of food wastes (Source: SWMD and UOM, 2021)

Similar to food wastes, the TS contents for the yard waste samples are highly variable with values ranging from 9.8% (La Laura transfer station) to as high as 83% (Poudre d'Or transfer station). Over a one-year period, the TS content of yard wastes for the whole island averages 44% (close to that of food wastes). The TS contents of food and yard wastes tend to preliminary indicate that a high solids anaerobic digestion system may be more suited to the Mauritian context. However, a more profound analysis will be made in subsequent deliverables to confirm this preliminary deduction.

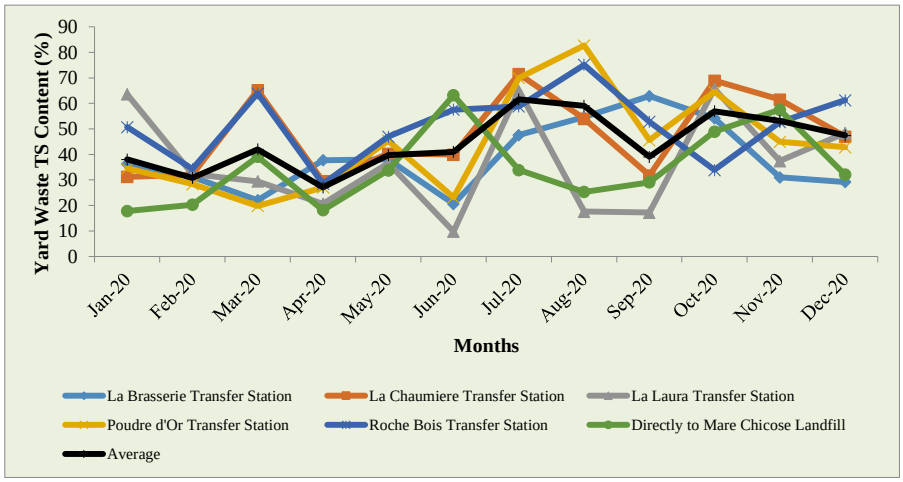

Figure 10 – TS content of yard wastes (Source: SWMD and UOM, 2021)

3.3.2 Volatile solids content

The VS represent the organic portion of a substance that is biodegradable as opposed to fixed solids (ash) which are inorganic (mineral) and cannot be digested. The VS content of a feedstock determines its organic loading rate which is an important parameter of the anaerobic digestion process. A high organic loading rate may result in an unstable digestion process with high volatile fatty acids formation/accumulation while a too low organic loading rate may result in low biogas production. As such, determination of the VS content of the feedstock assists in deciding the organic loading rate and the amount of substrates to be fed to the biogas plant. From Figure 11, it can be observed that the VS content of food wastes across disposal sites and over the one-year period is not highly variable. The lowest VS content is observed for the month of October 2020 at Poudre d'Or transfer station and stands at 84% while the highest VS content has been reported at 98% for La Chaumière transfer station in December 2020. The yearly average for VS content for the whole island is 94%.

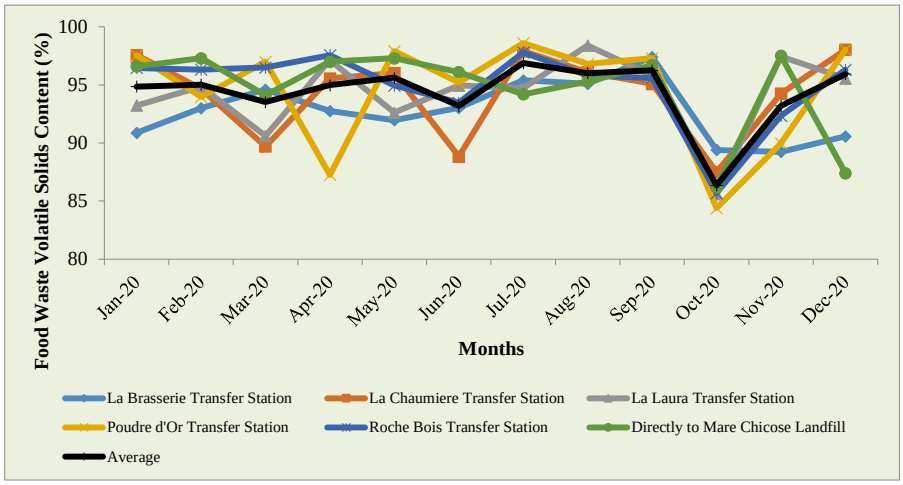

Figure 11 – VS content of food wastes (Source: SWMD and UOM, 2021)

As opposed to food waste, the VS content for yard wastes shows a more erratic trend and a higher variability, as illustrated in Figure 12. The lowest VS content is observed for La Chaumière transfer station at 70.3% while the highest VS content is reported for Roche Bois transfer station at 98%. The yearly average of VS content for yard wastes for the whole island is 87%.

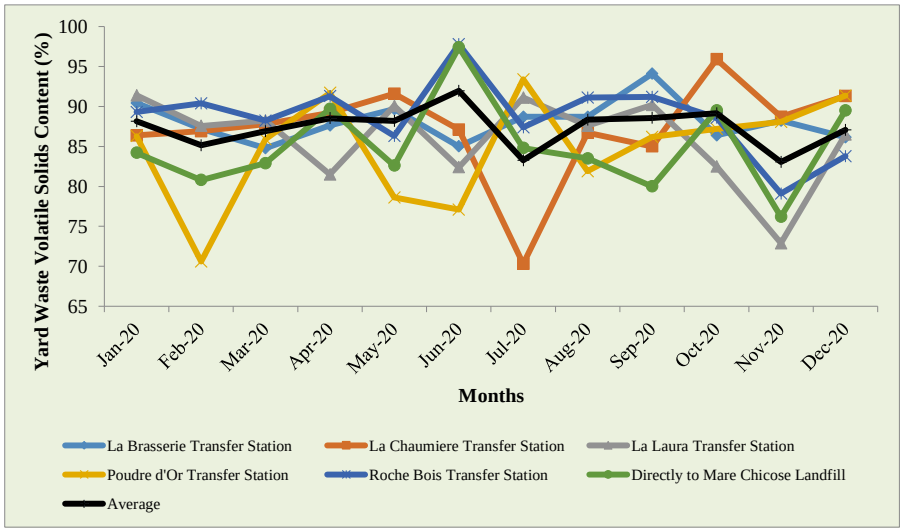

Figure 12 – VS content of yard wastes (Source: SWMD and UOM, 2021)

The low variability of the VS content for food wastes implies that no significant alteration will need to be made to the amount of food wastes fed to a future biogas plant and this will also ensure a stable digestion process. As opposed, the higher variability of the yard wastes implies that the amount of yard wastes fed to a future biogas plant needs to be properly worked out and calculated in view to preventing any shock loading to the biogas reactor, thereby minimising the risks of process failure.

3.3.3 Ultimate analysis (CHNS content)

Ultimate analysis is carried out to determine the carbon (C), hydrogen (H), nitrogen (N) and sulphur (S) content of a waste sample while the oxygen (O) content is then determined by subtraction (total makes up 100%). The determination of the CHNS content of the food and yard waste samples in the context of this feasibility study may assist in the calculation of the empirical formula of food and yard wastes that may be subsequently used to quantify the theoretical biogas production potential of the waste samples. The C and N contents may be further employed to determine the C/N ratio of the waste sample which is another important parameter of the anaerobic digestion process.

The CHNS analysis of the food wastes and yard wastes, as observed in Table 3 and 4, depict high carbon contents and a C:N ratio on the lower end of the optimum C:N ratio range for effective anaerobic digestion (optimum C:N ratio range is 20:1 to 30:1 (Abbasi et al., 2012). It is also observed that there is a small variability between the values for each component as well as for the C:N ratios and this implies a stable waste mass throughout the year.

Table 3 – Ultimate analysis and C:N ratio of food wastes (Source: SWMD and UOM, 2021)

Months	C (%)	H (%)	N (%)	S (%)	O (%)	C/N Ratio
Jan-20	43.382	8.603	2.127	0.000	45.888	20.396
Feb-20	38.858	7.969	1.635	0.000	51.537	23.765
Mar-20	39.140	8.905	2.205	0.000	49.750	17.751
Apr-20	41.270	9.052	1.940	0.000	47.738	21.273
May-20	37.980	8.156	2.060	0.000	51.804	18.437
Jun-20	39.938	8.430	2.049	0.000	49.582	19.489
Jul-20	37.758	8.845	1.978	0.000	51.419	19.089
Aug-20	39.457	8.924	2.018	0.000	49.602	19.556
Sep-20	39.190	8.314	2.035	0.000	50.461	19.258
Oct-20	38.700	9.091	2.012	0.000	50.196	19.231
Nov-20	36.491	8.270	1.966	0.000	53.272	18.557
Dec-20	39.233	9.325	2.282	0.000	49.160	17.194

Average	**39.209**	**8.752**	**2.035**	**0.000**	**50.004**	**19.269**

Table 4 – Ultimate analysis and C:N ratio of yard wastes (Source: SWMD and UOM, 2021)

Months	C (%)	H (%)	N (%)	S (%)	**O (%)**	**C/N Ratio**
Jan-20	41.800	6.957	2.026	0.000	49.216	20.629
Feb-20	39.290	7.873	2.201	0.000	50.636	17.849
Mar-20	37.620	6.880	1.510	0.000	53.990	24.914
Apr-20	41.090	7.320	1.590	0.000	50.000	25.843
May-20	38.910	6.610	1.670	0.000	52.810	23.299
Jun-20	35.386	6.943	2.852	0.000	54.819	12.408
Jul-20	41.564	8.040	1.627	0.000	48.769	25.547
Aug-20	37.865	7.401	1.924	0.000	52.810	19.680
Sep-20	39.746	7.585	1.751	0.000	50.919	22.703
Oct-20	38.363	6.926	1.875	0.000	52.836	20.457
Nov-20	39.464	8.297	1.765	0.000	50.474	22.360
Dec-20	25.799	5.786	1.614	0.000	66.801	15.983
Average	**37.796**	**7.238**	**1.888**	**0.000**	**53.078**	**20.018**

3.4 Solid wastes quantification

Quantification of solid organic wastes is determined through the amount of total solid wastes generation and the composition of organic wastes (food and yard wastes) in the total solid wastes generated. As indicated in the previous sections, most of the solid wastes generated in Mauritius (households, hotels or fresh produce markets) end up at the transfer stations prior to being ultimately disposed at the Mare Chicose landfill. It thus seems more scientifically appropriate to rely on figures available from the different transfer stations and the Mare Chicose landfill to quantify the total solid wastes generated in Mauritius.

In 2020, the total solid wastes landfilled at Mare Chicose reached 509,085 tonnes, representing a decrease of 5.2% over the preceding year (Statistics Mauritius, 2020b; SWMD, Personal Communication, May 10, 2021). This anomalous decrease for 2020 is mainly attributed to the lockdown period in Mauritius due to the COVID-19 pandemic, resulting in a decrease in consumption and a decrease in waste generation. Over the past 10 years, the amount of solid wastes landfilled has nonetheless experienced a general increase of 2.2% year on year. The total solid wastes landfilled and composted can be observed in Figure 13. As can be depicted, a fraction of the total solid wastes generated was composted from 2011 to 2017 owing to the operation of the composting plant at La Chaumiere. However, since it ceased operation in mid-2017, no waste was eventually composted as from 2018 onwards.

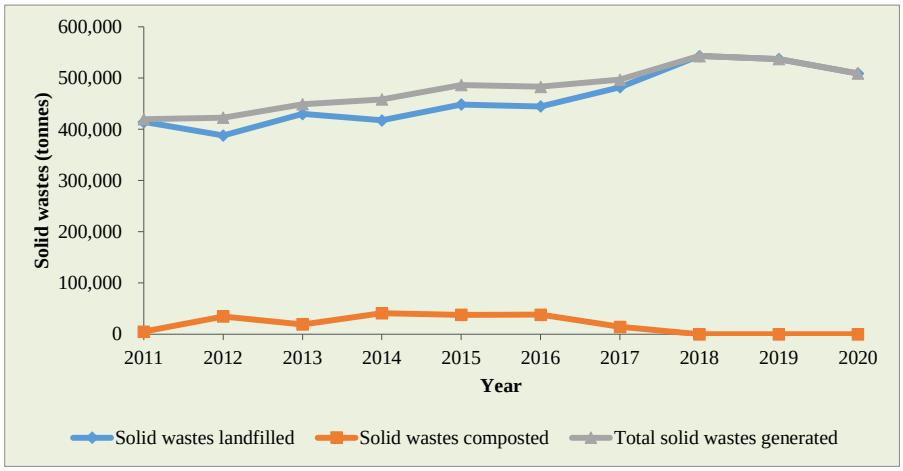

Figure 13 – Solid Wastes landfilled and composted in Mauritius (Total amount excludes solid wastes recycled) (Source: Statistics Mauritius, 2020b; SWMD, personal communication, May 2021)

The total amount of solid wastes landfilled in 2020 can be broken down based on the different transfer stations that these transit through, as summarised in Table 5.

Table 5 – Solid wastes recorded by facility for the period January to December i 2020 (Source: SWMD, personal communication, May 2021)

Transfer Stations / Other Sources	Tonnes
La Chaumière	119,202.12
Roche Bois	97,760.36
La Brasserie	91,860.08
Poudre d'Or	71,497.86
La Laura	49,869.54
Directly to Mare Chicose landfill *(from Grand Port & Savanne District Councils)*	45,361.91
Others*	33,532.80

Total	**509,084.67**

***Others refer to solid wastes disposed directly at the landfill that comprise industrial wastes, asbestos, condemned goods, clinical wastes, construction and demolition wastes and sludge, amongst others.

To ensure that there is a consistent feedstock available for a biogas plant, it is important to establish the monthly variation of solid wastes generation throughout the year. The amount of waste is measured in the weigh bridges at the Transfer Stations and landfill. Figure 14 provides the monthly variation of solid wastes disposed in Mauritius for 2020. As can be observed, the amount of solid wastes landfilled averages 40,000 tonnes on a monthly basis, with the exception of April 2020 and May 2020. These two months corresponded to the lockdown period due to COVID-19 in Mauritius. It can thus be inferred that without the lockdown period, the amount of solid wastes landfilled for these two months would have also averaged 40,000 tonnes/month.

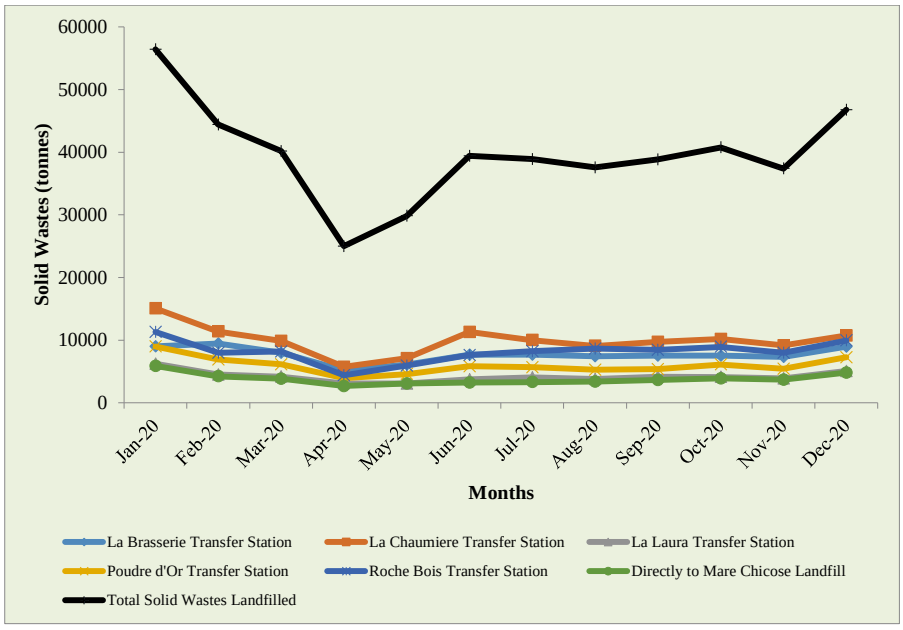

Figure 14 – Solid wastes disposed at the Mare Chicose landfill via transfer stations or directly to the landfill (Source: SWMD, personal communication, May 2021)

With regards the different transfer stations or wastes directly sent to the landfill (that is from the south and south-east of Mauritius), it is also observed that there are no significant variations

in wastes from each disposal site. These data thus confirm that the setting-up of a biogas plant in any future locations in Mauritius will have a constant feedstock throughout the year, without any major variations anticipated in waste quantities (except in the case of extreme events or force majeure).

3.5 Solid organic wastes quantification

Using the data reported from the previous sections, the total solid organic wastes (food wastes and yard wastes) disposed at the different disposal sites in Mauritius were determined on a monthly basis. *It is assumed that 80% of the total wastes disposed come from the domestic sector while 20% come from the commercial sector (SWMD, personal communication, May 2021).* As observed in Figure 15, the lowest tonnage of food wastes received at a particular disposal site is for La Laura transfer station which service the rural region and stands at 262 tonnes for April 2020 while the highest tonnage is for Roche Bois transfer station and is 3,229 tonnes for October 2020. The lowest amount of food wastes disposed at a disposal site over a one-year period is that disposed directly at the landfill (that is from Grand Port and Savanne district councils which service the rural region) and stands at 8,565 tonnes/year while the highest amount of food wastes disposed over one year is at La Chaumière transfer station and stands at 17,942 tonnes/year. Over one year, the total amount of food wastes disposed in Mauritius stands at 80,754 tonnes.

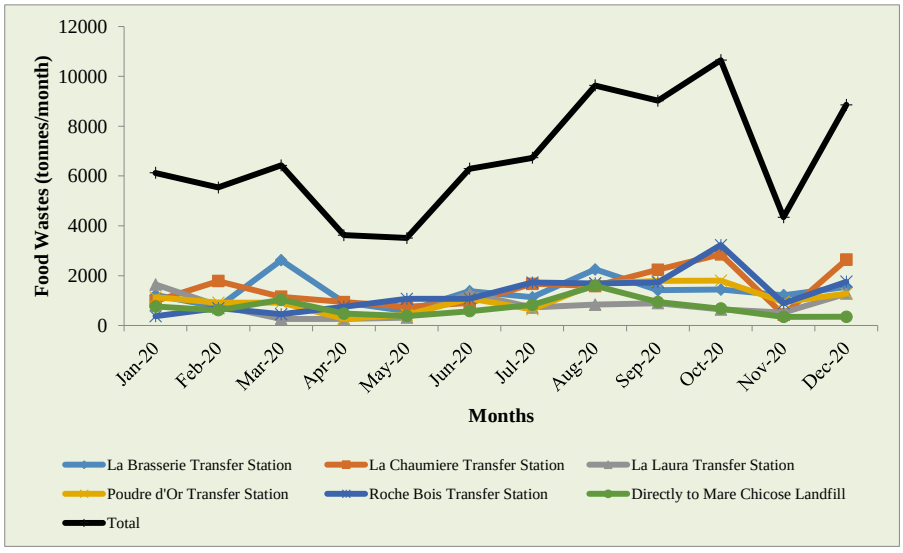

Figure 15 – Food wastes quantification for different disposal sites (Source: Authors' calculations)

With regards to yard wastes quantification, the lowest tonnage of yard wastes received at a particular disposal site is for La Brasserie transfer station and stands at 235 tonnes for November 2020 while the highest tonnage is for La Chaumière transfer station and is 6,026 tonnes for January 2020, as shown in Figure 16. The lowest amount of yard wastes disposed at a disposal site over a one-year period is for La Laura transfer station and stands at 12,683 tonnes/year while the highest amount of yard wastes disposed over one year is at La Chaumière transfer station and stands at 35,117 tonnes/year. Over one year, the total amount of yard wastes disposed in Mauritius stands at 137,544 tonnes.

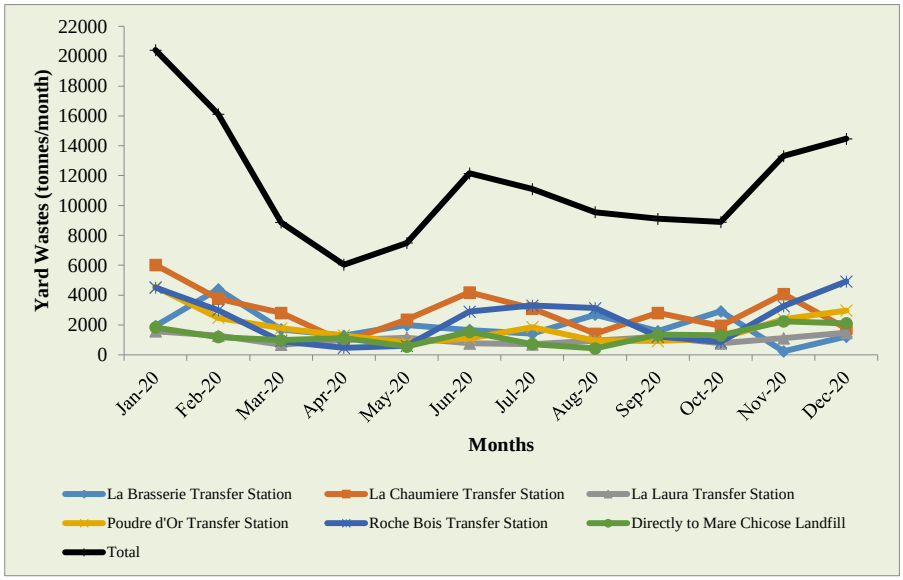

Figure 16 – Yard wastes quantification for different disposal sites (Source: Authors' calculations)

Considering both food wastes and yard wastes (solid organic wastes) disposed in Mauritius, it can be determined that the highest amount is at La Chaumière transfer station and stands at 53,060 tonnes/year while the lowest amount is for La Laura transfer station at 22,157 tonnes/year. Over one whole year, a total of 218,298 tonnes of solid wastes are disposed in Mauritius, out of which, yard wastes represent the major fraction at 63% while food wastes represent the remaining 37%.

With regards to the solid wastes from fresh produce markets and hotels, these eventually reach the transfer stations and the landfill and are accounted as part of the total solid wastes landfilled annually. Indicatively, the total amount of solid organic wastes generated from the different

fresh produce markets across the island is estimated at 8,632 tonnes/year, as summarised in Table 6.

Table 6 – Solid organic wastes generation from fresh produce markets (Source: [1]Local Authorities (2020) and [2]Ministry of Local Government and Disaster Risk Management (2020))

Local Authority	No. of markets[1]	Amount of Green/Vegetable Wastes Generated (Weekly/tonnes)[2]	Total amount (yearly/tonnes)[2]
District Council of Flacq	3	14	728
District Council of Moka	4	8.5	442
District Council of Rivière du Rempart	2	8	416
District Council of Pamplemousses	3	2.5	130
District Council of Savanne	5	4	208
District Council of Grand Port	3	37	1924
Municipal City Council of Port-Louis	6	31	1612
Municipal Council of Quatre-Bornes	1	17	884
Municipal Council of Beau-Bassin Rose-Hill	2	24	1248
District Council of Black River	-	-	-
Municipal Council of Vacoas-Phoenix	1	12	624
Municipal Council of Curepipe	1	8	416
Total	31	166	8,632

As for the solid organic wastes generated from hotels, this varies from 142 kg to 780 kg of food wastes on a daily basis, as summarised in Table 7, corresponding to 1.43 kg per customer per day to 2.6 kg per customer per day respectively (Maudarbux, 2019). Based on these figures, it is estimated that the total amount of food wastes generated on a daily basis from hotels in Mauritius approximate 49.1 tonnes, corresponding 17,937 tonnes on a yearly basis.

Table 7 – Food wastes generation from hotels (Source: [1]Maudarbux (2019); [2]Tourism Authority (2021) and [3]Authors' Calculations)

Hotels Rating	Food wastes generation (kg/day)[1]	No. of hotels[2]	Total food wastes generated daily (kg)[3]
3-star	142	26	3,692
4-star	631	30	18,930
5-star	780	34	26,520
	Total	90	49,142

3.6 Conclusions

Deliverable 2.3 provided a baseline analysis of organic waste including composition, characterization and quantification. Through this analysis, it was noted that food wastes average 17% of total MSW disposed in Mauritius while yard wastes represent 29%. The food and yard wastes are generated across the island, albeit in different quantities, as depicted in Figure 17. The TS contents of food wastes and yard wastes average 47% and 44% respectively, demonstrating the potential suitability for high solids anaerobic digestion in Mauritius. The C:N ratios of 19.3 and 20.0 for food wastes and yard wastes respectively also indicate that the wastes may be subjected to the anaerobic digestion process on an "as-received" basis without the need for co-digestion with other waste materials. The next deliverable will use the findings of deliverable 2 to assess the anaerobic digestion potential of food and yard wastes in Mauritius with quantification of biogas/methane and energy production.

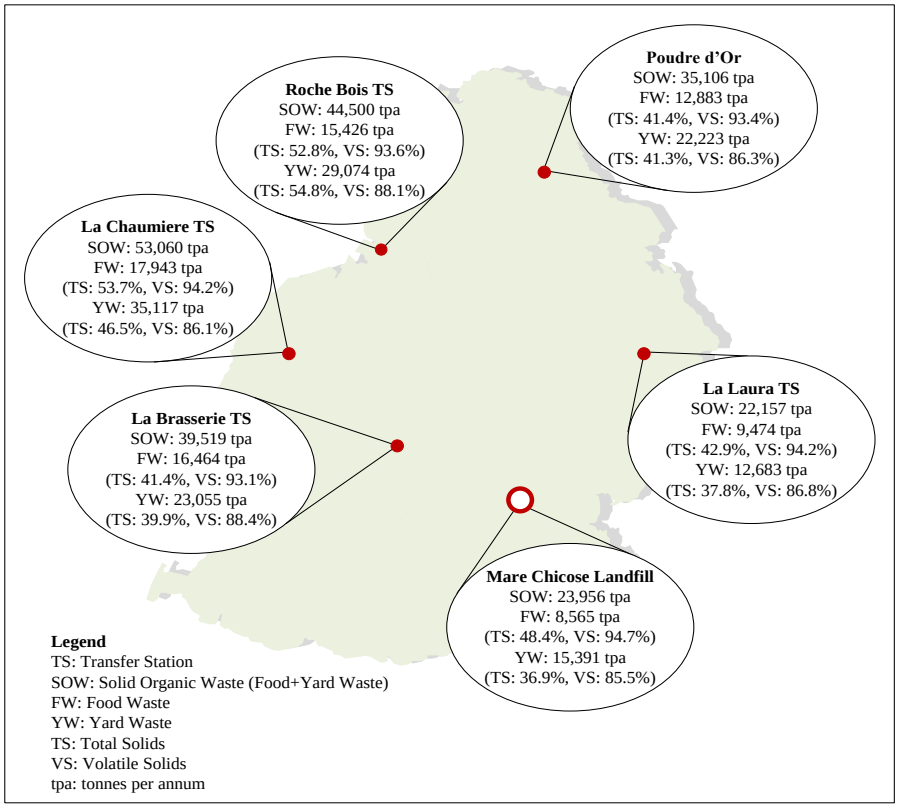

Figure 17 – Illustration of food and yard wastes generation/disposal in Mauritius

4. Summary of Deliverable 2

Deliverable 2 comprised 1 an analysis of the value chain for organic waste across collection, transport and disposal in Mauritius and 3) a baseline assessment of organic wastes from fresh produce markets, hotels and households including the waste composition, characterization and quantification. Through deliverable 2, it has been established that Mauritius possesses an effective waste collection system and most of the solid wastes generated in the island are eventually disposed at the Mare Chicose landfill. This deliverable has also enabled the identification of the quantities of food wastes and yard wastes generated at each transfer station and the landfill including their characteristics such as total solids and volatile solids contents. The results from deliverable 2 will be used to perform an analysis of the potential of anaerobic digestion of food wastes and yard wastes in Mauritius with a quantification of the methane and bio-energy produced.

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Appendix

Table A1 – Food wastes composition (%) in MSW stream for different disposal sites (Source: SWMD and UOM, 2021).

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Average
Jan-20	13.66	6.50	26.44	12.68	3.30	13.00	10.86
Feb-20	7.80	15.66	17.80	13.26	8.70	14.50	12.47
Mar-20	32.76	11.68	6.36	14.88	5.52	26.80	16.00
Apr-20	17.98	16.32	8.46	6.80	17.04	17.90	14.49
May-20	9.44	10.54	10.36	9.32	18.00	12.40	11.78
Jun-20	17.86	8.00	34.40	18.56	14.08	17.90	15.98
Jul-20	14.84	16.78	17.88	11.44	20.94	24.90	17.30
Aug-20	30.40	17.48	22.26	31.76	19.56	46.90	25.65
Sep-20	18.78	23.12	21.46	33.30	20.48	26.10	23.21
Oct-20	19.10	28.04	15.68	29.44	36.20	17.40	26.12
Nov-20	16.66	4.74	13.24	17.42	11.14	9.40	11.61
Dec-20	17.26	24.62	25.34	17.66	17.66	7.20	18.94

Table A2 – Yard wastes composition (%) in MSW stream for different disposal sites (Source: SWMD and UOM, 2021)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Average
Jan-20	21.48	40.04	25.28	50.72	39.80	31.20	36.18
Feb-20	46.54	33.12	28.76	35.92	37.60	28.20	36.31
Mar-20	21.36	28.46	16.26	28.96	11.18	25.60	22.07
Apr-20	25.06	15.12	32.00	32.96	10.64	41.80	24.14
May-20	32.78	33.28	37.32	18.14	10.16	18.20	25.13
Jun-20	21.66	37.04	20.56	18.88	37.92	48.00	30.85
Jul-20	18.42	31.12	17.64	32.64	40.08	21.80	28.55
Aug-20	36.40	15.52	24.88	18.08	36.16	12.80	25.44
Sep-20	21.04	29.04	29.04	17.04	14.56	37.20	23.44
Oct-20	38.76	19.04	18.72	18.08	9.68	33.60	21.84
Nov-20	3.22	44.48	28.72	44.08	40.96	61.10	35.61
Dec-20	13.62	16.38	29.36	41.00	49.42	44.10	30.94

Table A3 – TS content of food wastes (%) (Source: SWMD and UOM, 2021)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Average
Jan-20	49.91	39.30	27.05	35.10	57.76	52.10	40.08
Feb-20	29.59	61.89	47.51	37.05	61.40	51.80	50.23
Mar-20	32.64	67.20	54.58	44.04	62.10	41.80	44.90
Apr-20	40.45	33.57	50.48	67.10	56.62	68.40	48.40
May-20	36.78	67.56	18.76	74.20	51.14	61.00	53.21
Jun-20	24.72	46.30	32.09	17.89	32.40	38.50	30.71
Jul-20	51.01	57.96	49.51	63.20	57.44	42.90	54.41
Aug-20	55.26	44.23	69.07	31.30	61.37	45.00	49.86
Sep-20	40.79	44.00	39.67	44.71	36.80	42.60	41.68
Oct-20	57.22	51.29	83.10	69.90	59.55	63.80	60.47
Nov-20	27.13	49.23	61.08	26.09	36.53	57.50	37.46
Dec-20	42.34	67.73	27.32	20.89	56.94	35.00	47.25

Table A4 – TS content of yard wastes (%) (Source: SWMD and UOM, 2021)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Average
Jan-20	36.28	31.23	63.60	34.51	50.76	17.80	38.03
Feb-20	31.23	32.10	32.30	28.40	34.30	20.30	30.85
Mar-20	22.04	65.17	29.44	19.80	63.87	39.10	42.02
Apr-20	37.75	29.51	20.70	27.10	28.44	18.20	27.13
May-20	38.07	40.30	36.56	45.40	47.00	33.80	39.75
Jun-20	20.64	39.91	9.80	23.20	57.55	63.20	41.01
Jul-20	47.60	71.50	65.02	70.00	58.80	33.90	61.59
Aug-20	54.60	54.00	17.60	82.70	75.10	25.30	59.05
Sep-20	62.88	31.80	17.20	45.60	52.80	29.10	39.09
Oct-20	54.17	68.90	65.70	64.50	33.90	49.00	56.94
Nov-20	31.04	61.50	37.40	44.98	52.70	57.50	53.15
Dec-20	29.24	46.97	48.40	42.86	61.25	32.10	47.45

Table A5 – VS content of food wastes (%) (Source: SWMD and UOM, 2021)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Average
Jan-20	90.88	97.57	93.23	97.55	96.46	96.60	94.85
Feb-20	93.00	94.66	94.84	93.96	96.32	97.30	95.02
Mar-20	94.60	89.70	90.59	96.99	96.50	94.10	93.53
Apr-20	92.75	95.57	97.14	87.25	97.57	97.00	94.98
May-20	91.97	96.02	92.61	97.90	94.95	97.30	95.62
Jun-20	93.03	88.84	94.95	95.21	93.47	96.10	93.18
Jul-20	95.40	97.90	94.70	98.60	97.80	94.20	96.89
Aug-20	95.10	96.10	98.40	96.80	95.81	95.30	96.01
Sep-20	97.40	95.10	95.80	97.30	95.60	96.70	96.24
Oct-20	89.40	87.50	85.60	84.40	85.70	86.20	86.35
Nov-20	89.23	94.25	97.43	89.97	92.34	97.50	93.21
Dec-20	90.58	98.03	95.56	98.02	96.31	87.40	95.94

Table A6 – VS content of yard wastes (%) (Source: SWMD and UOM, 2021)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Average
Jan-20	90.42	86.38	91.40	86.28	89.30	84.20	88.14
Feb-20	87.18	86.90	87.57	70.60	90.40	80.80	85.16
Mar-20	84.78	87.81	88.24	85.90	88.22	82.90	86.91
Apr-20	87.63	89.19	81.50	91.70	91.29	89.70	88.53
May-20	89.67	91.60	90.08	78.60	86.30	82.60	88.18
Jun-20	85.00	87.11	82.40	77.10	97.78	97.40	91.96
Jul-20	88.70	70.30	91.10	93.40	87.40	84.80	83.27
Aug-20	88.70	86.70	87.60	81.90	91.10	83.50	88.35
Sep-20	94.10	85.00	90.20	86.20	91.20	80.00	88.57
Oct-20	86.40	95.90	82.50	87.20	88.60	89.50	89.15
Nov-20	88.22	88.70	72.90	88.06	79.10	76.20	83.06
Dec-20	86.15	91.32	86.50	91.36	83.79	89.50	87.07

Table A7 – Solid Wastes landfilled and composted in Mauritius (Total amount excludes solid wastes recycled) (Source: Statistics Mauritius, 2020b; SWMD, personal communication, May 2021)

Year	Solid Wastes landfilled (tonnes)	Solid Wastes Composted (tonnes)	Total solid wastes generated (tonnes)
2011	414,543	5,154	419,697
2012	387,926	34,785	422,711
2013	429,935	19,257	449,192
2014	417,478	41,032	458,510
2015	448,476	37,979	486,455
2016	444,695	38,308	483,003
2017	482,196	14,533	496,729
2018	543,196	0	543,196
2019	537,147	0	537,147
2020	509,085	0	509,085

Table A8 – Solid wastes disposed at the Mare Chicose landfill via transfer stations or directly to the landfill (tonnes) (Source: SWMD, personal communication, May 2021)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill*	Total
Jan-20	8986	15049	6226	8974	11298	5880	56413
Feb-20	9454	11373	4498	6888	7966	4220	44398
Mar-20	7996	9873	4167	6137	8180	3831	40183
Apr-20	5167	5741	3096	3929	4392	2681	25006
May-20	6085	7097	3077	4573	5920	3066	29818
Jun-20	7690	11287	3730	5839	7636	3216	39398
Jul-20	7659	9993	4032	5682	8234	3301	38901
Aug-20	7400	9079	3774	5267	8645	3397	37561
Sep-20	7536	9701	4175	5385	8445	3619	38860
Oct-20	7523	10193	4121	6115	8921	3891	40764
Nov-20	7302	9147	3874	5428	7975	3669	37396
Dec-20	8966	10738	5060	7246	9950	4795	46754

Table A9 – Food wastes quantification for different disposal sites (tonnes) (Source: Authors' calculations)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Total
Jan-20	1227.4	978.2	1646.2	1137.9	372.8	764.4	6126.9
Feb-20	737.4	1781.0	800.6	913.4	693.0	611.9	5537.2
Mar-20	2619.4	1153.2	265.0	913.1	451.5	1026.6	6428.9
Apr-20	929.1	936.9	261.9	267.2	748.3	479.9	3623.3
May-20	574.4	748.1	318.7	426.2	1065.6	380.1	3513.2
Jun-20	1373.4	903.0	1283.2	1083.6	1075.2	575.6	6294.0
Jul-20	1136.6	1676.8	720.9	650.0	1724.2	821.9	6730.4
Aug-20	2249.5	1587.0	840.0	1672.7	1691.0	1593.0	9633.3
Sep-20	1415.2	2242.8	896.0	1793.2	1729.5	944.4	9021.1
Oct-20	1437.0	2858.2	646.1	1800.3	3229.3	677.0	10647.8
Nov-20	1216.6	433.6	512.9	945.5	888.5	344.9	4341.9
Dec-20	1547.6	2643.7	1282.2	1279.6	1757.1	345.2	8855.4

Table A10 – Yard wastes quantification for different disposal sites (tonnes) (Source: Authors' calculations)

Months	La Brasserie Transfer Station	La Chaumiere Transfer Station	La Laura Transfer Station	Poudre d'Or Transfer Station	Roche Bois Transfer Station	Directly to Mare Chicose Landfill	Total
Jan-20	1930.1	6025.6	1574.0	4551.6	4496.7	1834.6	20412.6
Feb-20	4399.9	3766.7	1293.5	2474.2	2995.2	1190.0	16119.5
Mar-20	1707.9	2809.9	677.6	1777.1	914.5	980.7	8867.7
Apr-20	1294.9	868.1	990.6	1295.1	467.3	1120.6	6036.6
May-20	1994.7	2362.0	1148.2	829.6	601.5	558.0	7493.9
Jun-20	1665.6	4180.7	766.9	1102.3	2895.7	1543.6	12155.0
Jul-20	1410.8	3109.8	711.2	1854.6	3300.1	719.6	11106.2
Aug-20	2693.5	1409.1	938.9	952.2	3126.1	434.8	9554.6
Sep-20	1585.5	2817.0	1212.5	917.6	1229.6	1346.1	9108.3
Oct-20	2916.0	1940.8	771.4	1105.6	863.5	1307.3	8904.7
Nov-20	235.1	4068.7	1112.7	2392.6	3266.7	2241.6	13317.3
Dec-20	1221.2	1758.9	1485.6	2970.7	4917.1	2114.4	14468.0