Identifying Sustainable Markets for Compost Products:

An Evaluation of the Market for Compost Produced from Municipal Organic Waste and Factors Affecting Compost Utilization in Metro Vancouver

Photo by: Meg McIllfaterick; July, 2017

Meg McIllfaterick

UBC Sustainability Scholar, 2017
September 8th, 2017

Prepared for Metro Vancouver under the mentorship of Sarah Wellman
Pages: 1 – 28

UBC sustainability

metrovancouver
SERVICES AND SOLUTIONS FOR A LIVABLE REGION

Executive Summary

In Metro Vancouver, municipal organic waste (MOW) is source separated from regular garbage and is processed separately; organic waste is most commonly processed through composting. The regional organic waste management strategy for Metro Vancouver relies on a healthy and functioning organic waste to compost process. The organic waste to compost process is supported by an institutional framework consisting of processing and servicing steps to source separate, transport, collect, and process organic waste and utilize the resultant compost. The utilization of compost is driven by the health of the market for MOW compost.

This evaluation assesses the health of the market for MOW compost in Metro Vancouver, and thus the sustainability of composting as a regional organic waste management strategy for Metro Vancouver.

Based on the information reported by the composting facilities that participated in the evaluation it was identified that composting facilities processing Metro Vancouver's organic waste are able to sell the compost and compost products they produce. Despite the ability to sell compost, it was identified that composting facilities are producing compost of variable quality; furthermore, facilities demonstrate variable levels of investment in value-adding strategies for composting and compost product diversification which are reflected in a composting facility's pricing scheme and reported profitability within the industry.

The range of characteristics demonstrated by composting facilities and their products impact the sectors that utilize compost. The composting facilities interviewed in this study identified that the primary purchasers of MOW compost are in the commercial sector, such as landscaping companies. As the markets for compost in the commercial sector were reported to be large and well-established, this evaluation focuses on sectors that are under-utilizing compost in order to encourage future market growth.

It was identified that the residential and agricultural sectors are under-utilizing MOW compost, limiting potential new users such as the residents and farmers of Metro Vancouver. Specific issues that are impacting utilization by the residential and agricultural sectors are variable compost quality, limited accessibility to compost, and limited awareness regarding MOW compost's characteristics and the organic waste to compost process.

Strategies to address the issues of accessibility, compost quality and awareness and to improve utilization by the residential and agricultural sectors are recommended for the benefit of Metro Vancouver's composting industry stakeholders. Reducing the barriers to compost for sectors currently under-utilizing the product will facilitate future growth of the market for compost, enhancing the sustainability of composting as a regional waste management strategy.

Table of Contents

List of Figures

List of Tables

Acknowledgements

This evaluation was possible thanks to the University of British Columbia's Sustainability Initiative and with the support of the project partner, Metro Vancouver. Thank you to the individuals in the Solid Waste Services department of Metro Vancouver who offered their time, knowledge and resources to this project. In addition, the evaluation was enriched by the participation of waste services representatives of Metro Vancouver's member municipalities and by the managers and operators of regional composting facilities.

A special thank you to my project mentor Sarah Wellman at Metro Vancouver for the ongoing guidance, feedback and support that contributed to this evaluation.

Acronyms, Abbreviations and Terminology

Acronyms/Abbreviations	Definition
DO	Drop-off, also referred to as self-haul
FW	Food waste
ICI	Industrial, commercial and institutional
MF	Multi-family residential
MOE	Ministry of Environment
MOW	Municipal organic waste
MSW	Municipal solid waste
MV	Metro Vancouver
SF	Single-family residential
SSO	Source separated organics
SWS	Solid Waste Services
YW	Yard waste

Terminology	Definition
Compost	A stabilized earthy matter having the properties and structure of humus, is beneficial to plant growth when used as a soil amendment, is produced by composting, and is only derived from organic matter.
Composting	The actively managed process of decomposition of organic matter.
Contaminant	Element, compound, substance, organism, or form of energy which through its presence or concentration causes adverse effect on the natural environment or impairs human use of the environment.
Food Waste	Municipal solid waste comprised of food, including meat, fish, fat, dairy products, bread, baking products, fruits and vegetables, whether cooked or uncooked and packaged or unpackaged.
Foreign Matter	A contaminant that is not readily decomposed during the composting process, and includes plastic, glass, ceramic and metal.
Garbage	Materials that cannot be recycled or composted and are source separated and disposed of at a landfill.
Green bin	The large, green colored bin that remains outside one's home or place of business to collect food waste and/or yard waste.
Hauler	A waste disposal company that collects and transports municipal solid waste to a disposal facility with a vehicle.
Landfill	A waste disposal facility where waste that cannot be recycled or composted is diverted to and buried under the ground.
Load	Amount of waste contained in a hauler truck.
Mature	Designates a compost as not having phytotoxic effects when used as an organic soil conditioner.
Municipal Solid Waste	Solid, non-hazardous refuse originating from residential, industrial, commercial, institutional, and consumer drop-off/self-haul sources.
Municipal Organic Waste	The organic fraction of MSW consisting of food waste and yard waste.
Source separation	Separation of wastes into specific types of material at the point of generation.
Stable	Designates a compost as having a biological activity at a level that indicates the decomposition process is finished.
Tipping fee	The cost of disposal for organic waste at a composting facility or garbage at a landfill, typically charged per tonne with a minimum fee.
Trace element	Chemical element present in compost at a very low concentration, often used in reference to heavy metals.
Windrow	Elongated piles of triangular or trapezoidal cross-section that are turned in order to aerate and blend the compostable material.
Yard Waste	Vegetative matter such as tree and shrub trimmings, plant remains, grass clippings, and chipped trees.

Introduction

Sustainable waste management is of increasing importance for regional governments, especially in urban areas where populations continue to grow. Composting organic waste is a method that is used to reduce the impacts of organic waste on the environment as well as maximize the value of organic waste as a resource (Cooperband, 2000). Compost is the primary output of this process; it is a valuable soil amendment with a variety of uses. The successful marketing and sale of compost and compost products is an indicator of the sustainability of composting as a regional waste management strategy.

Metro Vancouver is an example of a regional government that is using policies to divert and process organic waste into compost. Metro Vancouver's Solid Waste Services is responsible for setting policies regarding municipal solid waste (MSW) such as facilitating the diversion of municipal organic waste (MOW) from landfills. It is the responsibility of Metro Vancouver's member municipalities to implement these policies through programs and services. In addition to setting policies, Metro Vancouver has developed a number of educational resources for municipalities, residents and businesses to utilize in order to improve organics diversion.

The organic waste to compost process is supported by an institutional framework that has evolved in Metro Vancouver through the participation of both public and private stakeholders. The institutional framework can be defined as the processing and servicing steps that occur to source separate, collect, transport and process organic waste and utilize the resultant compost. Figure 1 shows the organic waste to compost process and the alternative destination for organic waste if it were not source separated.

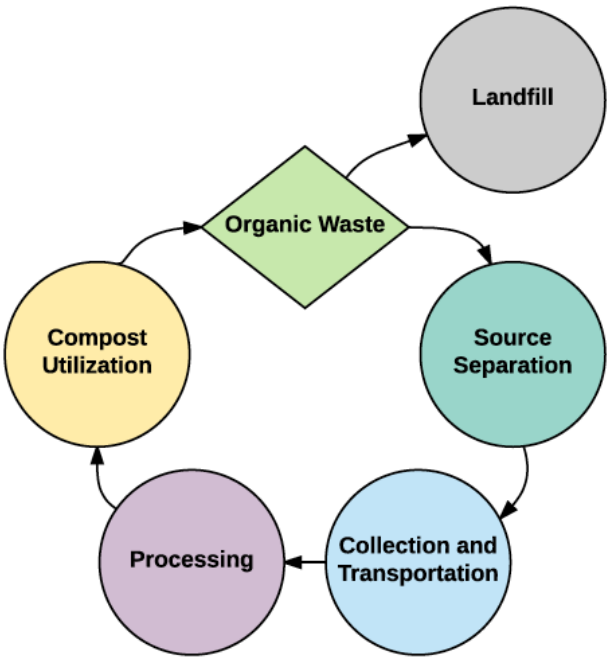

Figure 1: The institutional framework of services and processes that support the organic waste to compost process in Metro Vancouver.

Each phase of the institutional framework supporting the organic waste to compost process is facilitated by stakeholders. Figure 2 shows the framework in relationship to the stakeholders responsible for each step in the process.

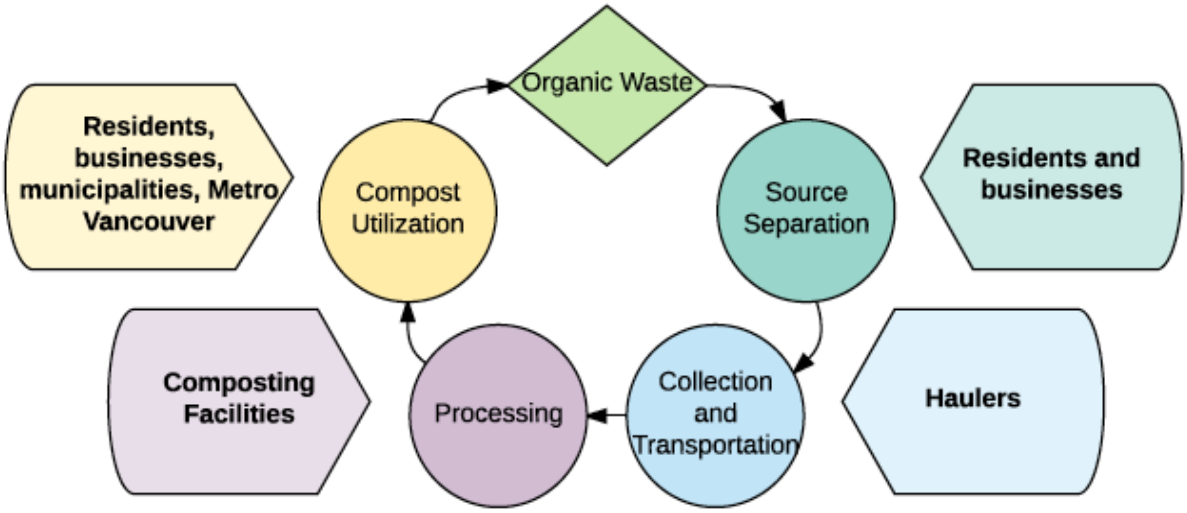

Figure 2: The stakeholders of the institutional framework supporting the organic waste to compost process.

Of these stakeholders, the composting facilities, municipalities and Metro Vancouver are the target audience for this evaluation; the results of the evaluation can be used to inform and improve their operations in order to improve compost quality and subsequent compost utilization within Metro Vancouver.

The success of compost utilization in Metro Vancouver is an indicator of the system's health and the overall sustainability of the process as a regional waste management strategy. Compost utilization is determined by the health of the market for compost produced from MOW. This evaluation has demonstrated that composting facilities processing Metro Vancouver's organic waste are successfully selling the compost products they produce; none of the composting facility managers or operators interviewed in this study identified a concern with their ability to sell the compost and compost products they produce.

A distinct range of quality and product types characterize the market for compost in the region. Some facilities are producing compost that is of a variable quality and with characteristics that limit accessibility, impacting the sectors that are utilizing MOW compost. It was identified through interviews that the residential sector and the agricultural sector are under-utilizing compost produced from MOW, indicating areas for potential future market growth.

The commercial sector was identified by composting facilities as the largest purchaser of MOW compost; as there was no concern demonstrated regarding the ability to sell compost to commercial users and due to the time frame and scope of this evaluation, future growth in the landscaping industry is not discussed in this report. Rather, end-markets that are currently under-utilized are discussed to encourage potential new users of MOW compost.

The factors that are potentially limiting the use of MOW compost by the residential and agricultural sectors are identified as variable compost quality, limited accessibility and limited awareness. Strategies to address these barriers include increased compost quality assurance, compost product diversification, education to improve source separation habits by the region's residents and businesses, and education to improve understanding of the organic waste to compost process for residents and businesses of the region.

Objectives

The objectives of this study are to:

- evaluate the market for compost produced from organic waste in Metro Vancouver and identify if any composting facilities processing Metro Vancouver's organic waste are experiencing challenges with selling their products;
- evaluate the organic waste to compost process and assess the characteristics of organic waste, composting facilities and compost produced in the region;
- identify how these characteristics are impacting the market for compost in Metro Vancouver and thus, compost utilization by different user groups; and,
- recommend strategies to reduce barriers to compost utilization and facilitate future growth in the market for compost.

Methods

This evaluation has been primarily informed through interviews with stakeholders during May, June and July of 2017, including Metro Vancouver's Solid Waste Services employees, municipal waste representatives, composting facility managers and operators, third-party compost retail managers, and compost users such as farmers and residents in the region. Through personal communications and site visitations, the issues that are challenging stakeholders were identified and strategies to resolve these issues were discussed. In addition, characteristics of composting facilities that are contributing to or limiting success in the industry were evaluated.

Due to the limited study time frame, only composting facilities processing significant volumes of organic waste were contacted for interviews and some of those contacted did not wish to comment. Significant facilities in the region that did not wish to comment were evaluated based on publically available information. Table 4 summarizes the composting facilities interviewed and/or evaluated for the purpose of assessing the market for MOW compost in the Metro Vancouver region.

A literature review was conducted to assess the relevant processes and regulations regarding composting and organic waste management in British Columbia and Canada, as well as organic waste and compost characteristics. In addition, policies developed by Metro Vancouver's Solid Waste Services were reviewed to assess the current context under which organic waste is processed into compost in the region.

Organic Waste in Metro Vancouver

Organic Waste Diversion

In Metro Vancouver, organic waste has been diverted from landfills since the late 1980's and has been banned from landfills as of January 1st, 2014 (Metro Vancouver, 2017). Metro Vancouver's organics diversion policies have been successful in reducing the amount of waste entering landfills and has required the participation of municipalities as well as private stakeholders. Figure 3 shows the increase in organics diversion tonnage in Metro Vancouver since 2010 and projected future diversion rates.

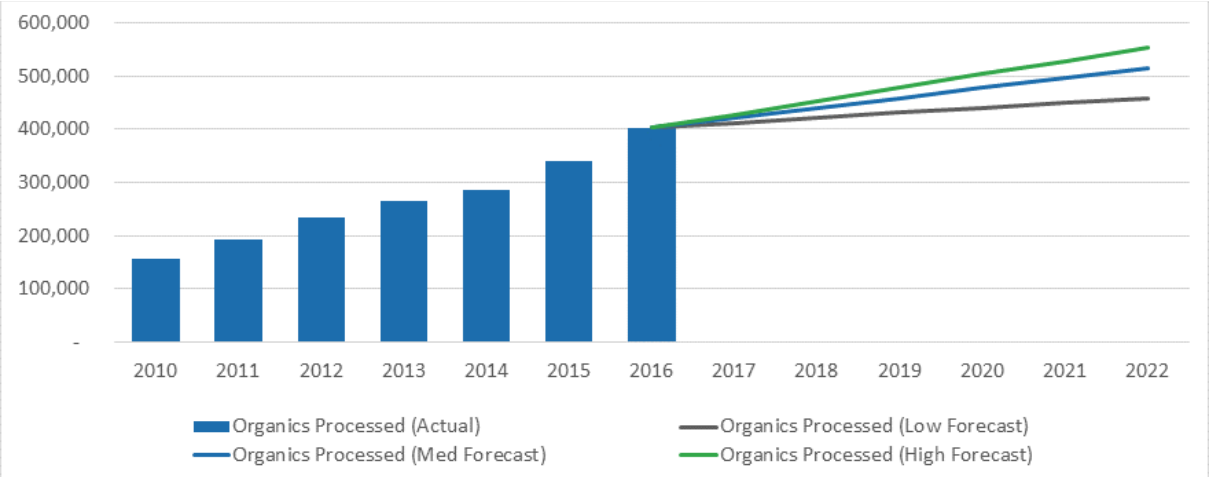

Figure 3: Actual organic waste diversion tonnage from 2010 to 2016 and forecasted diversion rates from 2016 to 2022 in Metro Vancouver (Metro Vancouver, 2017).

Organics diversion policies are beneficial for a variety of reasons. The diversion of organic waste reduces the volume of material entering landfills, extending the life of existing landfills; this is an important issue in urban areas such as Metro Vancouver where sites for landfilling are hard to obtain (Metro Vancouver, 2017).

When sent to landfills, organic waste exacerbates the environmental impacts that landfills commonly demonstrate. For example, due to the high moisture content of organic waste and the lack of oxygen in a landfill, organic waste will decompose anaerobically and produce methane, a greenhouse gas emission; leachate is also produced, a liquid that has extracted dissolved and suspended matter from materials in the landfill and risks polluting waterways and soils (Oliveira et al., 2017).

Organics diversion allows for the controlled processing of organic waste into compost, turning what would otherwise be garbage into a valuable resource. Composting also has some impact on the environment, but at much lower levels than when organic waste is landfilled. For example, both methane and leachate can be produced during composting; there are however opportunities to utilize these by-products such as collecting the methane for use as biogas and using compost leachate as a fertilizer, referred to as 'compost tea' (Oliveira et al., 2017).

Organic Waste Characteristics

Organic waste is a fraction of municipal solid waste (MSW); the other fraction of MSW is garbage (Figure 4). Garbage consists of materials that cannot be practically or economically recycled or composted that are disposed of at a landfill. Organic waste consists of compostable, organic materials originating from food waste and yard waste, and in some cases food-soiled paper products. When organic waste is utilized for compost production, it is referred to as feedstock.

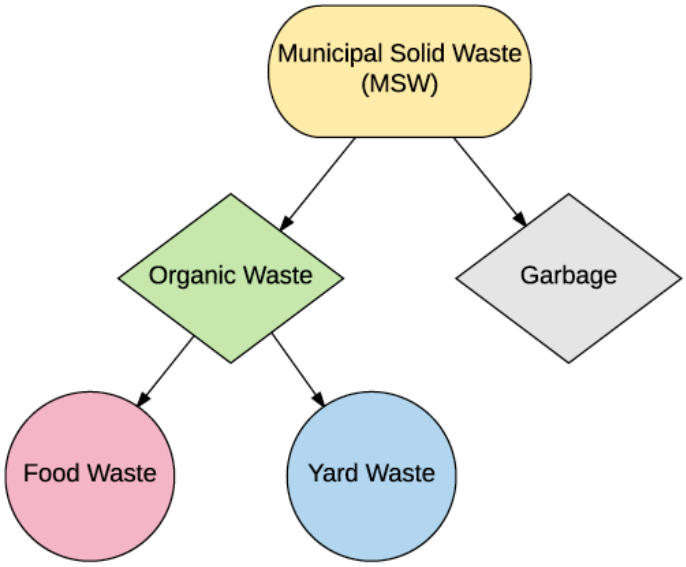

Figure 4: The fractions of MSW and sub-fractions of organic waste.

Food and yard wastes have different chemical and physical properties and because of this, composting facilities will manage the amounts of each they accept as a feedstock. Food waste can be post-consumer or pre-consumer; typical post-consumer sources are residences and commercial kitchens and pre-consumer sources are retail companies such as grocery stores (MOE, 2013). Food waste has been identified by stakeholders as having the potential to be a challenging feedstock. Because of the high moisture content, food waste can generate a high amount of leachate and odors (MOE, 2013). In addition, waste composition studies have shown that food waste has higher amounts of contamination than yard waste, especially plastic bags (MOE, 2013; Metro Vancouver, 2017). According to composting facilities, plastics are the primary contaminant seen in food waste, including compostable/ biodegradable plastics. Because of these characteristics, some facilities will only accept yard waste. The technology that a composting facility uses will reflect the type of feedstock they accept.

The generation of yard waste varies widely throughout seasons based on climatic factors; because of this, composting facilities must manage yard waste strategically and can sometimes store excess yard waste for use throughout the year (MOE, 2013). Yard waste has been reported as a relatively clean and contaminant-free feedstock. Common contaminants of yard waste are plastic bags, pet wastes, dirt, rocks and fertilizer packaging (MOE, 2013).

Organic Waste Production

There are four sectors that produce organic waste in Metro Vancouver: Multi-Family Residential (MF), Single-Family Residential (SF), Industrial, Commercial and Institutional (ICI) and Drop-Off (DO) sectors (Figure 5). These sectors distinguish the sources of organic waste and allow for the analysis of waste content and consumer habits.

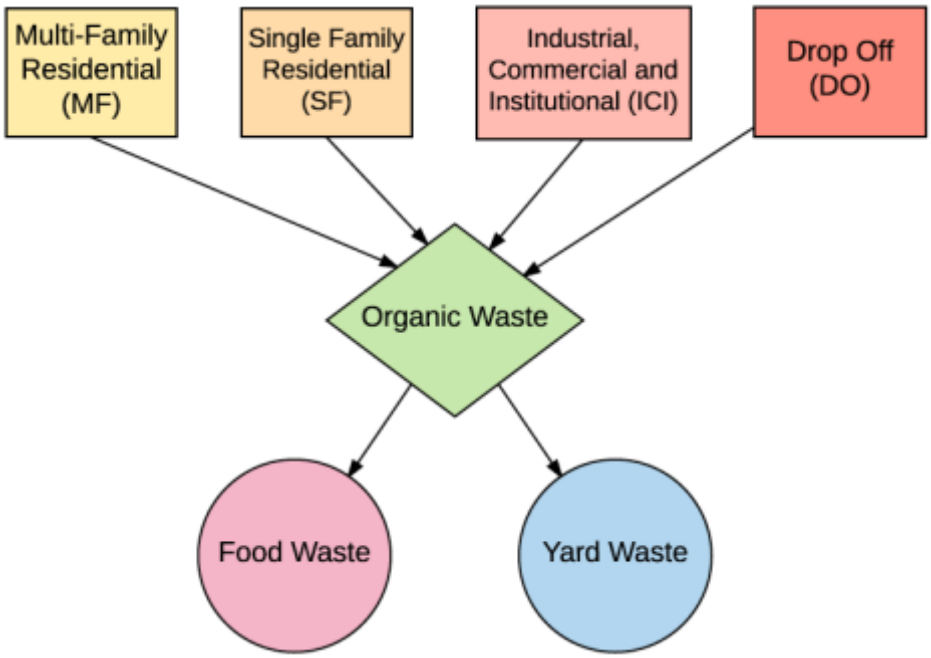

Figure 5: The sectors contributing to the production of organic waste in Metro Vancouver and the constituents of organic waste.

Each sector in Metro Vancouver produces different quantities of garbage, food waste and yard waste with varying characteristics. Metro Vancouver conducts periodic waste composition studies to analyze components of the garbage and organic waste streams of MSW, which can be used to make conclusions on consumer habits and identify waste types and sectors that face source separation challenges. In the 2016 study, MSW composition data was obtained for all sectors except for organic waste of the DO sector; pertinent data to this study is summarized in Table 1.

Table 1: Percentages of compostable organics found in garbage as well as percentages of food and yard waste found in diverted organic waste in Metro Vancouver in 2016.

	Compostable Organics found in Diverted Garbage	**Food Waste found in Diverted Organic Waste**	**Yard Waste found in Diverted Organic Waste**
Multi-family sector	37%	79%	17%
Single-family sector	29%	6%	88%
Industrial, commercial and institutional sector	25%	68%	10%
Drop-off	15%	N/A	N/A

(Metro Vancouver, 2016)

Analysis of diverted organic waste showed that, across all sectors, the MF sector demonstrated the highest percentage of compostable organics in its diverted garbage, indicating it has the poorest source separation techniques (Table 1). In addition, the MF sector produced the highest percentage of food waste across all sectors at 79% of organic waste (Figure 6) (Metro Vancouver, 2016). In contrast, the SF sector produced only 6% food waste and 88% yard waste (Figure 7). This distinction is important as food waste has been shown to be a challenging feedstock to manage and process at composting facilities in addition to demonstrating a higher presence of contaminants than yard waste (MOE, 2013).

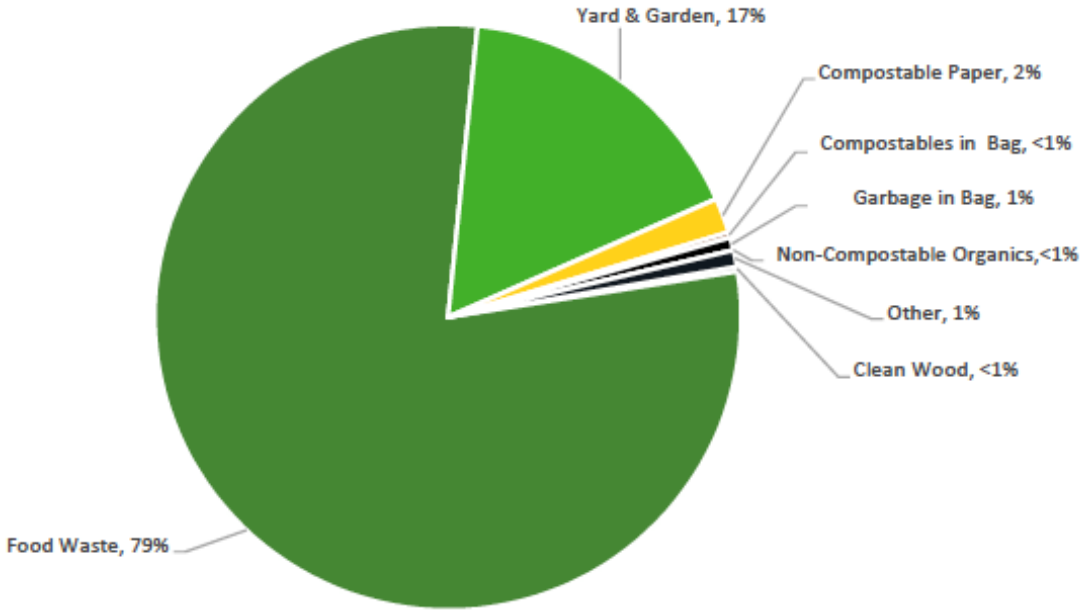

Figure 6: The composition of Multi-Family residential organic waste, 2016, Metro Vancouver (Metro Vancouver, 2016).

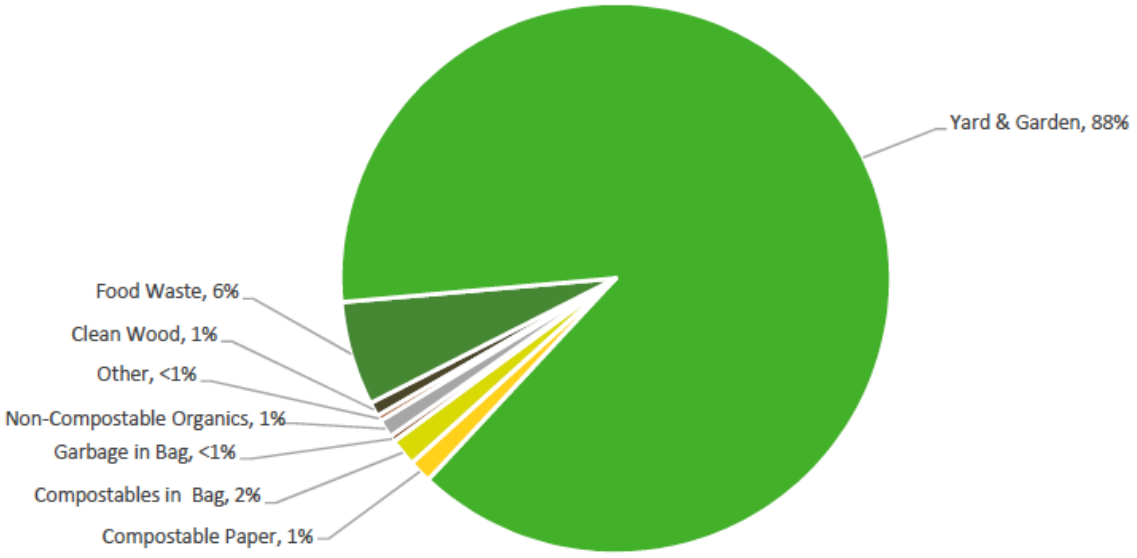

Figure 7: The composition of Single-Family residential organic waste, 2016, Metro Vancouver (Metro Vancouver, 2016).

The analysis of MSW constituents across sectors is important in order to target sectors and address their specific challenges. Through this study, the MF sector is identified as the target audience for both improving organics diversion as well as reducing contamination during source separation in order to improve the quality of food waste as a feedstock before it enters the compost system. In addition, organic waste produced by the SF sector may present challenges as yard waste production experiences seasonal highs and lows (MOE, 2013).

Metro Vancouver produced approximately 1.3 million tonnes of MSW in 2016; approximately 900 million tonnes were managed as garbage and approximately 400 million tonnes diverted as organics (Metro Vancouver, 2017). In 2016, compostable organics was identified as the largest component of garbage produced by the MF, SF and ICI sectors, indicating that there is a potential for the volume of diverted organics to be even higher. Figure 8 demonstrates the significant presence of compostable organics in diverted garbage on a per capita basis.

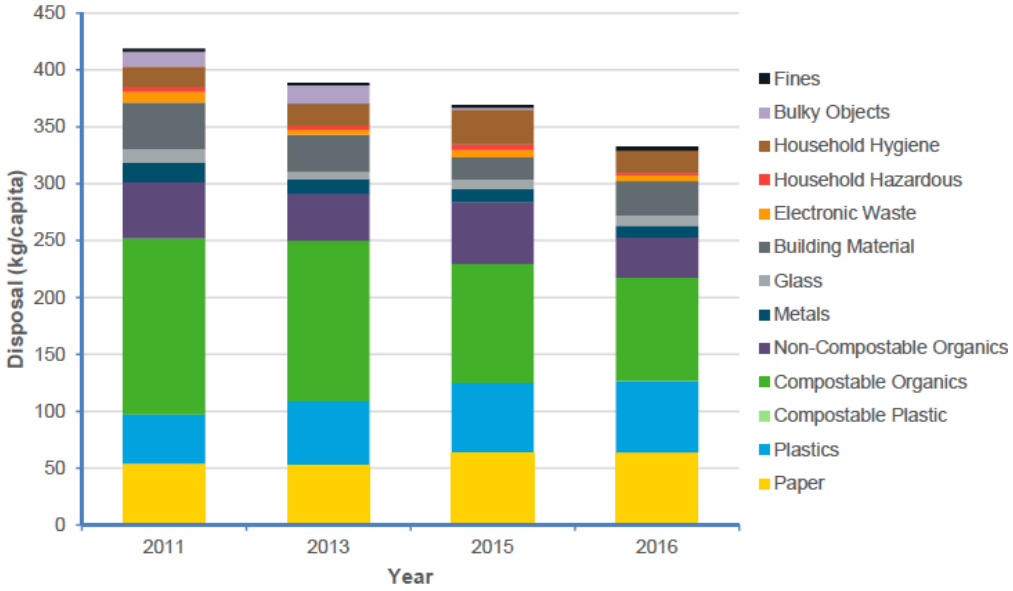

Figure 8: Source separated garbage per capita by composition, all sectors combined for 2011 to 2016 (Metro Vancouver, 2016).

The regional capacity for processing organic waste in Metro Vancouver cannot be precisely determined as composting facilities' permitted capacity and realistic capacity differ from each other. However, the current, realistic capacity for processing organic waste is estimated to be approximately 340,000 tonnes annually (personal communication, Metro Vancouver, July, 2017). This indicates a processing capacity concern for organic waste in Metro Vancouver. Given that the source separated tonnage of organic waste reached approximately 400,000 in 2016 and that there is the potential for additional tonnage with improved source separation, increasing regional capacity for processing organic waste is an acknowledged priority of Metro Vancouver and overarching challenge affecting the composting system.

Composting in Metro Vancouver

Compost Characteristics

The primary output of composting organic waste is the production of compost, a dark, earthy-smelling organic material with high nutrient and humus content (MOE, 2017). Compost is a valuable soil amendment that can be used to improve plant productivity, suppress soil-borne diseases, prevent soil erosion and topsoil loss and in soil remediation (MOE, 2017).

The Organic Matter and Recycling Regulation (OMRR) regulates composting in BC; it defines compost as a stabilized earthy matter having the properties and structure of humus, is beneficial to plant growth when used as a soil amendment, is produced by composting, and is only derived from organic matter (MOE, 2016). There are two classes of compost, class A and B, based on the end use of the compost material and determined by trace element concentrations and fecal coliform counts (CCME, 2005; MOE, 2016). OMRR is used to determine if a compost is stable, mature and pathogen-free (MOE, 2016). In addition, standards are used to determine the acceptable quantities of trace elements and foreign materials, such as plastics, glass and metals (MOE, 2016).

Despite compost production meeting the standards outlined in OMRR, stakeholders of the organic waste to compost process in Metro Vancouver have indicated that the most common and persistent contaminant in compost produced from MSW is plastics, in particular, plastic bags. This falls under the foreign materials category in OMRR. In addition, compostable and biodegradable plastics have been identified as problematic contaminants as they are often intentionally source separated into the organics stream by misinformed consumers. Compostable/biodegradable plastics cannot be easily processed at commercial composting facilities as they decompose at a much slower rate relative to food and yard waste; they are also not easily distinguishable from regular plastics and must be handled as a contaminant (Metro Vancouver, 2017; MOE, 2013). Screening for and removing plastics add significant processing costs to composting facilities. Trace element concentrations in compost (including heavy metals) have not been identified as a concerning contaminant in Metro Vancouver.

Composting Technologies

Composting can be defined as the actively managed process of the decomposition of organic matter; in the context of Metro Vancouver, the organic matter being composted is source separated organic waste (SSO). Composting technologies for processing organic waste are ideally designed to produce a high quality compost while minimizing public nuisances and negative environmental impacts. Managing the appropriate mixes of feedstocks and the moisture, temperature and oxygen of composting material is critical in mitigating public nuisances and environmental impacts.

Table 2: Composting technologies used in Metro Vancouver to process regional organic waste.

Composting Technology	Description
A) Windrows	Outdoor composting in piles that rely on mechanical aeration, typically with a compost windrow turner, to optimize the composting process.
B) Enclosed Aerated Static Pile using 'Gore Cover'	Gore Cover is a membrane cover that is permeable to gaseous substances but retains odor emissions and helps regulate moisture and temperature. It is used to cover an aerated static pile where the majority of composting occurs. The process is finished using windrows.
C) In-Vessel Aerobic Decomposition	Tunnel composting systems with forced aeration through the floor and internal air circulation. The tunnels are loaded from one end and operate in batch mode after the tunnel is fully loaded; multiple tunnels are used to obtain continuous operation.
D) Anaerobic Digestion	The biological breakdown of organic materials in the absence of oxygen. During this process, biogas containing methane and carbon dioxide is produced which can be captured and used as an energy source. The remaining material is a partially stabilized organic material that can be aerobically cured and used as compost.

(CCC, Composting Processing Technologies)

Although windrow composting is one of the most simplistic and least costly composting techniques, it can result in challenges when processing large volumes of food waste. Anaerobic digestion has the benefit of generating energy, while it's disadvantages include high costs and odor concerns. Each composting technology comes with trade-offs in terms of overall costs and factors contributing to producing a high quality compost product while mitigating public nuisances and environmental impacts (CCC, *Composting Processing Technologies*). Generally, the composting technologies outlined in Table 2 increase in overall processing costs from technology A to D (CCC, *Composting Processing Technologies).*

In MSW feedstocks, carbon (C) or nitrogen (N) can be limiting factors in the composting process. Both food and yard wastes contain materials with relatively high nitrogen contents; composting facilities balance this by adding materials with a relatively high carbon content, such as woody materials, dried leaves and cardboard (MOE, 2013). The ideal C:N ratio range for composting is between 25:1 and 30:1 (MOE, 2013). Phosphorus (P) and potassium (K) usually exist in sufficient quantities in MSW feedstocks to sustain the composting process. Together, C, N, P and K levels support the microorganisms involved in the composting process, reflecting the importance of quantities and types of feedstocks being input to composting facilities (MOE, 2013).

Table 3: Common feedstocks and their typical C:N ratios.

Feedstock	Typical C:N Ratios
Food	15:1
Green Grass	10:1
Leaves	55:1
Woodchips	200:1
Newsprint	400:1
Cardboard	560:1

(MOE, 2013)

Composting Facilities

Table 4 summarizes the composting facilities that were interviewed and/or evaluated in this study. Although some facilities were not available for interview or to comment for the compost market evaluation, they were included in the evaluation based on their significant characteristics (Harvest Power is an example of this case). In these cases, characteristics have been summarized based on publically available information. The number of facilities that were evaluated within this study was determined by the time frame of the project, the successful response by facilities, and facilities demonstrating significant characteristics. Significant characteristics include a high capacity to accept waste and unique processing technologies used.

The organic waste produced by Metro Vancouver residents and businesses is processed by composting facilities both within and outside of Metro Vancouver's boundaries. Most composting facilities in the region are private, with the exception of the Vancouver Landfill (owned by the City of Vancouver) and the Surrey Biofuel Facility (owned by the City of Surrey). A composting facility has the right to accept and reject any type of feedstock; this decision is typically dependent on the composting technology used, visible contamination of the arriving organic waste and the feedstocks required for the desired output. Some examples of types of feedstocks that a facility may specify for include FW, YW, pre-consumer waste, or agricultural waste. It has been shown that composting facilities that are selective with the types of feedstocks they accept demonstrate less quality concerns with the resultant compost.

Composting facilities that have invested in advanced composting technologies will typically invest in additional strategies that contribute to quality assurance. This results in an improved output quality as well as the ability for facilities to charge higher prices for the product. Following voluntary quality assurance guidelines in addition to OMRR is an example of additional investments. The Organic Materials Review Institute (OMRI) is a third party certifier that reviews and lists products for use in certified organic production and processing by following independent quality guidelines (OMRI, 2017); OMRI certification was the only organic certification process observed for MOW compost produced by facilities processing Metro Vancouver's organic waste. OMRI certification allows for compost produced from MOW to be used in certified organic agriculture, expanding the market for compost and increasing the return on compost for facilities and retailers. However, it was identified that the potential for MOW compost to be certified as organic is largely unknown by compost users; this finding is especially impactful for the agricultural sector.

Table 4: A selection of composting facilities both within and out of the Metro Vancouver region that process Metro Vancouver's organic waste.

Within Metro Vancouver:					
Facility	**Processing Technology**	**Accepted Feedstock**	**Output**	**Location**	**OMRI listed products**
Harvest Power	Windrow; Anaerobic Digestion	FW and YW	Compost	Richmond	No
Enviro-Smart Organics	Windrow	FW and YW	Compost	Delta	No
Vancouver Landfill	Windrow	YW	Compost	Delta	No
Ecowaste	Windrow	YW	Compost	Richmond	No
Surrey Biofuel Facility*	Anaerobic Digestion and In-Vessel Aerobic Decomposition	FW and YW	Biofuel and Compost	Surrey	No
Enterra Feed Corporation	Insect Digestion	Pre-consumer FW	Feed Production	Langley	No
Out of the Metro Vancouver Region:					
Facility	**Processing Technology**	**Feedstock Type**	**Output**	**Location**	**OMRI listed products**
The Answer Garden Products	Windrow	FW and YW	Compost	Abbotsford	Yes, some products
Net Zero Waste	Enclosed Aerated Static Pile using 'Gore Cover'	FW and YW	Compost	Abbotsford	Yes, all products
Revolution Ranch	Windrow	FW and YW	Compost	Lytton	No
Sea to Sky Soil	Enclosed Aerated Static Pile using 'Gore Cover'	FW and YW	Compost	Pemberton	Yes, all products

**Under construction and projected to open in fall, 2017*

Another example of additional investments to improve quality assurance include using quality-enhancing machinery during the composting process. Screening machinery can be used to increase the frequency and intensity that feedstocks and compost are screened for bulky materials and contaminants. Grinders are sometimes used to breakdown the feedstocks or compost into smaller, homogenously-sized pieces that will decompose at an even rate. Commercial-sized machinery for screening and grinding can be very expensive; some facilities have indicated the cost of such machinery to be approximately $100,000 per item. For this reason, composting facilities can be hesitant to invest in new or high-tech machinery, especially if they are struggling to increase their return on composting. Some facilities will rent machinery on an annual basis, rather than invest in purchasing machinery up front.

Compost and Compost Products

Composting facilities produce a variety of products from compost depending on the level of investment they have made in product diversification. For example, facilities often produce compost blends using materials such as river sand, woody debris or perlite. Compost blends include potting mixes, garden mixes, turf blends and compost-mulch blends; these products are more readily used in gardening and improve compost accessibility to a larger range of user groups.

Some facilities demonstrate diversified distribution options such as bagging their product or selling their product through a third-party retailer such as nurseries, garden centers or general stores. Bagging compost and compost products has been shown to improve the accessibility to the product for a variety of different user groups, especially those who do not own vehicles required for picking up bulk compost or those users that only require a small quantity. The bagging process typically does not take place at the composting facility, but is done by a third party. This shares the cost of bagging with other stakeholders in the compost production chain. Some facilities are able to offer the delivery of bulk compost for customers. These strategies add costs to production, however allow the producer to sell their compost products for a higher price and expands the market for compost.

The pricing range for compost and compost products reflects the level of investment that a composting facility has made in the composting process and product diversification. For example, composting facilities accepting only YW and using windrow technology typically sell their product at a cheaper rate than facilities that accept FW and YW and use advanced composting technologies such as anaerobic digestion to process feedstocks. In addition, facilities that voluntarily follow additional quality standards will price their compost higher than facilities following only OMRR requirements in order to reflect the additional quality assurance.

Table 5 shows the range of compost products available from composting facilities evaluated in this study; the varying prices reflect each facility's investment in composting technologies and value-adding strategies. The prices in Table 5 are for small scale customers, such as residents, who wish to purchase directly from a composting facility (on-site); it does not include products that may be available at third-party retailers. Most facilities offer volume discounts for large scale purchasers and some will even have specific rates for certain large scale clients. Some facilities do not sell anything on-site and only distribute through third party retailers, such as the Surrey Biofuel Facility (i.e. absent pricing in Table 5). Many do not offer bagged product on-site, but their compost is available bagged at a retailer and it may be branded as the retailer's product. The prices were obtained either through facility interviews or by phoning the front desk of a facility and receiving product quotes as a prospective customer.

Table 5: Products available on-site, at homeowner prices and pricing range for major composting facilities processing Metro Vancouver's organic waste; bulk volumes are CAD/yard

	Bulk Compost	Premium Bulk Compost	Bagged Compost	Bulk Turf Blend	Bulk Potting Blend	Bulk Garden Blend	Premium Garden Blend	Bulk Compost-Mulch Blend
Vancouver Landfill	$10.40	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Harvest Power	$18.50	n/a	n/a	$21	n/a	$19.60	$26	$21
Ecowaste	$19.30	n/a	$2.63/5lb bag	n/a	n/a	n/a	n/a	n/a
Enviro-Smart Organics	$25	$28.50	n/a	$25	n/a	$25	$28.50	$25
Net Zero Waste	$30	$40	$4/4L bag	n/a	n/a	$35	n/a	n/a
The Answer Garden Products	n/a	$40	n/a	$40	$65	n/a	$40	$25
Surrey Biofuel Facility*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

**Under construction and projected to open in fall, 2017*

Table 5 demonstrates the significant range in pricing and product diversity that exists across composting facilities; it can be used to assess the impacts of the facility characteristics outlined in Table 4. For example, the Vancouver Landfill processes YW using windrow technology, does not produce OMRI listed products and does not make their product available off-site (Table 4); this level of investment is reflected in the limited product range (Table 5). This also reflects the fact that the Vancouver Landfill's primary function is not to produce compost but is to landfill waste. In contrast, a facility such as Net Zero Waste uses an advanced composting technology, has OMRI certified compost, has reported selectivity in the feedstocks accepted, distributes products off-site and its primary function is composting. Net Zero Waste's price for bulk compost reflects this additional investment.

A note-worthy facility based on the characteristics presented in Tables 4 and 5 is The Answer Garden Products; this facility demonstrates a relatively low investment in technology (windrowing) and yet has a diverse product range and a high pricing scheme. The Answer Garden Products reported to practice a very high level of selectivity with feedstock sources, meaning they only accept organic waste from municipalities and businesses with which they have established positive relationships. The Answer Garden Products also donates compost to the municipality from which they accept organic waste in order to improve residential awareness regarding the organic waste to compost system. This investment in local education has improved the resultant compost quality at their facility.

There are composting facilities that specialize in products other than compost. The Surrey Biofuel Facility (currently under construction) will use anaerobic digestion of primarily FW to produce methane; the methane will be collected and used to fuel the city of Surrey's waste collection vehicles. Enterra Feed Corporation in Langley uses pre-consumer FW to feed larvae, which in turn are harvested and used as animal feed as well as ground into a fertilizer. These facilities are using diverted organics to produce specialized products other than compost, diversifying the resources that can be produced from organic waste while still contributing to regional waste management.

Compost Users

As a soil amendment, compost and compost products have a variety of uses. Generally, compost is incorporated into soils to amend soil quality and texture, or mixed with other media in order to establish and maintain vegetation (RAA, 2014). Practical examples of this are landscaping applications, such as turf establishment or planting beds. Compost is increasingly used for alternative bioengineering purposes such as erosion and sediment control, run-off protection and storm water management (RAA, 2014). The users of compost and compost products can be grouped into sectors made up of small scale, large scale and agricultural users (Table 6).

Table 6: Compost user groups and the typical desired characteristics of compost products.

User groups	Examples	Desired Product Characteristics
Small scale	Residents; general public	Small volumes; bagged; potting mixes and garden blends; delivery available; OMRI listed or high quality assurance
Large scale	Landscaping companies, developers, municipalities and Metro Vancouver	Bulk volume discount; compost, compost-mulch blends and turf blends; client-based pricing
Agricultural	Both small and large scale farmers	OMRI listed or high quality assurance; locally available; bulk volume discount; compost

None of the composting facilities interviewed were able to provide data on the quantity of compost that is purchased by different user groups. However, every composting facility representative that was interviewed indicated that large scale users are the primary purchasers of compost and compost products. Many identified that the agricultural and small scale sectors are under-utilizing compost produced from MOW; the literature review supported this finding (MOE, 2013).

Interviews with farmers found that the agricultural sector is commonly under-utilizing compost as farms typically have their own fertilizer sources; this could be compost or manure from their own farm or from a neighboring farm which is often available very cheap or free. In addition, the farmers interviewed demonstrated a lack of confidence or trust in the quality of compost produced from MOW, due to the unknown source of feedstocks used. The residential sector is under-utilizing compost due to accessibility challenges and because potential users are unaware that MOW compost exists or that it is available to be purchased in small quantities. When compost is available only on-site or in bulk it is more difficult for a resident to access it, negatively impacting utilization.

Results and Discussion: Evaluating the Market for Compost Produced from MOW

Based on interviews with the composting facility managers and operators whom responded to the evaluation, there is a healthy market for the compost and compost products produced from Metro Vancouver's organic waste. All of the participatory composting facilities expressed that they are able to sell the products they are producing; furthermore, a diverse range of compost products have been observed with prices that target different user groups. In particular, the landscaping industry was reported as the largest purchaser of compost and likely experiences the least barriers to purchasing and utilizing compost out of the potential user groups.

The evaluation identified that there is a relationship between the type of technology used, the type of feedstocks accepted, the desired product output and the resultant success of compost production; success in this context refers to a composting facility's ability to produce a high quality product and profit from production. The compost market in Metro Vancouver demonstrates that composting facilities are experiencing variable success in this context; facilities demonstrate a range in compost quality and profitability, as reported by composting facility representatives. None the less, all facilities are able to sell the compost they produce and the variability in compost quality and pricing reflects which user groups are accessing the compost products.

The evaluation demonstrated that issues existing throughout the organic waste to compost process are impacting potential future markets and the utilization of the resultant compost. Specifically, issues impacting the quality of organic waste used as feedstocks result in added expenses for the private stakeholders in the institutional framework and negatively impact the quality of the resultant compost. Reducing plastics that enter during the source separation stage has been identified as a key strategy to improve the quality of MOW compost in Metro Vancouver and therefore increase its utilization.

Potential Future Growth in the Compost Market

Although none of the stakeholders interviewed were able to provide data regarding quantities of compost sold to particular user groups, composting facility representatives identified that large scale compost users, such as landscaping companies, are the primary purchasers of MOW in Metro Vancouver. Through the market evaluation, it was identified that the residential sector and agricultural sector are under-utilizing MOW compost. Future growth in the residential sector would mean more residents are purchasing small amounts of compost and using it in their backyard or patio gardens, or for personal landscaping projects. Future growth in the agricultural sector would mean more farms are using compost as a fertilizer for their farm operations; certified organic farms would require OMRI listed compost products for this purpose.

Barriers to Compost Utilization and Strategies to Achieve Future Growth

The market for compost has the potential to grow by reducing the barriers impacting utilization by the residential and agricultural sectors. These barriers include variable compost quality, limited accessibility of products and limited awareness regarding MOW compost characteristics and the organic waste to compost process.

A) Quality

Variable quality has been identified as a barrier to compost utilization by the residential sector; this is likely because it is very probable that small scale users will become aware of any visible contaminants in compost through hands-on use. Small scale users are also likely to use compost for a special project such as a backyard garden (which may produce food, requiring a consistent and relatively high compost quality). This barrier may also explain why large scale users experience less barriers to compost utilization; when applying compost in large volumes, it is less likely for a user to be aware of small contaminants or for such contaminants to compromise the overall project.

Quality is compromised primarily because of contaminants entering the composting process during the source separation step. Plastics have been identified by composting facilities as the most common and persistent contaminant present in compost produced by MOW. Once plastics enter the composting system due to poor source separation, they become very expensive, difficult to remove and are often broken down into tiny pieces through the composting process (making them even more difficult to remove). Users of compost have indicated that the presence of visible plastics negatively affects their use of compost and their relationship with the product. It has been observed that even compost produced with OMRI certification standards has some visible plastics remaining in the final product (Figure 9). The evaluation showed that some third-party retailers will only sell compost produced from facilities with a demonstrated high standard for quality assurance for this reason.

Figure 6: OMRI listed (certified organic) compost in its final condition with visible plastic contaminants.

The agricultural sector has indicated that they are reluctant to use compost produced from MOW because the source of the organic waste used as feedstocks is largely unknown to them. The agricultural sector has strong substitutes for MOW compost such as manures or compost produced at their farm or by neighboring farms to use as fertilizer; these resources are often available for cheap or free. Because of this, compost produced from MOW needs to be of consistently high quality for agricultural customers to utilize the product.

The primary strategy to address variable quality is to improve source separation techniques, particularly targeting the MF residential sector in Metro Vancouver. As discussed, the MF sector demonstrates the highest presence of contaminants in their SSO (Metro Vancouver, 2016). Campaigns that target improved source separation techniques by this sector will positively impact the entire organic waste to compost process in the region, reducing costs for all stakeholders and improving resultant compost quality output. This will ultimately improve the trust for MOW compost, increase utilization and facilitate future growth in compost markets.

B) Accessibility

A barrier to compost utilization for the residential sector is limited accessibility. Accessibility is determined by the ability for a user to easily purchase and use the product. Accessibility is improved when compost products are available for sale at third-party retailers such as garden centers, nurseries or general stores which are likely geographically closer to a user's home than a composting facility; when compost is available in different forms, such as potting mixes or garden blends; when compost is available in bags or small quantities; or when a facility offers delivery of bulk compost. All of these characteristics increase the ease at which a user can access compost making it more likely that they will purchase and use the product. In addition, these characteristics add value to the compost products allowing composting facilities and retailers to charge more, increasing the potential for profitability.

Figure 7: Bagged and certified organic compost; a product with value-adding characteristics allows a composting facility to charge more and results in diversified user groups.

Specific strategies to improve accessibility for the residential sector is to encourage composting facilities to invest in value-adding strategies, such as bagging and third-party retail distribution. Composting facilities that partner with retailers have demonstrated success in making their product accessible to a variety of user groups. Retailers can share the costs of bagging compost, as well as branding or marketing the product. This allows composting facilities to focus on the composting process while continuing to expand their target markets. Actions that reduce contaminants from entering composting facilities will ultimately reduce the cost of processing for facilities, allowing facilities to invest in diversifying their products.

Through interviews with farmers it was identified that they often have strong substitutes for MOW compost such as their own compost or manure that are used as fertilizers. A strategy to improve accessibility for farmers is to encourage composting facilities to reach out and connect with farms that neighbor their facilities as potential customers and offer them delivery options and/or discounted bulk rates, much the same as is offered to large scale purchasers. In addition, composting facilities that offer OMRI listed products should reach out to local certified organic farms and communicate the added quality assurance of their compost's certification.

C) Awareness

Misinformation and lack of awareness regarding the characteristics of compost produced from MOW has been identified as a barrier to market growth. Some potential users of compost, in particular the small scale sector, are unaware that the organic waste diverted into green bins is used to produce compost and that this compost is available to be purchased and used at the home-owner level. When residents aren't aware that the contents of the green bin are used for composting they are less likely to care about reducing contamination at the source separation step. Improving the understanding of the organic waste to compost process will improve public accountability to SSO quality, which will result in an improved compost quality.

Interviews with certified organic farmers indicated that many are unaware that MOW compost is eligible for organic certification. Farmers indicated that such added quality assurance would change their perspective on the quality of MOW compost and that they would consider using it. This demonstrates the importance for composting facilities to build relationships and share information about their facilities and products with local farmers to facilitate market growth in the agricultural sector.

There are specific strategies to address misinformation, improve awareness and facilitate growth in the residential market. Some facilities have reported partnering with municipalities to organize compost giveaways or public sales that are supplemented with information regarding the organic waste to compost process. The Answer Garden Products in Langley has reported this strategy improves the quality of feedstocks they receive from Langley's MOW. Encouraging community events of this nature will likely improve source separation habits of residents and increase their utilization of MOW compost.

Metro Vancouver has developed successful educational resources regarding organic waste diversion and food waste reduction. A potential future campaign for Metro Vancouver could be targeted at reducing contamination during the source separation step, as well as improving public understanding that source separated organic waste becomes compost that is available to be purchased by small scale users such as residents.

Conclusions

It has been demonstrated that the market for compost produced from Metro Vancouver's MOW is healthy, given that each facility interviewed in this evaluation identified they are able to sell their compost and compost products. The quality and pricing of MOW compost is diverse and targets different user groups, reflecting a composting facility's choice of technology, feedstocks accepted and desired product output.

Although facilities are able to sell all of the product they are producing, facilities have described variable levels of success in the industry. In addition, the residential and agricultural sectors have been identified as user groups that are currently experiencing barriers to the MOW compost market. These findings indicate a potential for future market growth, particularly within the residential and agricultural sectors. The commercial sector has been identified as the largest purchaser of MOW compost indicating that this user group experiences less barriers than other sectors and that the markets for compost end-uses by its users are relatively established; however, there is still the potential for future growth in the commercial sector especially in the area of non-traditional landscaping applications.

It has been demonstrated that composting facilities that are able to invest in value-adding strategies are able to sell their product for a higher price, provide higher quality assurance and reach more user groups than composting facilities demonstrating minimal investment. Strategies to reduce barriers to MOW compost and increase future market growth emphasize the impact of value-adding strategies, such as strategies to improve accessibility and quality. In addition, composting facilities that have demonstrated partnerships with local municipalities in order to improve education around their product and MOW compost have reported having good relationships with customers, minimal feedstock quality concerns and demonstrate success in the industry.

Based on the characteristics of composting facilities demonstrating less compost quality or profitability concerns than other facilities, it has been recommended that improving the quality, accessibility and awareness regarding MOW compost will facilitate future growth in the market for MOW compost. In particular, addressing these issues will open the market up for the residential and agricultural sectors as MOW compost users. Ultimately, continuing to expand the market for MOW compost will help to maintain the health of the composting industry and Metro Vancouver's regional organic waste management strategy.

References

British Columbia Ministry of Environment (MOE). (2016). Organic Matter Recycling Regulation (OMRR). *Environmental Management Act; Public Health Act.* Retrieved from: http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/18_2002

British Columbia Ministry of Environment (MOE). (2013). *Technical Document on Municipal Solid Waste Organics Processing.* Retrieved from: https://www.ec.gc.ca/gdd-mw/3E8CF6C7-F214-4BA2-A1A3-163978EE9D6E/13-047-ID-458-PDF_accessible_ANG_R2-reduced size.pdf

Canadian Council of Ministers of the Environment (CCME). (2005). *Guidelines for Compost Quality.* Retrieved from: http://www.ccme.ca/files/Resources/waste/compost_quality/compostgdlns_1340_e.pdf

Composting Council of Canada (CCC). No Date. *Composting Processing Technologies.* Retrieved from: http://www.compost.org/pdf/compost_proc_tech_eng.pdf

Cooperband, L.R. (2000). Composting: Art and Science of Organic Waste Conversion to a Valuable Soil Resource. *Laboratory Medicine, 31 (6), 283 – 290.*

Faverial, J., Boval, M., Sierra, J., & Sauvant, D. (2016). End-product quality of composts produced under tropical and temperate climates using different raw materials: A meta-analysis. *Journal of Environmental Management, 183, 909 – 916.*

Hargreaves, J.C., Adl, M.S., & Warman, P.R. (2008). A review of the use of composted municipal solid waste in agriculture. *Agriculture, Ecosystems and Environment, 123, 1 – 14.*

Illinois Food Scrap Coalition (IFSC). (2015). *Food Scrap Composting Challenges and Solutions in Illinois Report.* Retrieved from: http://illinoiscomposts.org/files/IFSC-FoodScrapReportFINAL-Jan2015.pdf

Jara-Samaniego, J., Perez-Murcia, M.D., Bustamante, M.A., Perez-Espinosa, A., Paredes, C., Lopez, M., Lopez-Lluch, D.B., Gavilanes-Teran, I., & Moral, R. (2017). Composting as a sustainable strategy for municipal solid waste management in the Chimborazo Region, Ecuador: Suitability of the obtained composts for seedling production. *Journal of Cleaner Production, 141, 1349 – 1358.*

Metro Vancouver. (2017). *Metro Vancouver Solid Waste and Organics Workshop.*

Metro Vancouver. (2016). *2016 Waste Composition Monitoring Program.* Retrieved from: http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/2016WasteCompositionMonitoringProgram.pdf

Metro Vancouver. (2014). *Bylaw no. 11092 – A By-law to amend Solid Waste By-law No. 8417 regarding organic waste.* Retrieved from: http://former.vancouver.ca/blStorage/11092.PDF

Metro Vancouver. (2014). *Organics Disposal Ban Consultation Program.* Retrieved from: http://www.metrovancouver.org/services/solid-waste/SolidWastePublications/ODBConsultationProgram.pdf

Metro Vancouver. (2010). *Integrated Solid Waste and Resource Management Plan.* Retrieved from: https://www.metrovancouver.org/services/solid-waste/SolidWastePublications/ISWRMP.pdf

Morris, J., Scott Matthews, H., & Morawski, C. (2013). Review and meta-analysis of 82 studies on end-of-life management methods for source separated organics. *Waste Management, 33 (3), 545 – 551.*

Mu, D., Horowitz, N., Casey, M., & Jones, K. (2017). Environmental and economic analysis of an in-vessel food waste composting system at Kean University in the U.S. *Waste Management, 59, 476 – 486.*

Oliveira, L., Oliveira, D., Bezerra, B., Silva Pereira, B., & Battistelle, R. (2017). Environmental analysis of organic waste treatment focusing on composting scenarios. *Journal of Cleaner Production, 155, 229 – 237.*

Organic Materials Review Institute (OMRI). (2016). *OMRI Canada Standards Manual.* Retrieved from: https://www.omri.org/sites/default/files/app_materials/16CanStanMan-pub-version4F.pdf

Plata-Diaz, A., Zafra-Gomez, J.L., Perez-Lopez, G., & Lopez-Hernandez, A.M. (2014). Alternative management structures for municipal waste collection services: The influence of economic and political factors. *Waste Management, 34 (11), 1967 – 1976.*

Ron Alexander Associates (RAA). (2014). *Report on the Technical Assessment of Compost Specifications.*

Recycling Council of British Columbia (RCBC). (2015). *Diverting Compostable Organics.* Retrieved from: https://www.rcbc.ca/files/u7/RCBC%20Organics%20Fact%20Sheet%202015.pdf

Saer, A., Lansing, S., Davitt, N., & Graves, R.E. (2013). Life cycle assessment of a food waste composting system: environmental impact hotspots. *Journal of Cleaner Production, 52, 234 – 244.*