A system of prioritising organic wastes generated in Victoria

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Abstract

Industries such as agriculture, extractive industries, food processing, fisheries and municipal sectors generate approximately 1.7 million tonnes of putresible waste. In the Melbourne Metropolitan area alone, close to 90,000 m^3 of putrescible waste is taken to landfill each year(1). In order to identify the more urgent needs in managing these putresible wastes, a system of prioritisation of waste streams was developed. Prioritisation of waste streams allows the identification of areas of research and development in waste to be addressed in the immediate future. This was carried out through ranking different wastes and determining the highest scoring wastes with respect to social, economic and environmental impacts- these highly ranked wastes being the priority wastes. Five key 'drivers' (re-use, contamination, barriers, impacts and processing) that are useful in identifying the situation that prevents wastes from being reused or recycled were identified and a scoring system was developed to rank their importance. Out of the top 20 priority waste streams identified, biosolids were identified as the highest, most important waste stream that should be addressed immediately. This paper examines the process that was used to determine the priorities and the scoring that was given to a range of organic waste streams.

Key Words

organic waste, waste characterisation, waste re-use, agricultural waste

Introduction

After mining, the agricultural sector is the second largest generator of waste in Australia, producing an estimated 367 million tonnes of solid waste each year (1). Various disposal methods for this waste range from landfill to total recycling such as garden compost. Some of these disposal techniques are known to significantly contribute to the cost of agricultural production or have significant environmental impacts that are unsustainable (2). When disposal techniques are approached strategically, techniques can be improved or modified to aid in environmental and economic gain. In the past, the Department of Natural Resources and Environment (DNRE) has approached waste management as an isolated issue for each industry sector rather than as a discipline requiring a collective approach (3). In the case of the environmental impact of nutrients, DNRE has paid special attention to the offsite impacts and origins of nutrient rich wastes. Too often, these instances have been viewed in isolation as individual problems requiring a single solution rather than as an opportunity to create gains for both the polluter and the environment. Through prioritising waste streams, wastes can be isolated, identifying priority waste streams and commonalties between them, and then identifying potential research can reduce this isolation and development projects based on these waste streams.

Methods

In developing a system to prioritise organic wastes generated in Victoria, we:

1. Identified the major organic waste streams

2. Characterised the waste streams based on common 'descriptors' (chemical, physical, environmental, economic and microbial characteristics).

3. Characterised the importance of waste streams their positive and negative impacts on the 'triple bottom line' (environmental, social and economic factors)

4. Ranked the waste streams based on a scoring system against five drivers to determine the status of the waste

5. Selected the top 20 wastes according to the scores and developing a strategy to manage and re-use according priority needs.

Waste Stream Identification

To characterise organic wastes generated within various primary industries a hierarchical list of sectors and industries was developed. The different 'sectors' used were Agriculture (animals, horticulture and grains), Food Processing, Fisheries, Municipal and Extractive Industries (Table 1). These sectors were developed in comparison with hierarchies produced by the EPA and ABS groupings. In total, 193 waste streams were identified from 28 waste generating sources. These sources were identified from 20 sub-industries belonging to 13 industries.

Table 1. Number of waste streams identified within industries identified for this project.

Sector	Industries	Waste streams
Agriculture	Animal; Grains; Horticulture	85
Food Processing	Meat; Dairy; Fruit and Vegetable	74
Fisheries	Fisheries; Aquaculture	14
Municipal	Green Organics; Biosolids	6
Extractive	Mining; Forestry	14

Physical Waste Characterisation

A database was created by the research group resulting from an extensive literature review and contained the characteristics of all of the wastes was developed. The database was took into account the following criteria:

- The availability of accessible information and areas of research currently being undertaken,
- To identify common descriptors for different waste materials, which helped to arrange the information that was collected so that it was in a format where wastes generated across the different sectors could be compared to one another, and;
- To collect information on descriptors (eg. chemical, etc.).

Common descriptors and common characteristics used for the characterisation of the waste streams are listed below:

- Chemical – nutrients, heavy metals, organic contamination, toxicity and biochemistry
- Physical – volume, transport, economic and disposal methods
- Microbial – pathogens, toxicity and beneficial microbial activity
- Environmental – soil degradation, air pollution, water pollution, water alternatives and soil amelioration.
- Economic – benefits of good disposal, and benefits of good re-use
- Other – pre-existing regulatory policy, known limitations, waste mix's, public perception, siting of the facility, and application use.

Quantitative Waste Characterisation

Information on the impact the waste stream may have on economic, social and environmental factors was also collected for inclusion in the database. Information was collected for both positive and negative impacts the waste stream may have.

The negative impacts on the Triple Bottom Line were:

- **Economic**: Transport costs, landfill costs, processing costs, fines for non-compliance and lack of community adoption
- **Environmental**: Viewed as a polluter, water and land degradation, unacceptable odours, visual impacts and land space/siting
- **Social**: Health risks, fear of the unknown, diminished resources, community costs for cleaner environment, indirect costs for management

Positive impacts considered were:

- **Economic**: Clean green image, profit from resale, reducing imports of primary commodities, export niche and subsidy incentives
- **Environmental**: Alternative nutrients, soil conditioner, reduced use of primary resources, sustainability/reclamation, biodiversity protection and cross industry use.
- **Social**: Cleaner lifestyle, feeling of well being, better informed community.

With the information gathered from waste characterisation and the impacts they have on the 'triple bottom line', a set of criteria to prioritise waste streams was selected. Employing these criteria, every waste stream identified for the database was "scored" by the RRRPI group and stakeholders involved with the project to get a form of consensus and then summed to produce an overall ranking.

Ranking of Waste streams against core drivers

The drivers and scoring chosen for prioritisation were:

1. Current re-use practices - the current status of re-use of the waste stream

    Depending on the level of current re-use in practice, the waste is ranked 0-3. The ranking is higher when less was re-used.

2. Processing - the amount of processing that might be required for effective re-use

    Depending on the level of treatment necessary before waste could be re-used the waste is scored between 0 to 2. If volume was a barrier for re-use, and did not reduce the unit cost of processing, this score was multiplied by a factor of 2 (this doubled the score)

3. Contamination - the level and type of contamination in the waste streams

    Four aspects of contamination were taken into account. Depending on the number of forms of contamination, the waste material can get a score of between 0 and 4. If volume was recognised as a barrier for re-use, and did not reduce the unit cost of processing, the scores were multiplied scores by a factor of 2 (this doubled the score).

4. Impacts of current waste re-use - the impacts of disposal both onsite and/or off-site

    There are direct (local) or indirect (off-site) impacts that can result from the disposal or re-use of wastes. For each of the impacts, local impacts were given a score of one and off-site impacts received a score of two. When a waste scored high for impacts, a "Role of Government" was recognised.

5. Barriers to alternative waste re-use - other barriers that affect the re-use of wastes including those such as transport and regulations

> Seven social, financial and technological barriers that prevented the effective re-use of the wastes were recognised. Depending on the number of barriers that existed, each waste material received a score between 0 and 7.

Results and Discussion

For the top 20 waste streams (Table 2), the range of scores received for some of the top ranking wastes was narrow. Down the list, the range of scores was much wider, indicating that the importance of a waste stream was highly subjective. Wide divergence in scoring may also have reflected a lack of available information and knowledge of a particular waste stream by an individual. Given the lack of statistical confidence in the difference between lower scoring wastes, issues associated with these wastes should be looked at closely from a 'factory' rather than an 'industry' point of view ie. the responsibility for these wastes more clearly rests with the producer more so than being an issue for the whole of industry . Although these wastes do not score "high", there still may be issues that need attention. These issues could be identified through closer examination of scores received for individual drivers. The top 20 waste types were grouped together to produce 5 main waste 'groupings'.

Table 2. Priority Waste Groups and Scores.

Sector	Waste Group	Waste Score		
		30+	20 - 30	<20
Municipal	Municipal	Biosolids		Green Organics
Food processing	Animal and Fish Processing		Beef, Fish, Pork, Sheep, Poultry	Fish Bi-catch
Agriculture	Manure		Beef Feedlots, Poultry Litter	Pig Litter, Dairy Shed Waste
Extractive	Mining		Extractive	
Food processing	Fruit & Vegetable Processing		Dairy	Wine, Dried Fruit, Grape Marc, Canned Fruit
Food processing	Manufacturing & other			Wool, Dairy Tankers

To broaden the scope of the research needs of the top 20 waste streams, five themes were identified. These themes align themselves and directly address issues covered by the five core drivers. These themes are:

1. Sustainable production through reuse of Recoverable Resources

2. New Technology for effective and efficient Waste Management

3. Public Safety and Cleaner Foods

4. Protection of the Environment and Sustainability of Natural Resources

5. Education, Regulation and Market Adoption

Considering the priority waste streams and the five program themes, six Research Development & Extension activities were seen as priorities in the short to medium term. Some of the specific areas of research identified were:

- **Research in Biosolids** ⇒Research to assess the suitability of biosolids for agricultural and forestry production.
- **Long-term Trials** Establish long-term trials across Victoria to assess economic performance and environmental impacts in different agricultural and forestry crops treated with recoverable resources.
- **Microbiological and Biochemical Capability** ⇒Identification of pathogens, isolating and culturing of desirable micro-organisms to enhance biological break down of organic wastes,
  - Bioremediation and biochemical processes during breakdown of organic materials,
  - Food safety issues identified with microbiological contamination
  - Appropriate withholding periods when growing crops or cattle on land treated with recoverable resources.
- **Contamination Assessment and Remediation** ⇒Identify, quantify and minimise the risks associated with various forms of contamination,
  - Build the capability to assess off site impacts and conduct research leading to containment of contaminants from waste streams.
- **Fisheries Wastes** ⇒Develop alternative re-use options for fisheries wastes and by-catch.
- **Composting Technology –** (Development not research) ⇒Improvement and modification to suit particular industrial situations or to generate desired final material.

Conclusions

Through a series of stakeholder meetings and a workshop involving government and industry representatives, the process undertaken to prioritise waste streams and determine the highest ranked wastes achieved industry and government consensus. This project successfully identified the top 20 priority waste streams for future research and development, with biosolids ranked highest priority waste. Biosolids is an area that will be further investigated through microbial, policy, and agronomic research. Apart from further research and development the need was identified for more conclusive quantitative data *eg*. cost of recycling per tonne, knowledge of disposal options and projects that may aid them in the recycling of their waste products and volumes of waste generated.

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