Environmental RTDI Programme 2000–2006

Assessment and Evaluation of Outlets of Compost Produced From Municipal Waste (2000-MS-6-M1)

Final Report

Prepared for the Environmental Protection Agency

by

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Executive Summary

1 Introduction

Composting is one way of meeting targets for reducing the biodegradable municipal waste (BMW) fraction of waste going to landfill. This waste fraction must be reduced by 65%, as set out in European Community (EC) Council Directive (1999/31/EC) (EC, 1999) and *"Changing Our Ways"* (DELG, 1998). Composting technologies will make up part of the infrastructure for biologically treating up to a target of 300,000 t of biodegradable waste annually.

In the National Waste Database (EPA, 1998), approximately 33% of household and 15% of commercial waste were estimated to be organic. Essentially this represents the putrescible fraction of biodegradable waste (PBMW), which is a subset of BMW. PBMW includes food scraps and green wastes. These wastes have often been called the organic fraction of municipal, household or commercial waste, or the organic fraction of municipal solid waste (MSW).

As part of this document, a National Strategy to develop market (for profit) and non-market (not-for-profit) outlets was devised by reviewing and synthesising existing successful models of compost distribution, and developing and synthesising relevant baseline Irish information. Most simply, an outlet is a venue in which compost can be used for the benefit of soil and plants. An outlet can be as simple as using compost from a home composter (non-market outlet), or as sophisticated as selling a blended (with other constituents) bagged product (market outlet).

It is recognised that compost produced from PBMW will have to compete with existing organic amendments (e.g. peat, manure, etc.), and/or new market or non-market outlets will have to be developed. In addition, compost will have to meet legal standards (e.g. re inorganic contaminants such as metals) and market-driven standards (e.g. particle size, nutrients, salinity, etc.) in order to secure markets.

1.1 Goal and Objectives

The key goal of this document was to formulate a National strategy to develop adequate, stable and reliable PBMW-compost market and non-market outlets.

The objectives pursued in achieving the above goal included:

- reviewing existing information regarding PBMW compost use;
- reviewing the status and future status of PBMW composting in Ireland;
- ascertaining existing outlets for organic amendments in Ireland;
- identifying potential new outlets for distributing PBMW compost.

1.2 Tasks

The main tasks undertaken included:

- a literature review;
- surveys of local authorities, private hauliers, producers of organic amendments and sectoral organisations;
- development and application of a marketing model for PBMW compost;
- development of Strategy to Develop Adequate Reliable and Stable Outlets for PBMW Compost.

2 Literature review

An estimate of PBMW requiring diversion was made and is presented in Table 1. From this, an estimate of the potential maximum amount of annual PBMW compost production was made. It is unlikely that all PBMW requiring diversion will be composted, so these estimates could be considered as maxima.

Compost has many advantageous attributes. These include soil conditioning qualities such as:

- water-holding capacity

Table 1. Estimated PBMW requiring diversion and estimate of resultant compost if all PBMW requiring diversion was composted.

Year	PBMW waste landfilled	PBMW to be diverted from landfill (t)	Compost produced from PBMW (t)	PBMW to be diverted from landfill (t)	Compost produced from PBMW (t)
		Zero growth*	Zero growth**	3% annual growth	3% annual growth*
1995	100%	0	0	0	0
2006	75%	111,000	55,500	281,000	140,500
2009	50%	221,000	110,500	448,000	224,000
2016	35%	287,500	143,750	668,000	334,000

*442,301 tonnes is used as the baseline tonnage for PBMW produced in 1995.

**Estimated 50% reduction in weight between PBMW and final compost.

- soil aeration
- organic matter
- soil stability and aggregation
- soil bulk density
- erosion prevention
- soil pH
- cation exchange capacity

Additional significant attributes include providing a source of plant nutrients and contributing to disease suppression. Due to these attributes, compost has been successfully utilised as a growing medium or soil conditioner, in the horticulture, agriculture, land remediation, forestry, and other sectors.

There are a number of general barriers to utilising PBMW compost. They include the fact that it is a new product in Ireland, the abundance of other soil amendments, and PBMW compost being a waste-derived product. The development and application of a marketing model can help surmount general barriers to utilising PBMW compost.

The main product-related barriers to PBMW compost use include the presence of heavy metals, pathogens (plant or animal) and phytotoxicity (salts, organic acids, pesticide contamination). Compost standards in the form of legal standards (e.g. heavy metals, pathogens, etc.) and market-driven standards or specifications can help overcome product-related barriers to PBMW compost use.

3 Surveys

Surveys of a number of stakeholders were carried out. The aim was to generate baseline data with regard to existing composting infrastructure, compost production and compost utilisation. Information was also sought in order to determine the development of future composting infrastructure, compost production and compost utilisation.

3.1 Survey of Local Authorities

Table 2 contains the PBMW composting infrastructure data obtained from the local authorities that responded (95%) to the survey.

In 2001, there were approximately 25,000 home composters, and 5700 households receiving separate PBMW collection. By late 2001, there were 22,100 households with separate PBMW compost collection.

Table 2. Summary of composting infrastructure (n = 36).

Composting Infrastructure	Number
Home Composting Programme	30
Centralised Facility	4
Community Composting Facility	0
Vermi-composting Programme	4
Seasonal Drop-off Facility	1
Year-Round Drop-off Facility	3
Sewage Sludge Composting Facility	1
Other	0
None of the above	6

Table 3. Home composting infrastructure (n = 36).

Number of home composters	24,916
Average sale cost (excluding pilot schemes) (€)	21.22
Range of costs (excluding pilot schemes) (€)	0–57
Average annual weight assigned (kg)	258
Range of annual weight assigned (kg)	100–500

Including PBMW diverted from home composters, at least 25,000 t of PBMW will be diverted in 2002. Home composting infrastructure is shown in Table 3.

Centralised composting infrastructure is shown in Table 4.

An expansion in PBMW composting is likely. Local authority plans for the expansion of existing programmes are presented in Table 5.

There are approximately 1.2 million households in Ireland (Census 1996). Using the above estimates, approximately 4% of households divert PBMW. It is estimated that 442,301 t of PBMW was produced in 1995 (the base year). Approximately 5% of PBMW is diverted, although this does not account for increases in PBMW generation since that time.

3.2 Survey of Private Hauliers

At present, there is no private sector involvement in centralised composting of PBMW although this is expected to change.

3.3 Survey of Retailers of Organic Amendments

A price survey of retailers of organic amendments was undertaken. The prices (2001) of existing organic amendments were found to be: €9.30–33.50/m^3 for wholesale bulk, €20.00–48.75/m^3 for wholesale bagged, and €49.23–108.50/m^3 for retail bagged. These prices represent the potential selling prices for PBMW compost.

Table 5. Summary of future composting infrastructure.

Future composting infrastructure	Number
Home Composting Programme	33
Centralised Facility	13
Community Composting Programme	1
Vermi-Composting Programme	2
Seasonal Drop-Off Facility	1
Year-Round Drop-Off Facility	2
Sewage Sludge Composting Facility	0
Other	1
None of the above	2

3.4 Survey of Sectoral Organisations

Organic amendments produced in Ireland are outlined in Table 6.

Horticultural amendments are produced specifically for commercial sale. Manure, which represents almost 99% of organic amendments produced, represents an on-farm management issue and as such will not compete directly with PBMW compost outlets. Spent mushroom compost represents a waste product that requires management. It may compete directly with PBMW compost for outlets.

There are approximately 535,000 t of organic amendments that could compete with PBMW compost outlets. An estimate developed for outlets that could be developed for PBMW compost is presented in Table 7. A conservative approach is taken in terms of obtaining existing market shares. It should be noted that these estimates do not include expanding existing outlets or creating new outlets that could result from the development of a PBMW composting industry.

Table 4. Centralised composting infrastructure.

Summary of centralised composting	2001	2002
Number of households receiving PBMW Collection	5700	22,100
Approx. weight of PBMW collected (t)	1700*	6600
Approx. weight of PBMW dropped off by residents to compost facility (t)	16,000	16,000
Approx. weight of PBMW composted (t)	17,700**	22,600
Approx. weight of PBMW compost (t)	9000	11,000

*Estimated at 300 kg/household/year.

**50% reduction in weight due to composting.

Table 6. Annual organic amendment production in Ireland.

Sector	Organic amendments	Tonnes	Comments
Horticulture	Peat	125,000	Peat and bark are produced and sold commercially to the horticultural sector
	Bark	130,000	
Agriculture	Animal manure	40,000,000	Manures that require management. Majority managed at the farm.
	Spent mushroom compost	280,000	Requires management. Some used in horticultural and agricultural sectors
Forestry		See bark	
Land remediation		Not applicable	
Total production of organic amendments (including manures)		**40,535,000**	
Production of organic amendments (excluding manures)		**535,000**	

Table 7. Estimates of potential annual outlets for PBMW compost.

Sector	Estimated potential outlets (t)	Rationale
Horticulture	55,000	• 20 % of existing horticultural peat and bark compost usage • No allowance made for usage on road verges
Agriculture		
Conventional	250,000	• PBMW compost best used on crop land • There is an estimated 400,500 ha of crop land • Assumes 12,500 ha (~3%) of crop land available annually and is applied with 20 t/ha PBMW compost as is (i.e. weight includes moisture).
Organic	64,000	• Presently 32,000 ha in production • Assumes 10% of land in organic production available annually and is applied with 20 t/ha PBMW compost (as is)
Land remediation		
Contaminated lands	No estimate made	• Need to refine estimate of hectarage requiring remediation • Need to refine targets (i.e. timing) for land remediation
Bogland restoration	20,000	• At least 50,000 ha bogland requiring restoration
Forestry	40,000	• Assumes 10% of land in forestry production available annually and is applied with 20 t/ha PBMW compost (as is)
Other		
Export	18,750	• Assumes 5% of annual 375,000 t of horticultural peat exported annually
Total	**447,750**	

4 Applying a Marketing Model to the Marketing of PBMW Compost

A model was developed and applied to the marketing of PBMW compost. This model was applied to the marketing of compost produced from PBMW and was completed by applying and synthesising information generated in the literature review, surveys and market study. The formulation of a final strategy for the development of stable, adequate and reliable outlets for PBMW emanates from this model application, and is presented in Chapter 5.

5 Strategy for Developing Stable, Adequate and Reliable Outlets for PBMW Compost

5.1 Introduction

The following has been ascertained:

- up to 334,000 t of PBMW compost will be produced annually by 2016 (based on 3% growth);
- annual organic amendment (e.g. peat, bark, etc.) production is 535,000 t (Table 6);
- estimates of potential annual outlets for PBMW compost are 447,750 t (Table 7).

The focus of this strategy centres on using PBMW compost in the market segments identified and described in Chapters 2, 3 and 4. Those segments are organic amendment markets in:

- Horticulture
- Agriculture
- Land remediation
- Forestry
- Other uses (non-organic amendment uses)

The strategy encompasses both market and non-market outlets for compost. In simple terms, this refers to profit and not-for profit markets.

Both local authorities and the private sector will be involved in the production of PBMW compost. The local authorities will probably produce PBMW compost for a non-market outlet although some will develop market outlets for their product. The private sector will produce PBMW at centralised composting facilities. The private sector will wish to produce PBMW compost for profit or to use internally.

A strategy is presented below. It is presented in a hierarchal format, from a macro- to micro-view.

5.2 Strategy

5.2.1 Hierarchy of PBMW Compost Usage

It is useful to develop a hierarchy of how PBMW compost should be used. Figure 1 depicts such a hierarchy.

This hierarchy combines elements (i.e. minimisation, re-use and recycling) of the waste hierarchy (as described in EPA (2000)) and links them to market segments. Producers of PBMW are at the top of the hierarchy. This is consistent with elements of the waste hierarchy (i.e.

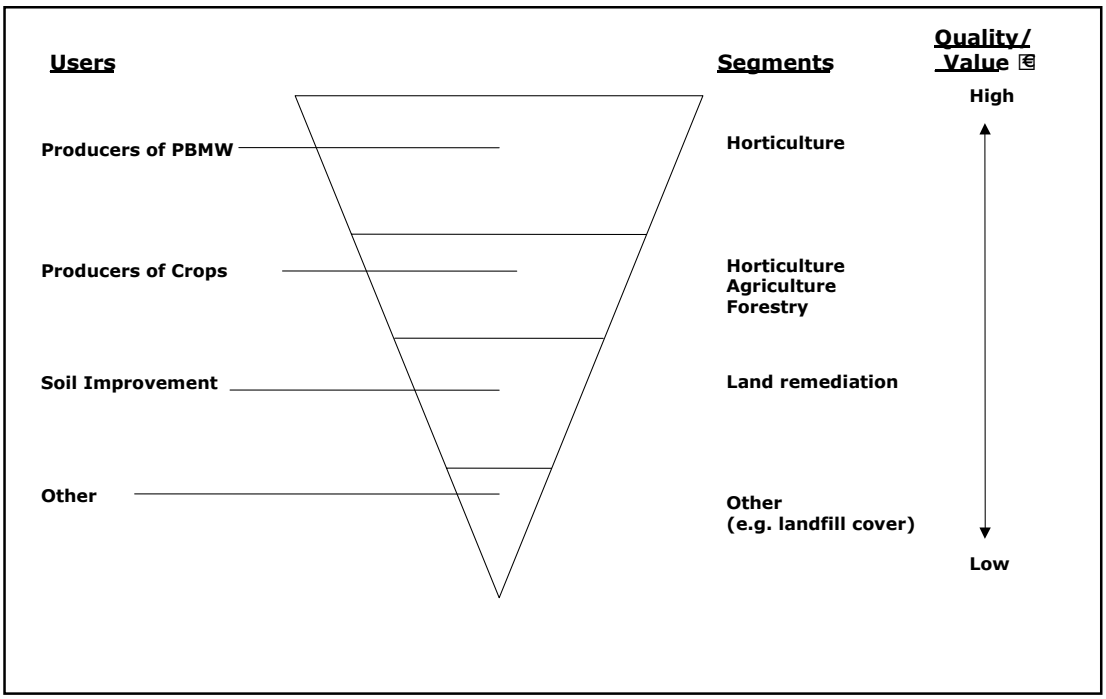

Fig. 1. Hierarchy of PBMW compost utilisation.

minimisation and re-use). Producers of PBMW are likely to use the resultant compost in a horticultural manner. Producers of PBMW include homeowners, and the uses of compost could encompass home use and amenity use by local authorities from whose jurisdiction the PBMW is collected and composted.

The production of crops includes the horticultural, agricultural and forestry segments. This is consistent with the recycling element of the waste hierarchy. The use of compost as a soil improver can also be linked to land remediation. This is consistent with the recycling element of the waste hierarchy. Other uses include using compost as daily cover at landfills; however, this is not a particularly productive use of PBMW compost, and it should be avoided where possible, given that the effort to manufacture the product is not commensurate with the return.

In cases where incoming waste is biologically treated at a landfill prior to emplacement, this should be referred to as 'treatment' rather than composting so as not to confuse potential consumers of PBMW compost.

It should be noted that there are some exceptions in the 'other' category that do not fit into the hierarchy. Niche uses such as biofilters and acoustic barriers are potentially good uses of PBMW compost. The export market is another potential outlet for PBMW compost although it would require considerable economic investment in order to develop. Compost sold into an export market would probably be used in a horticultural context. The hierarchy of PBMW compost utilisation can be correlated with quality requirements and potential monetary value for PBMW compost.

Local authorities or private contractors considering composting PBMW should consider developing markets in the order of the hierarchy. This is logical for local authorities because they are collecting and composting their residents' PBMW. In the case of the private sector, the generators of PBMW (i.e. householders) represent one of the more lucrative markets (i.e. horticultural segment).

Strategy

- **Develop PBMW compost market based on the hierarchy (i.e. Figure 1).**

5.2.2 Order of PBMW Composting Infrastructure Development

PBMW composting infrastructure should progress in an orderly fashion. The expertise gained from one step should be used to ensure success in the next.

Strategy

- **Local authorities should initiate PBMW compost infrastructure development with home composting and then proceed to centralised green waste composting and, finally, centralised composting of a full range of PBMW (including food wastes).**

5.2.3 Economic Value of PBMW Compost

5.2.3.1 General

In many respects, the composting of PBMW must be thought of as product manufacturing rather than a waste diversion activity. The strategy should be to strive to produce PBMW compost for the 'highest common denominator' – which means for the highest quality and potential monetary value. This translates into the horticultural segment.

Strategy

- **Strive to produce PBMW compost suitable for producers of PBMW (i.e. horticultural uses).**

5.2.3.2 Local Authorities

It is important that local authorities cultivate an appreciation of some monetary value for PBMW compost in their residents. A fee of some sort should be assigned to the distribution of the product. An alternative to the local authorities receiving the fee would be to involve local community groups in a 'compost value' day, whereby the community groups would be the recipients of the proceeds of compost distributed to residents.

Strategy

- **Give value to PBMW compost by assigning a monetary fee for this product.**

5.2.3.3 Private sector

Strategy

- **Ensure that both revenue streams (tipping fee and product sale) are exploited.**
- **Strive to produce PBMW compost that will have the highest possible monetary value.**

5.2.4 Quality

To produce a product that has monetary value requires that the product has certain qualities that will facilitate 'exchange relationships' (i.e. purchase product).

5.2.4.1 Quality of PBMW Feedstock

To manufacture a high quality product requires a high quality feedstock.

Strategy

- **Collect and treat only source-separated PBMW for composting.**

5.2.4.2 Quality of PBMW Compost

Given a high quality feedstock, it is important to ensure that the composting process will result in compost that has similar qualities to existing organic amendments, as well as the ability to develop unique and potentially marketable attributes. Reasonable process management requirements, monitoring and end-product requirements should be developed. It may be useful to develop a guide to assist producers of compost in making a high quality product. It should be noted that any legislative requirements will focus on ensuring environmental protection. Market-driven quality requirements will focus on addressing various market needs. PBMW compost manufacturers will have to understand and address both legislative and market-driven requirements.

Strategy

- **Develop Irish compost standards in line with international best practice.**
- **Develop reasonable compost facility process management requirements.**
- **Ascertain and disseminate market-driven quality requirements to PBMW compost producers.**
- **Inform the public of compost standards and compost quality, pointing out the differences.**

5.2.5 Facilitating Outlet Development

The production of PBMW compost will not be due to natural market forces, i.e. the market has not previously considered that PBMW compost would create sufficient 'exchange relationships' to make it a viable product. Although in reality there are sufficient potential outlets for PBMW compost to be utilised, in many cases they need to be facilitated.

5.2.5.1 National Procurement Policy

In the same manner that waste diversion is promoted through policy, the utilisation of the product can be facilitated via policy. The policy can be simple or comprehensive. A policy should be predicated on a product of acceptable quality.

Strategy

- **Develop a government procurement policy for compost produced from PBMW.**

5.2.5.2 Local Authority Procurement Policy

Local Authorities will probably produce a significant quantity of the PBMW compost. It will be prudent for them to set up systems whereby the finished product is utilised. A policy should be predicated on a product of acceptable quality.

Strategy

- **Local Authorities or Regions developing composting programmes should develop a procurement policy for compost produced from PBMW.**

5.2.5.3 Horticultural Peat Replacement Policy

In the United Kingdom, 40% of current peat-based products used horticulturally are targeted to be replaced by non-peat products by 2004. Ireland should develop a similar policy.

Strategy

- **The government should develop a horticultural peat replacement policy for Ireland in which 25% of current peat-based products are targeted to be replaced by non-peat products within a prescribed time period.**

5.2.6 Marketing Strategies

National policy will potentially result in the production of a significant quantity of PBMW compost. In order to create exchange relationships, the consumer must be confident that this is a product worth trying (i.e. one exchange) and the product should be developed such that the consumer will want to purchase it on a regular basis (i.e. multiple exchanges).

5.2.6.1 Certification

Consumers of products need to have some level of confidence with regard to product consistency.

Strategy

- **Develop certification programme for compost produced from PBMW.**

5.2.6.2 Marketing Plan

The marketing of a product has to be a very conscious act, not an afterthought. All producers of compost, whether they are local authorities or the private sector, should develop a marketing plan prior to the setting up of a composting facility. The marketing plan should be an integral part of decision-making with regard to developing a composting facility.

Strategy

- **Develop a handbook for the development of a marketing plan for those wishing to develop a compost facility that composts PBMW.**
- **Develop a marketing plan for PBMW compost prior to developing a composting facility.**

5.2.6.3 Linkages with Producers and Potential Users of Organic Amendments

Horticulture

Peat producers
Strategy

- **Investigate working with the peat industry to develop 'peat extenders'.**

Agriculture

Conventional agriculture
Strategy

- **Investigate working with the agricultural industry to identify possible uses of PBMW compost.**

Organic farming
Strategy

- **Investigate working with organic farming industry to identify possible uses of PBMW compost.**

Spent mushroom compost producers
Strategy

- **Investigate working with the mushroom industry to co-market compost.**
- **Investigate working with mushroom industry to co-compost PBMW with spent mushroom compost.**

Land Remediation
Strategy

- **Investigate working with the land remediation industry to identify possible uses of PBMW compost**

Forestry

Strategy

- **Investigate working with the forestry industry to identify possible uses of PBMW compost.**

5.2.6.4 Promotion and Education

PBMW composting is relatively new in Ireland. To produce an acceptable product that will meet the quality requirements, it will be necessary to educate those that are going to produce PBMW compost. Given that PBMW compost is of an acceptable quality, it still faces two significant barriers to its use. Firstly, it is a waste-derived product, and secondly, it is a new product in this jurisdiction.

It will be important to develop national and regional (i.e. close to where composting facilities will be developed) promotion and education programmes.

It should be noted that PBMW is composted and successfully used in many jurisdictions outside of Ireland. A considerable amount of existing promotional and education information can be adapted to Ireland. It will be important to develop some 'Ireland-specific' information.

Strategy

- **Develop educational programmes for producers of PBMW.**

- **Develop promotion and education programmes for consumers.**

5.2.7 Conclusions

The development of stable, adequate and reliable market and non-market outlets for compost produced from PBMW has been built on developing a hierarchy of users (Figure 1). Producers of PBMW (e.g. horticulturalists) present the most stable outlet for PBMW compost. Producers of biomass (i.e. crops), land remediation, and other uses will create sufficient demand to ensure that, in conjunction with PBMW producers, there are adequate outlets for PBMW compost.

The development of PBMW composting infrastructure must take place in an orderly and incremental fashion so that public acceptability of PBMW composting and compost utilisation can develop.

Reliable and stable outlets can be developed if PBMW is produced in such a manner that it can be ascribed some value – monetary or otherwise. Ensuring that PBMW and the resultant compost are of the highest possible quality can affect this. Given this, there is an urgent need for environmental and marketing compost standards.

Since the generation of PBMW composting is being driven by legislation as opposed to market forces, it would be useful to develop national and regional procurement policies.

Given that there are considerable sources of existing organic amendments, as well as some potential large users of PBMW compost, it may be prudent to develop linkages with relevant industries that may be able to assist in developing outlets for PBMW compost.

Finally, PBMW composting and PBMW compost are relatively new to Ireland. Promotion and education will be necessary to ensure that good quality compost is produced and that consumers will utilise PBMW compost.

1 Introduction

"*Composting is the biological decomposition and stabilisation of organic substrates, under conditions that allow development of thermophilic temperatures as a result of biologically produced heat, to produce a final product that is stable, free of pathogens and plant seeds, and can be beneficially applied to land*" (Haug, 1993). Compost is a stabilised and sanitised end product of the composting process that may be beneficial to soils and plants.

Composting is one way of meeting targets for reducing the biodegradable municipal waste (BMW) fraction of waste going to landfill. This waste fraction must be reduced by 65%, as set out in European Union Council Directive (1999/31/EC) and *"Changing Our Ways"* (DELG, 1998). Composting technologies will make up part of the infrastructure for biologically treating up to a target of 300,000 t of biodegradable waste annually.

The *National Waste Database – Report 1998* (EPA, 2000) defined municipal waste as "*Household waste as well as commercial and other waste which, because of its nature or composition is similar to household waste*". This report estimates approximately 33% of household and 15% of commercial wastes to be organic. Essentially this represents the putrescible fraction of biodegradable waste (PBMW), which is a subset of BMW. PBMW includes food scraps and green wastes. These wastes have often been called the organic fraction of municipal, household or commercial waste or the organic fraction of municipal solid waste (MSW).

Any resultant compost must have market (for profit) or non-market outlets (not-for-profit). Most simply, an outlet is a venue in which compost can be used for the benefit of soil and plants. An outlet can be as simple as using compost from a home composter (non-market outlet), or as sophisticated as selling a blended (with other constituents) bagged product (market outlet).

Compost produced from PBMW will have to compete with existing organic amendments (e.g. peat, manure, etc.), and/or new market or non-market outlets will have to be developed. Compost will have to meet legal standards (e.g. re inorganic contaminants such as metals) and market-driven standards (e.g. particle size, nutrients, salinity, etc.) in order to secure markets. Other countries in the European Union and countries such as the United States and Canada have successfully developed programmes to compost PBMW and to find outlets for the resultant compost.

In this document, a National Strategy to develop market and non-market outlets was devised by reviewing and synthesising existing successful models of compost distribution, and developing and synthesising relevant baseline Irish information.

1.1 Goal and Objectives

The key goal was to formulate a National strategy to develop markets for compost produced from PBMW. The objectives pursued in achieving the above goal are listed below.

- reviewing existing information regarding PBMW compost use;
- reviewing the status and future status of PBMW composting in Ireland;
- ascertaining existing outlets for organic amendments in Ireland;
- identifying potential new outlets for distributing PBMW compost;
- developing a strategy to develop adequate, stable and reliable PBMW compost market and non-market outlets.

1.2 Tasks

1.2.1 Baseline Information Gathering

1.2.1.1 Literature Review

The literature on PBMW compost use covers:

- current waste-management policy;
- quantity of PBMW compost that may be produced;
- attributes of compost;

- uses of compost produced from PBMW;
- barriers to using PBMW compost;
- compost standards.

1.2.1.2 Surveys

Surveys were conducted to:

- ascertain the status and potential future status of PBMW composting in Ireland,
- ascertain existing outlets for organic amendments in Ireland, and
- identify potential new outlets for distributing PBMW compost in Ireland.

Surveys were in the form of questionnaires, which were distributed via the post or conducted over the telephone. Groups surveyed were obtained from conventional databases.

Survey of County Councils and Local Authorities

These groups represent the generators of PBMW. They also represent groups that could produce and develop outlets for PBMW compost.

Survey of Private Hauliers

Private hauliers may collect wastes containing PBMW. In some cases, this waste may be collected on behalf of a local authority. Private hauliers may also be involved in the handling and processing of wastes, and as such may become involved in composting of PBMW.

Survey of Retailers of Organic Amendments

These groups produce organic amendments for market outlets that may compete with compost produced from PBMW. Additionally, they represent groups that could produce and develop outlets for PBMW compost.

Survey of Sectoral Organisations

Various sectoral organisations were contacted, utilising the broad categories of compost utilisation identified in the literature review. These groups are potential users of compost produced from the PBMW.

1.2.1.3 Market Study

A market study was conducted to identify existing market and non-market outlets for organic amendments.

Wholesale and Retail Outlets

Research was conducted into existing wholesale and retail markets for organic amendments. These organic amendments included peat-based products, compost products (including spent mushroom compost), and manure-based products. This study focused on contacting or visiting sellers of bulk and bagged retail outlets throughout the country. The information was divided between market and non-market outlets, bulk and bagged products and wholesale and retail prices.

1.2.1.4 Estimate of Size of Market

An estimate of the existing organic amendment and potential PBMW compost market was also made. This was completed utilising information generated in the wholesale and retail outlets study and information developed during the Survey of Sectoral Organisations.

1.2.2 Strategy to Develop Adequate Reliable and Stable Outlets for PBMW Compost

A marketing model was developed using standard marketing techniques. The marketing model was applied to developing a strategy to develop adequate, reliable and stable outlets for PBMW compost. Outputs from the baseline information gathering tasks were used during the application of the marketing model.

A strategic approach to the development of adequate, reliable and stable outlets for compost produced from PBMW was developed from the application of the marketing model. Methods were suggested for product development, marketing and market penetration at a National level.

2 Literature Review

2.1 Introduction

This literature review is designed to provide a context for the development of an infrastructure for the marketing of compost produced from PBMW.

In the context of composting PBMW, this literature review covers:

- Current waste-management policy
- Quantity of PBMW compost that may be produced
- Attributes of compost
- Uses of compost produced from PBMW
- Barriers to using PBMW compost
- Compost standards.

A number of useful literature reviews and reports have been written on the marketing of compost produced from PBMW. These include NRAES (1992), Biocycle (1994), DETR (1996, 1998, 1999), US EPA (1999) and DETR (2000). Because a considerable amount has been written on the subject, the level of detail in this literature review is minimised. The focus is on literature that describes the uses of PBMW composts (also referred to as MSW composts).

2.2 Current Waste-Management Policy

The European Union Council Directive (1999/31/EC) describes legislation pertaining to the landfilling of waste. Article 5 (2) (a–c) pertains to biodegradable waste and is summarised as follows:

- Biodegradable waste going to landfill must be reduced, on a weight basis, to 75% of municipal biodegradable waste produced in 1995, within 5 years of laws, regulations and administrative provisions being brought into force to comply with the above directive.
- Biodegradable waste going to landfill must be reduced, on a weight basis, to 50% of municipal biodegradable waste produced in 1995, within 8 years of laws, regulations and administrative provisions being brought into force to comply with the above directive.
- Biodegradable waste going to landfill must be reduced, on a weight basis, to 35% of municipal biodegradable waste produced in 1995, within 15 years of laws, regulations and administrative provisions being brought into force to comply with the above directive.

Changing Our Ways, the waste-management policy statement published in 1998 (DELG, 1998), preceded but addressed the EU Council Directive (1999/31/EC) and clearly articulated the government's preferred method of managing waste in Ireland. The main thrust of this policy is to reduce the present dependence on landfilling as a form of waste management. Targets (i.e. relative to 1995) to be attained in the next 15 years, as they pertain to composting, include the following:

- Diversion of 50% of overall household waste.
- A minimum of 65% reduction in biodegradable wastes consigned to landfill.
- The development of waste-recovery facilities employing environmentally beneficial technologies, as an alternative to landfill, including the development of composting and other feasible biological treatment facilities capable of treating up to 300,000 t of biodegradable waste annually.
- An 80% reduction in methane emissions from landfill, which will make a useful contribution to meeting Ireland's international obligations.

National waste policy promotes the development of alternative waste-management technologies such as composting (Nealon, 2000). Composting PBMW will not provide all the answers to the current waste crisis. However, as part of an integrated system, it offers a viable alternative to landfill and thermal treatment and would facilitate, in part, the meeting of recycling targets.

Table 2.1. Target years for reduction of landfilling of PBMW.

Year	PBMW landfilled
1995	100%
2006	75%
2009	50%
2016	35%

2.2.1 Potential Quantities of PBMW Compost

Early activity within the composting industry in Ireland coincided with the publication of the EU document entitled '*Composting, Status of Research and Commercial Production in Ireland*' (Prasad, 1992). However, in the years following its publication and up until the introduction of the Landfill Directive in 1999, there was very little development in the area of commercial composting.

Waste-management policy now has a bearing on the potential amount of PBMW compost that may be produced and will need to be marketed in this country. Table 2.1 describes the time frame for when Ireland must meet the targets of municipal biodegradable waste going to landfill, as set out in the EU Council Directive (1999/31/EC).

In 1995, approximately 1,503,171 t of municipal waste were generated (EPA, 1996). Of that, approximately 990,000 t were BMW. BMW consists of biodegradable municipal waste collected as bagged waste – separately collected food, paper, textile, and wood waste. This characterisation is broader than, and encompasses, PBMW. As of 1995, less than 90,000 t of BMW were collected separately and recycled.

The National Waste Database Report 1995 (EPA, 1996) estimated that household waste consisted of 36% organics (i.e. putrescible waste) and that commercial waste consisted of 22% organics. The municipal waste stream consisted of approximately 65.3% household waste and 26.9% commercial waste (the balance was street sweepings). Table 3.6 of that report estimated that 442,301 t of putrescible biodegradable municipal waste (PBMW) were disposed of. This functions as the baseline number for estimates of future diversion of PBMW from landfill.

One can apply the diversion targets, as they apply to BMW, to this part of the waste stream. In reality, the targets for PBMW may be higher or lower than the overall diversion targets because the targets set out in the Landfill Directive apply to biodegradable municipal waste, which includes food and garden waste, and paper and paperboard. Table 2.2 shows estimates of the amounts of PBMW that will have to be diverted from landfill to enable attainment of the EU Council Directive (1999/31/EC) targets. Estimates have been based on zero growth and 3% annual growth. The latter is a more realistic estimate.

It is unlikely that all PBMW requiring diversion will be composted so these estimates could be considered as maxima. Other biological technologies such as anaerobic digestion may also be employed.

Changing our Ways (DELG, 1998) stated that infrastructure for the biological treatment of 300,000 t (annually) of BMW should be developed by 2016. By 2016, up to an estimated 668,000 t of PBMW will require diversion. If all PBMW requiring diversion were

Table 2.2. Estimated PBMW requiring diversion and estimate of resultant compost if all PBMW requiring diversion was composted.

Year	PBMW waste landfilled	PBMW to be diverted from landfill (t)	Compost produced from PBMW (t)	PBMW to be diverted from landfill (t)	Compost produced from PBMW (t)
		Zero growth*	Zero growth**	3% annual growth	3% annual growth*
1995	100%	0	0	0	0
2006	75%	111,000	55,500	281,000	140,500
2009	50%	221,000	110,500	448,000	224,000
2016	35%	287,500	144,000	668,000	334,000

*Estimated 50% reduction in weight between PBMW and final compost.

composted, then an estimated 144,000–334,000 t of compost would be produced annually and would require markets.

2.3 Attributes of PBMW Compost

Compost has a number of beneficial attributes. It is primarily a soil conditioner. It also contains variable amounts of mineral nutrients, depending on the waste stream. A more recently recognised attribute is the disease-suppressive qualities that some composts appear to confer.

The main documented attributes of compost are:

- **Soil Conditioner**
  - organic matter
  - soil aeration
  - water-holding capacity
  - soil stability and aggregation
  - soil bulk density
  - erosion prevention
  - soil pH
  - cation exchange capacity
- **Source of Plant Nutrients**
- **Disease Suppression.**

Table A1.1 (Appendix 1) displays the attributes of compost, providing a definition of the given attribute and the relevant references in the literature. Comprehensive reviews of compost attributes were provided by NRAES (1992), McConnell *et al.* (1994), Alexander (1999), US EPA (1999), and DETR (1999, 2000).

2.4 Uses of PBMW Compost

Compost has been successfully utilised as a growing medium or soil conditioner in the following sectors:

- Horticulture
- Agriculture
- Land remediation
- Forestry
- Land remediation
- Other.

Table A1.2 (Appendix 1) summarises recent research (1997 onwards) within the sectors in which compost produced from PBMW has been utilised. Table A1.3 (Appendix 1) lists specific uses of compost.

2.4.1 Horticulture

Horticulture is defined as including growing media, protected crops (i.e. in a greenhouse) and outdoor crops. In the horticultural context, there are three different markets for compost: as a growing medium, as a soil conditioner, and as mulch (DETR, 1998). Horticultural users of compost include professional growers (i.e. greenhouse and nursery), landscapers, local authorities, and amateur gardeners. Compost has been used as a component of growing media, as a source of organic matter and nutrients for nursery crops, for sod growth, and landscape gardens. Amateur gardeners use compost in a similar fashion, with a focus on landscaping and vegetable gardens.

In Ireland and the UK, peat is dominant within the horticulture industry as a growing medium (Dublin Corporation, 1999) and is used predominantly by professional growers (DETR, 2000).

Composted municipal solid waste (i.e. PBMW) has been used extensively as a soil improver and mulch because of its physical and chemical characteristics. In the UK, non-peat composts accounted for 1.68 million m^3 of the total 1.83 million m^3 substrate used for soil improvement (i.e. non-peat substrates) in 1999 (DETR, 2000). Composted green waste represented 206,424 m^3 of the non-peat compost.

The use of composts for growing horticultural crops has been increasing in recent years (Chong 1999). In countries where use of peat can prove costly, composts adequately serve as peat substitutes, enhancing plant growth and suppressing soil-borne plant pathogenic fungi (Raviv *et al.*, 1998).

There is also support for the use of composted MSW in farming and flower growing if blended with other materials, namely peat (Corti *et al.*, 1998). Hicklenton

(1998) reported that there was a potential for MSW compost use in the nursery trade, concluding that media that incorporate MSW compost at rates up to 75% of total volume are highly suitable for container culture of woody plants. Prasad and Maher (2001a) found that peat blends consisting of up to 20% green waste compost gave satisfactory plant growth. In a separate study, it was concluded that up to 50% of green waste could be mixed with peat without affecting the performance of plants if additional N was added and the composting period was at least 16 weeks (Prasad and Maher, 2001b). The horticultural market will be the most lucrative for compost.

The horticultural sector represents a potentially low–medium volume/medium–high economic value outlet for PBMW compost.

2.4.2 Agriculture

In the agricultural context, the main markets for compost are as a soil conditioner, a source of nutrients and perhaps as a suppressant of some plant diseases. Agricultural users of compost focus on its use as a soil amendment for field crops.

It has been argued that Ireland does not have a large agricultural market for compost as it has productive soils, sufficient quantities of topsoil, a plentiful natural peat resource, and localised areas of nutrient surplus (Dublin Corporation, 1999).

However, limits currently being placed on farmers by EU and National Regulations, particularly those participating in the Rural Environmental Protection Scheme, may help make a case for compost for a number of reasons, particularly because nutrients like nitrogen, which have historically posed a problem for the farmer in terms of groundwater contamination, are generally of a slow-release nature (Sullivan *et al.*, 1998). Where heavy machinery is used in agriculture, particularly for crop production, the soil becomes compacted, resulting in greater bulk density. The application of composted MSW in such instances decreases the bulk density of the soil, thus increasing its aeration and water-holding capacities (McConnell *et al.*, 1994). There is also the potential for use in areas where slurry spreading is a sensitive issue, i.e. near schools and houses (Dublin Corporation, 1999). Soil amendments are also being used in organic farming. Although this is currently a very small sector in Ireland, it is inevitable that it will expand in response to consumer requirements, thereby providing a market for composted PBMW. Organic farming represents a potential niche for PBMW compost.

The agricultural sector represents a potentially high volume, low economic value outlet for PBMW compost.

2.4.3 Land Remediation

Composting is an accepted technique for the remediation of contaminated soil (DETR, 1998) and has been widely used for a number of years in the USA. Compost addition increases the rate of reduction of hydrocarbons present in soils (Abiola and Olenyk, 1998). The process can be carried out on site, and in some cases it is possible to continue to use the site during remediation. However, it is a carefully controlled process and so composting may not be suitable for all types of remediation (Dublin Corporation, 1999). In Ireland the most common types of land contamination are old gasworks, underground storage tanks, waste disposal, mining sites and associated tailing ponds. There are approximately 400 sites in Ireland where historic contamination is believed to exist and an additional 1500–2000 potential sites of contamination, which are currently in operation (Brogan *et al.*, 1999)

The land remediation sector represents a medium volume, low economic value outlet for compost.

2.4.4 Forestry

There are three potential uses for composted PBMW within the forestry industry: as a soil improver, as a growing medium or as mulch (Dublin Corporation, 1999). Preparation of the soil, growth of the seedlings and prevention of weed growth at the base of trees are all steps required to ensure the successful growth of a forested area, each of which can benefit from the addition of compost (Dublin Corporation, 1999). In Ireland, 9% of the total land area, i.e. 634,118 ha, is under forest (The Forest Service, 2000a) and Government policy is to increase this figure to 17% of the total land area by 2035 (approximately 1,200,000 ha) (Doolan, P., 2001, Coillte,

pers. comm.). Composted waste can be used for the growing of Christmas trees. Approximately 1.5 million trees were harvested in 1999 and 3 million trees were planted in the 1999/2000 period to meet this market demand (Seddon, 2001).

Composts could also be used within the biomass sector of this industry (DETR, 1998). Trees grown for this purpose need to grow rapidly and would therefore benefit from the high levels of organic matter and nutrients present in composted MSW (Dublin Corporation, 1999).

The Forestry Industry represents a potentially high volume, low economic value outlet for compost.

2.4.5 Other Uses

There are some niche areas where compost could be used in some non-soil amendment applications.

2.4.5.1 Biofilters

Biofilters use biological activity to degrade odorous and volatile organic compounds (Alexander, 1999). The media used as the filter is a moist, porous substrate that contains microorganisms. This substrate degrades the contaminants as air is passed through the filter. For this reason, compost is a suitable material. Compost biofilters have the added ability of being able to remove a large variety of compounds at relatively high contamination rates (Alexander, 1999).

Biofilters can also be used for treating contaminated water, and customised compost products have been developed for this purpose in the USA. Pilot schemes have resulted in the removal of 90% of solids, 85% of oil and grease and 98% of heavy metals from industrial storm water (US EPA, 1999; Dublin Corporation, 1999).

Use as a component of a biofilter represents a very low volume, medium–high economic value outlet for compost.

2.4.5.2 Acoustic Barriers

Acoustic barriers are utilised as a means of blocking out noise. As an experiment, Hampshire Council in the UK successfully developed an acoustic barrier by utilising compost produced at their centralised composting facility. Approximately 1 t of compost is used for the production of each metre of sound barrier. The barrier has proved very effective in blocking out traffic noise.

Use as a component of an acoustic barrier represents a low volume, low economic value outlet for compost.

2.4.5.3 Landfill Cover/Capping

Although not a productive end use, composted PBMW can be used successfully as a landfill cover. Research in Austria has indicated that the application of compost as a cover material can mitigate methane emissions by 60–80% (Block, 2000). *Changing Our Ways* (DELG, 1998) sets a goal of 80% reduction in methane emissions from landfill. Compost could also be used as part of the final capping.

The landfill sector represents a medium volume, low economic value outlet for compost.

2.4.5.4 Export Market

Horticultural grade PBMW could potentially be exported. This market would require considerable development.

2.5 Barriers to Using PBMW Compost

There are a number of barriers to utilising PBMW compost. The greatest barrier is that it is a new product in Ireland. Like any other new product, people need to be convinced that this is a product worth using and perhaps buying. Another potential barrier is the abundance of soil amendments such as peat and other organic amendments currently available in Ireland. Compost produced from PBMW is a waste-derived product. At present, there tends to be some negative public perception with regard to the use of PBMW compost as a growing medium (Dublin Corporation, 1999). In some cases this is due to substandard products that have been launched onto the UK market in the past (DETR, 2000).

The main product-related barriers to PBMW compost use include:

- **Heavy metals**
- **Pathogens (plant or animal)**
- **Phytotoxicity**
  - Salts
  - Organic acids

- Pesticide contamination

Table A1.4 (Appendix 1) shows the main product-related barriers to using waste-derived compost, and the relevant literature.

The development and application of a marketing model (Chapter 4) can help surmount general barriers to utilising PBMW compost. The development of standards can help overcome product-related barriers.

2.6 Compost Standards

Standards help to ensure that the marketplace supplies products that meet minimum specifications. There are generally two sets of standards for compost – one legal and one market driven. The legal standard focuses on environmental protection, i.e. ensuring that the product does not contaminate the environment. Market-driven standards are not always formalised; however, they represent the standards that must be met, beyond legal standards, to be used in a particular sector. For example, a market-driven compost specification for horticultural use will differ from a market-driven specification for agricultural use. However, the legal standard may be the same.

Standards, both legal and market, will minimise the product-related barriers discussed in Section 2.5, and are necessary to ensure that the barriers towards introducing a new product into the marketplace and of competing with existing products in that marketplace can be overcome.

2.6.1 Legal Standards

Ireland currently has no legal standards for the production of compost. However, limits for various parameters are specified within relevant waste licences (e.g. Reg. No. 15-1, Dun Laoghaire–Rathdown County Council – Ballyogan).

The European Commission has prepared a working document for the 'Biological Treatment of Biowaste' (2nd Draft). Although at present the document has no legal standing, it is expected that it will result in formal European composting guidelines. This document presents information on composting and anaerobic digestion. The information presented in this document focuses on aspects pertaining to compost utilisation.

There are end-product requirements listed for:

- Indicator pathogens
- Weed seed germination
- Heavy metals
- Organic chemicals
- Impurities
- Gravel and stones.

Compost is divided into three classes based on the concentration/quantity of heavy metals, PCBs, PAHs, impurities and gravel and stones:

i Class 1 Compost
This compost shall be used according to best agronomic practice without specific restriction.

ii Class 2 Compost
This compost shall be used in a quantity not exceeding 30 t dry matter/ha on a 3-year average.

iii Stabilised biowaste
Stabilised biowaste is produced from unsorted waste. This product shall be used in artificial soils or in those land applications that are not destined for food and fodder crop production. Stabilised biowaste can be used if it is not reapplied to the same areas for at least 10 years and for a total quantity not exceeding 200 t dry matter/ha.

Table A1.5 (Appendix 1) presents heavy metal limits for compost for a variety of European countries.

Table A1.6 (Appendix 1) compares environmental quality classes presented in the 'Biological Treatment of Biowaste', 2nd Draft, with a voluntary Canadian standard developed by the Bureau de Normalisation du Quebec (BNQ). The BNQ is part of the Standards Council of Canada. In general, the Canadian AA and A standards lie in between the proposed Biological Treatment of Biowaste Class 1 and Class 2 values, or slightly higher than the Class 2 values. The Canadian B standard is generally higher than the proposed Biological Treatment of Biowaste Stabilised biowaste category.

2.6.2 Market Standards

Market standards or specifications relate to the attributes of organic amendments required by potential compost markets. These are often informally developed in a local context. There have been some efforts to try to develop market standards. These standards would not likely have a legal standing *per se*, although they may be linked to a product certification programme.

The Composting Council of Canada is in the process of developing marketing standards for compost. Table A1.7 (Appendix 1) shows draft market standards for various potential outlets for compost. There is no comprehensive listing of market standards in Ireland.

3 Surveys

Surveys of local authorities, private hauliers, retailers of organic amendments (i.e. competitors of compost) and sectoral organisations (i.e. split into producers and users of organic amendments) were conducted. Surveys were conducted by means of questionnaires, which were either sent out directly (i.e. local authority, private hauliers) or completed by telephone.

The goal of the surveys was to ascertain:

- existing PBMW composting infrastructure;
- future PBMW composting infrastructure;
- existing organic amendments and quantities produced;
- existing users of organic amendments and quantities used.

3.1 Local Authority Survey

3.1.1 Introduction

Local authorities represent the generators of PBMW, and are required to arrange for its recovery. They also represent groups that could produce and develop outlets for PBMW compost. The local authority survey was a key part of this study. Its aim was to generate baseline data with regard to existing composting infrastructure, compost production and compost utilisation. Information was also sought to determine the development of future composting infrastructure, compost production and compost utilisation.

3.1.2 Method

The local authority survey took the form of a questionnaire consisting of 15 questions relating to present and future plans for composting and compost utilisation within the functional area of each authority. A list of all the local authorities in the Republic of Ireland (88 in total) was compiled. This list included corporations, county councils and urban district councils. A package containing two cover letters (one from the EPA and one from ERML) and the questionnaire was forwarded to each authority by post. A one-page form was also included for those not responsible for waste management in their jurisdiction (i.e. most UDCs). Each authority was requested to return the completed survey or the one-page form. Copies of the letters and survey are available from the EPA. One week after sending out the survey, a follow-up phone call was made to each corporation and county council to ensure receipt of the survey and its referral to the correct person. Weekly telephone calls were made over a period of 4 weeks to corporations and county councils that had not returned a completed survey. After 1 month, those who had not replied were forwarded another copy of both cover letters and the survey. Further follow-up telephone calls were made in an effort to maximise survey response.

3.1.3 Results

3.1.3.1 Survey Return

Surveys were sent to 88 local authorities. Table 3.1 shows the gross return rates of either the full survey or the form that indicated that they were not responsible for waste management in their jurisdiction.

In terms of compiling statistics, only those local authorities responsible for waste management were considered relevant. Table 3.2 shows the number of local authorities responsible for waste management.

Table 3.1. Gross return rate of surveys or forms.

Type of authority	Number responsible	Returned	Response rate
Corporations	10	9	90.0
County Councils	29	27	93.1
UDCs	49	25	51.0
Total	**88**	**61**	**69.3**

Table 3.2. Number of local authorities responsible for waste management.

Type of authority	Number
Corporations	6
County councils	29
UDCs	3
Total	**38**

Table 3.3. Net return rate of surveys.

Type of authority	Number responsible	Returned	Response rate
Corporations	6	6	100.0
County councils	29	27	93.1
UDCs	3	3	100.0
Total	**38**	**36**	**94.7**

Table 3.3 shows the survey return rate for those local authorities responsible for waste management in their jurisdiction.

A survey return rate of almost 95% was achieved for local authorities responsible for waste management in their jurisdiction.

Data analysis focused principally on two areas:

1. Baseline data with regard to existing composting infrastructure, compost production and compost utilisation.
2. Development of future composting infrastructure, compost production and compost utilisation.

3.1.3.2 Existing Composting Infrastructure and Production

Table 3.4 shows the current composting programme statistics amongst local authorities, as outlined in the completed surveys.

Table 3.4 Local authorities with existing composting infrastructure (n = 36).

	%	x
Home Composting Programme	83.3	30
Centralised Facility	11.1	4
Community Composting	0.0	0
Vermi-composting	11.1	4
Seasonal Drop-off Facility	2.8	1
Year Round Drop-off Facility	8.3	3
Sewage Sludge Composting Facility	2.8	1
Other	0.0	0
None of the above	16.7	6

The following equation was used for data analysis:

$$Q = (x/n) \times 100$$

where: Q = question, X = affirmative responses, and n = total number of surveys returned.

Home composting

Over 83% of local authorities responsible for waste management have a home composting programme (Table 3.4). This represents a non-market outlet for compost. Table 3.5 provides a summary of home composting statistics.

Home composters have been distributed to approximately 24,916 households, costing the public an average of €21 to buy. In all cases the cost of the composters is subsidised by the local authority and in a number of cases a further cost reduction was offered to old age pensioners (OAPs) and the unwaged. Forty-three percent of local authorities sell the composters for €13 or less whereas 10% offered them free of charge to schools and those participating in pilot schemes. One local authority offered all composters free of charge. The annual weight assigned to home composters varies widely amongst local authorities. The average amount is quite high.

Conservatively, the authors estimate that 100kg/year of PBMW can be diverted per home composter. At present this would result in 2500 t of PBMW being diverted annually, resulting in about 1300 t of PBMW compost (i.e. weight estimated to reduce by 50% during composting process).

Of the local authorities engaged in home composting programmes, 25 (71%) took measures, some more extensive than others, to advertise and promote the programme to the public. Table 3.6 shows a breakdown of the measures utilised by these local authorities.

Table 3.5. Local authority home composting programme (n = 36).

Summary of home composters		n
Number of home composters	24,916	30
Average sale cost (excluding pilot schemes)	€21.22	30
Range of costs (excluding pilot schemes)	€0–57	30
Average annual weight assigned	258 kg	15
Range of annual weight assigned	100–500 kg	15

Table 3.6. Local authority promotional measures (n = 25).

1. Advertising	
Media, i.e. newspapers, television, radio	96%
Website, posters, newsletter, flyers	64%
Other	8%
2. Start-up programmes	
Visits to community & residence groups, schools	56%
Public displays, one-day sales	24%
Demonstrations, training, workshops	36%
Information packs, booklets, leaflets, videos	80%
Website, posters, newsletter, flyers	8%
3. Follow-up/maintenance programmes	
Media, i.e. newspapers, television, radio	4%
Website, posters, newsletter, flyers	8%
Technical service, help line, contact name	20%
Home visits	4%
Surveys	4%

Centralised Composting

There are presently four centralised composting facilities in Ireland, with a number in development. The present sites are located at St Anne's Park, (Dublin Corporation), Kerry County Council, Cork County Council and Galway Corporation (Pilot). Kerry County Council and Galway Corporation compost source-separated waste, including green waste, whereas Dublin Corporation and Cork County Council compost green waste.

Table 3.7 shows PBMW collected and PBMW compost generated in Ireland. The expansions of programmes in late 2001 are included in the estimates for 2002.

(i) St Anne's Park

This facility has been operational since 1993 and is managed by the Parks Department of Dublin Corporation. At the time of survey, this facility was composting approximately 16,000 t of green waste annually. This is delivered to the site by residents and landscapers and yields in the region of 8000 t of compost. Approximately one-third of this compost is sold to the public at a cost of €1.30 per 70-litre bag. The Corporation uses the remainder.

(ii) Kerry County Council

Since 1999, Kerry County Council have collected source-separated municipal organic waste as part of the Tralee Composting Scheme. Approximately 2600 households were involved in the initial scheme. A dedicated wheelie bin is used for PBMW segregation, and set out rate is, at best, close to 70%. Thirty-five hotels in Killarney also participate in the scheme.

Compost samples of the end product have been analysed by Bord na Móna Environmental and have been found to have a satisfactory level of nutrients and organic matter content. *E-coli* and *Salmonella* were not detected in the compost. Approximately 50% of the end product is given away to the public, in particular to those participating in the scheme. The Council uses the remainder for maintenance of civic amenity areas. In late 2001, the scheme was expanded to 3500 households in Killarney Town.

(iii) Cork County Council

Cork County Council's green waste composting scheme began in 1988 when the council began a campaign for shredding Christmas trees. This scheme has since expanded, with the council now shredding and composting all types of green waste otherwise destined for landfill.

Table 3.7. Local authority centralised composting.

Summary of centralised composting	2001	2002	n
Number of households receiving PBMW collection	5700	22,100	3
Approximate weight of PBMW collected (t)	1700*	6600	3
Approximate weight of PBMW dropped off by residents to compost facility (t)	16,000	16,000	1
Approximate weight of PBMW composted (t)	17,700	22,600	
Approximate weight of PBMW compost (t)**	9000	11,000	4

*Estimated at 300 kg/household/year.

**50% reduction in weight due to composting.

The Council have acquired their own shredder, which is taken around the county at different times during the year on designated days, which are advertised in advance in local newspapers. Residents can then bring their waste to the landfill sites on those days for recycling. The end product is used by the council as mulch in town parks and on roundabouts and grass verges. No incoming tonnage estimates were available.

(iv) Galway Corporation

Galway Corporation began a pilot collection of PBMW from 590 households in late 2000, using wheelie bins. In 2001, it was decided to roll out a city-wide programme. By the end of 2001, approximately 15,000 households had received wheelie bins to separately collect PBMW. Wheelie bins are collected every 2 weeks. Composting infrastructure development is ongoing.

(v) Limerick Corporation

Limerick Corporation developed a pilot collection programme for 2500 houses in the north side of the city. A green wheelie bin was provided for organic waste and a black wheelie bin for all other waste. Bins were collected on alternate weeks. Mr Binman, a private waste haulier, took over responsibility for the collection of waste in Limerick City in June 2000.

(vi) Other Composting Schemes

Other composting schemes currently in place include Vermi-composting. Of the authorities surveyed, four are engaged in such schemes: Kerry County Council, Galway Corporation, Galway County Council and Wexford County Council. The projects have been geared mainly towards schools and households, in response to demand. Wexford County Council is running a pilot project involving 30 households and a number of schools. In addition, Galway Corporation vermi-composted the PBMW from its 590-household pilot collection area.

3.1.3.3 Future Composting Infrastructure and Production

In general, local authorities with composting schemes in place have plans for further expansion in 2001 and beyond. Table 3.8 outlines the future development of composting infrastructure.

Table 3.8. Local authorities with plans for future (2001 and beyond) composting infrastructure (n = 36).

	%	x
Home Composting Programme	91.7	33
Centralised Facility	36.1	13
Community Composting Programme	2.8	1
Vermi-Composting Programme	5.6	2
Seasonal Drop-off Facility	2.8	1
Year Round Drop-off Facility	5.6	2
Sewage Sludge Composting Facility	0.0	0
Other	2.8	1
None of the above	5.6	2

Of the 92% of local authorities that had plans for future home-composting schemes, 85% (28) had specific expansion plans in place, while 15% (five) concluded that, while they had no detailed objectives in terms of numbers of households facilitated, the scheme would continue to grow according to demand.

One local authority with an existing home composting programme was certain that this programme would not expand. Of the four existing centralised facilities, all have expansion plans for the future. A further nine green waste facilities are also planned throughout the country, with no time frame specified for their development. It is important to note that this figure differs with the 16 proposed facilities outlined in the regional waste-management plans. Two local authorities had no plans for any form of composting scheme, either in the immediate or long-term future.

Waste-Management Plans

As prescribed in the Waste Management Act of 1996 (Anonymous, 1996), local authorities are required to develop new, detailed plans for the management of non-hazardous wastes within their functional areas. These have taken the form of waste-management plans. Requirements in relation to these plans are set out in the Waste Management (Planning) Regulations. In some cases, individual county councils have prepared them. In other cases they have been prepared on a regional level (i.e. a number of county councils). Some local authorities have prepared both. Table A1.8 (Appendix 1) shows planned composting infrastructure in the context of waste plans. Most regions have plans to institute home

composting, although few targets are provided. During the life of the waste-management plans, it is estimated that up to 16 green waste composting facilities may be constructed. There is little information on tonnages to be composted. In addition, it is estimated that up to eight biological treatment facilities (i.e. including source-separated waste and other organic wastes), whether they be composting or anaerobic digestion, will be constructed during the life of the waste-management plans.

3.1.3.4 Assessment

In 2001, there were approximately 25,000 home composters and 5700 households receiving separate PBMW collection. By late 2001, there were 22,100 households with separate PBMW compost collection. Including PBMW diverted from home composters, at least 25,000 t of PBMW will be diverted in 2002.

There are approximately 1.2 million households in Ireland (Census, 1996). Using the above estimates, approximately 4% of households divert PBMW. It is estimated that 442,301 t of PBMW were produced in 1995 (the base year). Approximately 5% of PBMW is diverted, although this does not account for increases in PBMW generation since that time. This diversion does not include BMW diverted through other methods of organic waste management although this is believed to be quite low.

A 25% reduction of BMW going to landfill has been set for 2006. It has been assumed that a similar target is appropriate for PBMW. A considerable amount of infrastructure, for composting and other methods of biological treatment, is required to meet this goal.

In 2001, approximately 11,500 t of PBMW compost were produced. In 2002, preliminary estimates suggest that 13,500 t of PBMW compost will be produced. To date there have been no issues with finding market and non-market outlets for this compost.

3.2 Private Hauliers Survey

Private hauliers may collect wastes containing PBMW. In some cases this waste may be collected on behalf of a local authority. Private hauliers may also be involved in the handling and processing of wastes and, as such, may become involved in the composting of PBMW.

3.2.1 Introduction

The private hauliers survey and its aims were similar to the local authority survey (Section 3.1). The survey was modified from the local authority survey, and distributed to private sector waste-management firms that had licences or had applied for licences (i.e. Waste Management Act, 1996; Fourth Schedule, Class 2 Waste Recovery Activity) that would allow them to divert and potentially compost PBMW.

3.2.2 Method

The private hauliers survey consisted of a questionnaire containing 10 questions relating to present and future plans for composting and compost utilisation within the functional area of each private haulier. A total of nine surveys were sent out. A package containing two cover letters (one from the EPA and one from ERML) and the survey was forwarded to each private haulier. Private hauliers were requested to return the completed survey and the follow-up measures taken were similar to those employed for the local authority survey. A copy of the survey is available from the EPA.

3.2.3 Results

Surveys were sent to nine private hauliers. One of the private hauliers had been taken over by another private haulier to whom a survey had also been sent. Thus, effectively eight surveys could be returned. Five surveys were returned, resulting in a 71.4% return rate.

The analysis focused principally on two areas:

1. Baseline data with regard to existing composting infrastructure, compost production and compost utilisation.
2. Development of future (i.e. 2001 and beyond) composting infrastructure, compost production and compost utilisation.

3.2.3.1 Existing Composting Infrastructure and Production

Table 3.9 shows existing composting infrastructure in this group.

There were no private composting programmes identified from this survey.

Table 3.9. Private hauliers with existing composting infrastructure.

	%	n
Centralised facility	0.0	0
Other	0.0	0
None of the above	100	5

3.2.3.2 Future Composting Infrastructure and Production

Table 3.10 shows plans in terms of composting infrastructure. Two of the five private hauliers who returned completed surveys have specific plans to develop centralised facilities for green waste or source-separated waste. One of these already has a collection scheme for source-separated PBMW waste in place. One private haulier indicated that they have plans for implementation of a composting scheme but did not provide details.

3.2.4 Assessment

At this point, private hauliers are not composting PBMW. This may change in the future.

3.3 Survey of Retailers of Organic Amendments

3.3.1 Introduction

These groups produce organic amendments for market outlets that may compete with compost produced from PBMW.

3.3.2 Method

A list of 64 organic amendment retailers (peat, SMC, bark, etc.) was compiled from the Golden Pages and the Amenity and Nursery Stock Directory (The Blue Book).

A telephone survey (split into wholesale and retail categories) was developed, which asked retailers the following questions:

Table 3.10. Private hauliers with plans for future composting infrastructure.

	%	n
Centralised facility	40	2
Other	20	1
None of the above	40	2

- How much is being produced?
- Who are the main producers?
- Who are the end users of the products?
- What standards need to be met?
- What potential exists for new products?

3.3.3 Results

3.3.3.1 Wholesale Survey

A list of 64 individual bulk suppliers was compiled and wholesale prices were obtained through conversations conducted over the phone. Twenty-eight (43.75%) were able to provide figures that were relevant to this survey. Eleven (17.2%) suppliers sold products other than soil improvers or growing media (e.g. peat as a fuel, etc). Eight (12.5%) suppliers were no longer in business. Four suppliers (6.3%) sold compost to the mushroom industry only. Thirteen (20.3%) suppliers could not be contacted.

The results from the survey are presented in Table 3.11.

Table 3.12 presents average wholesale bulk prices for 2001. As can be seen from the data presented, there is a considerable variation in the price per litre of the products currently on the market. Peat is the least expensive to buy at just over 0.93 cent/l, compared with just under 3.35 cent/l for alternative products.

Table 3.11. Results from wholesale survey.

Product	Contacted	Used for analysis
Peat moss	38	13
Multi-purpose compost	9	8
Alternative amendments	6	4
Topsoil	16	8

Table 3.12. Average wholesale prices (bulk) for 2001.

Products sold in bulk	Average price/ litre	n
Peat Moss	0.93 c	8
Multi Purpose Compost	–	–
Alternative Amendments	3.35 c	1
Topsoil	1.65 c	8
Spent Mushroom Compost	–	–
Other	–	–

Table 3.13. Average wholesale prices (bagged) for 2001.

Bagged products sold	Average price/litre	n
Peat Moss	2.01 c	7
Multi-Purpose Compost	4.04 c	7
Alternative Amendments	4.87 c	3
Topsoil	–	–
Spent Mushroom Compost	–	–
Other	–	–

Table 3.13 presents average wholesale bagged prices for 2001. The situation is similar to wholesale bulk prices, with peat being the most cost effective at almost 1.6 cent/ litre. This increases to approximately 3.85 cent for alternative products.

Alternative Products

The alternative products currently available on the market in Ireland are derived from a variety of materials, and include bark, recycled garden waste, source-separated waste, Guinness brewery grains and barley.

3.3.3.2 Retail Survey

Retail surveys were conducted in person by visiting garden centres throughout the country. Seventeen garden centres were visited and price and product information for bagged products were recorded. A consistent range of products was selected and costed at each garden centre. This information was utilised to establish a cost per litre for various products. There were no bulk products at garden centres.

As can be seen from Table 3.14, the retail price of organic amendments is consistently higher than the wholesale price as expected.

Table 3.14. Average retail prices.

Product	Average price/litre	n
Peat moss	4.92 c	17
Multi-purpose	9.09 c	27
Ericaceous	5.44 c	5
Bark	6.86 c	5
Cocoa shell	10.85 c	1

3.3.4 Assessment

The range of pricing per cubic metre (i.e. 1000 litres) for PBMW compost (2001 figures) would be: €9.30–33.50 for wholesale bulk, €20.00–48.75 for wholesale bagged and €49.23–108.50 for retail bagged.

These prices represent the potential selling prices for PBMW compost.

3.4 Survey of Sectoral Organisations

3.4.1 Introduction

Utilising the broad categories of compost utilisation identified in the literature review, various sectoral organisations were identified and contacted. These groups are producers of organic amendments and users of organic amendments. There was some overlap between the two groups.

3.4.2 Method

A list of sectoral organisations was compiled from the 2001 Administration Yearbook and through discussions with organisations identified from the 2001 Administration Yearbook. A telephone survey was developed to determine the existing amounts of organic amendments produced in Ireland and the areas in which PBMW compost could potentially be utilised.

The questions asked included:

- What quantity of organic amendments is being produced in the sector?
- What quality or other product standards need to be met?
- Who are the end users of the products?
- What tonnage or land area available for use of organic amendments including PBMW compost is available?
- What potential exists for new products?

All sectoral organisations were contacted by telephone and it is important to note that not all questions were applicable in each case. The outcomes of the communications are dealt with in the following sections.

3.4.3 Results – Production of Organic Amendments

Table A1.9 (Appendix 1) lists organisations contacted to discuss the production of organic amendments.

3.4.3.1 Peat Production

In the Republic of Ireland, there are roughly 1.17 million ha (11,757 km^2) of peatland (Bather and Miller, 1991; Shier, 1996), of which 6972 ha are used for the production of horticultural peat (Bather and Miller, 1991).

From the telephone surveys it was concluded that approximately 2,000,000 m^3 of horticultural peat are extracted in a good harvest year (Table 3.15) in Ireland. Up to 100,000 m^3 horticultural peat are produced in Northern Ireland. Approximately 500,000 m^3 (125,000 tonnes) are used for horticultural markets in Ireland (including Northern Ireland) (van Schie, 2000). The remainder is exported, primarily to the UK and continental Europe.

Attributes of Peat

Peat combines a number of physical, chemical and biological attributes (Table 3.16), which make it suitable for many types of use.

Uses of Peat

Approximately 500,000 m^3 of peat are utilised in Ireland for horticultural purposes on an annual basis (van Schie, 2000). It can be used in three main ways, i.e. as a soil conditioner, as mulch or as an ingredient in growing media.

In the UK, at least 85% of peat produced is sold as growing media, and in Ireland this figure is approximately 55%. In most countries with a horticultural industry, peat extracted from raised bog is the basic constituent of growing media.

Table 3.15. Annual horticultural peat extraction.

Volume m^3	Reference
1,600,000	Bather and Miller (1991)
2,000,000	Schmilewski (1996)
1,800,000	Shier (1996)
1,826,000	van Schie (2000)

Bord na Móna

Bord na Móna have peat resources to last for the next 25–30 years. They own 10% of the total area of bog in Ireland, which includes 25% of the raised bogs in the Midlands. In 1998/1999, Bord na Móna extracted 385,200 t (1,540,800 m^3) of milled peat for horticultural purposes (Bord na Móna, 1999). Ninety percent of annual extraction is exported to the UK.

3.4.3.2 Manure Production

The most recent estimate of manure production in the Republic of Ireland indicates that cattle, sheep, pigs and poultry produce 108 million t of manure annually. Of this, just over 40 million t require management as the manure is collected during the indoor feeding period (Carton, 2001).

Attributes of Animal Manure

Animal manure has many attributes that have made it suitable for use:

- High in organic matter
- High nutrient content containing N, P and K
- Contains plant-available S and Mg
- Ideal water-holding capacity

Table 3.16. Attributes of peat. Source: Schmilewski (1996).

Physical	• good cellular structure • good water holding capacity • good aeration • low bulk density • easy to process, grade and blend
Chemical	• high organic content • low salinity • low pH • buffer capacity • low nutrient content
Biological	• free from pathogens and pests • free from seeds and plant propagules • no microbial activity
Economical	• readily available in large volumes • consistent quality • relatively inexpensive • cheap to transport

- Ideal aeration.

End Use of Animal Manure

The primary management option for manure is land spreading and this is likely to remain the same in the future. At present, there is limited composting of animal manures. Poultry manure is used to make compost for the mushroom industry.

3.4.3.3 Mushroom Production

The mushroom industry in Ireland produces €108 million worth of mushrooms per year, of which 70% are exported (Maher *et al.*, 2000). The industry is widely distributed throughout the country but with a greater concentration in Counties Monaghan and Cavan.

The production of mushrooms involves the utilisation of compost manufactured from wheaten straw and poultry manure with the addition of gypsum and calcium sulphate. This is then composted and pasteurised before being spawned with mushroom mycelium and filled into 20-kg bags. When the mycelium have colonised, a 5-cm peat and limestone layer (casing layer) is placed on top, which induces the formation of mushrooms. The mushrooms can be harvested after 1 week and harvesting continues for 5–6 weeks.

Spent Mushroom Compost (SMC)

Approximately 280,000 t of compost were used in the production of mushrooms by the industry in 1998 (Maher *et al.*, 2000). This amount probably has not changed in the last 2 years. Loss of dry matter as a result of cropping is roughly 50 kg/t of fresh compost with a dry matter content of 30%. However, this loss is countered by the addition of the casing layer, so the weight of SMC is very similar to the weight of the incoming fresh compost (Maher *et al.*, 2000).

Attributes of Spent Mushroom Compost

Spent mushroom compost displays many traits including:

- relatively low bulk density
- high moisture content
- high organic matter content
- moderate plant nutrient content.

SMC does, however, have high electrical conductivity (i.e. high salt content) and can contain organisms that are potentially pathogenic to actively growing mushrooms.

End Use of Spent Mushroom Compost

Spent mushroom compost is primarily utilised by the landscaping sector as a soil improver. It has also been used as part of the remediation process for contaminated land, returning nutrients to the soil after the contamination has been removed.

Over one-third of the mushroom industry is based in the Monaghan/Cavan area resulting in a surplus of SMC relative to demand. In this region, large quantities with no end use have the potential to cause a pollution problem and local authorities are anxious to find a solution. In these instances, SMC has been sent to landfill for disposal. However, in areas like Wexford, where there is a lot of arable farming and a small percentage of mushroom production, there is a shortage of available SMC.

3.4.3.4 Bark Production

Approximately 130,000 t of bark are produced annually in Ireland (Prasad, M., 2001, Bord na Móna, pers. comm.). Most of this is sent to pulp or OSB mills for production of chipboard and OSB board. Relatively little composting of bark chips takes place in Ireland and these products are generally imported from Northern Ireland and the UK. Coniferous softwood is utilised for the production of bark chips.

Attributes of Bark

Bark has many attributes that have made it suitable for use:

- good drainage properties
- weed barrier
- resistant to decomposition
- uniform appearance
- low nutrient content (discourages weeds).

End Uses of Bark

Bark is used in the landscaping industry primarily as either a soil improver or as mulch due to its ability to suppress weeds. It can also be used as a percentage of

some mixes for nursery stock in containers and in propagation media for cuttings (DETR, 2000).

One retail chain in the UK has been successfully selling over 40,000 m^3 of composted bark as a growing medium (Prasad, M., 2001, Bord na Móna, pers. comm.; Keating, D., 2001, Bord na Móna, pers. comm.).

3.4.3.5 Assessment

Table A1.10 (Appendix 1) shows annual organic amendment production in Ireland. Horticultural amendments are produced specifically for commercial sale. Manure, which represents almost 99% of organic amendments produced, represents an on-farm management issue and as such will not compete directly with PBMW compost outlets. Spent mushroom compost represents a waste product that requires management. It may compete directly with PBMW compost for outlets.

There are approximately 535,000 t of organic amendments that could compete with PBMW compost outlets.

3.4.4 Results – Utilisation of Organic Amendments

Table A1.11 (Appendix 1) shows organisations contacted to discuss the utilisation of organic amendments.

At the conclusion of each description of the results from each segment (i.e. horticulture, agriculture, land remediation, forestry), there is a subsection entitled 'Potential for Compost Use'. Estimates of the amount of PBMW compost that could be used in each segment were developed. Section 3.4.4.6 describes 'Other' potential PBMW compost uses. An estimate of PBMW compost use was similarly developed. A conservative approach was taken in terms of capturing existing market shares, available land area, and compost application rates. An estimate of total available PBMW compost outlets is generated in Section 3.4.4.7.

3.4.4.1 Horticulture

Peat is the main product used as an organic amendment in the horticultural sector. The main uses of peat in this sector are as a growing medium, as a soil improver or as mulch. The area of land currently under horticultural crop production is 9038 ha (Teagasc, 2001a). Amateur or home gardeners are the main users of growing medium products, whereas soil improvers and mulches are used extensively in landscaping or by local authorities.

The total value of organic amendments used within the horticultural industry in Ireland is approximately €9.50–10.15 million (McGlynn, A., 2001, Bord Glas, pers. comm.; Harrington, K., 2001, Irish Commercial Horticultural Association, pers. comm.). These figures primarily represent peat and bark and are split between commercial growers (45%) and retailers (55%).

Irish Commercial Horticultural Association

This organisation is a commodity section of the Irish Farmers Association and represents the interests of vegetable, fruit and crop growers in Ireland. They noted that the main organic amendments used in the horticultural industry are predominantly of peat-based products. The main product used by growers is peat. SMC is the main soil improver used by landscapers. SMC has a relatively low monetary value.

Bord Glás

Bord Glás is the Irish Horticultural Development Board, and is responsible for assisting and promoting all aspects of horticulture in Ireland. It also has a statutory role in relation to the horticultural content of the annual Teagasc programme of research, training and advice. Bord Glás directed the authors to many useful contacts and publications.

Roads

Compost use on road verges, etc., represents a potential landscaping type use of compost. The National Development Plan 2000–2006 outlines future plans for road development in Ireland. Total planned investment in national roads will be €5.57 billion during 2000–2006 (NDP, 2000). A total of 575 km of additional motorways and dual carriageways developments are proposed for the 2001–2006 period. In the remit for the development of a new section of major roadway (i.e. motorway or dual carriageway), provision is made for 3 m of verge-way on either side of the road (Hughes, H., 2001, NRA, pers. comm.). PBMW compost could be utilised in this area. In the process of road development, large areas of topsoil are removed. This topsoil is later used for landscaping when the roadway has been completed. This tends to

largely eliminate the need for other materials in this sector. Similarly, compost could be utilised along existing road verges, etc.

On occasion when there is a shortage of available topsoil, other materials are used. Compost would be ideal for use in these instances. Mass removal of topsoil also leaves the subsoil vulnerable to erosion, and where there are road embankments with a slope higher than 2H:1V, there have been problems with erosion under conditions of heavy rainfall (Hughes, H., 2001, NRA, pers. comm.). Research by the US Department of Transportation on newly constructed intersections showed that use of compost resulted in an increase in the growth of fescue grass and a reduction in erosion due to the ability of the compost to improve the infrastructure of the soil (US EPA, 1997). Other research being carried out in Iowa over a 3-year period is currently showing that compost can be used as a viable alternative to conventional erosion control methods (Codner, 2001). Erosion of roadway embankments by rain has been a significant problem and analysis 1 year into the study has shown that the compost absorbs the water, thereby reducing runoff. Foliage also displays strong root development, which will bind the soil and prevent erosion. In Texas, a similar project was conducted to establish vegetation growth on roadway embankments where wind erosion was causing problems. Compost made from animal manures and green waste was mixed with grass seed and applied at a depth of 3 in. Within 2 months, grass was growing on soil that had been barren for over 30 years (McCoy and Cogburn, 2001).

Potential for Compost Use

Peat products dominate the market within the Irish horticultural sector. Peat is a widely accepted product and for this reason it has acted as a barrier to alternative products in the past.

SMC is also used for soil improvement where available, and bark is used as mulch. Composted bark is used as a growing medium and peat diluting agent. PBMW compost can be utilised in the horticultural sector as a replacement or diluting agent product. Given that 125,000 t of peat and 130,000 t of bark compost are used annually in Ireland, this market will be limited. An achievable goal would be for PBMW compost to supplant 20% of existing organic amendments used in this sector. In terms of peat and composted bark, this would amount to 55,000 t annually. In the future this could be expanded by obtaining a greater proportion of the market share or through expansion of the size of the market.

On a per km basis, assuming a minimum 3 m of verge on either side of the road, there should be 0.6 ha/km of grassland. Assuming that 20 t/ha (as is) are used, this equates to 12 t/km of road. No annual estimates are made here.

3.4.4.2 Agriculture – Conventional

One of the eight strategic areas highlighted under 'Agriculture' in the National Development Plan is "improving the environment at farm level". Under the Agenda 2000 Agreement, the integration of environmental concerns is central to the CAP Reform element and, in future, all farmers receiving EU aid under CAP or under the Structural Funds must practice farming in accordance with minimum EU and national environmental requirements (Drennan, P., 2001, Department of Agriculture, pers. comm.). Under the CAP Rural Development Plan, approximately €1899 million is being made available for the Rural Environment Protection Scheme (REPS). Funding of roughly €186 million is being made available for the Farm Waste Management Scheme (NDP, 2000). Almost 4.5 million ha of land are used for agriculture in Ireland. Of this, 80% is devoted to grass, 11% to rough grazing and 9% to crop production.

Department of Agriculture

The Department of Agriculture is responsible for the implementation of the REPS and the Farm Waste Management Scheme. It is not responsible for legislation that deals with the quality of water, air and soil. The Department was able to provide information on animal manure production and handling, and additional fertiliser utilisation within this sector, agricultural land use, and agricultural output in Ireland.

Teagasc

Teagasc provide a research, advisory and training service for the agricultural sector in Ireland. They also provided information on animal manure production and handling, soils, forestry and organic farming in Ireland.

Potential for Compost

In the agricultural sector the main potential outlets for compost are as a soil conditioner, as a source of nutrients and perhaps as a suppressant of weeds and some plant diseases. However, it may be difficult to enter this market because of the availability of other products and the fact that Irish soils for the most part are not deficient in nutrients. In addition, the agricultural sector is not typically in a position to pay a high price for compost.

Approximately 1.25 million ha are in some form of agricultural production. The land that would benefit most from PBMW compost application is the estimated 400,500 ha devoted to crop production. Approximately 12,500 ha/year (~3%) of this land is estimated to be available for PBMW compost application. Assuming an application rate of approximately 20 t/ha (as is), this sector could potentially utilise 250,000 t of compost annually.

3.4.4.3 Agriculture – Organic Farming

In Ireland, 32,000 ha are under organic management. The markets for organic produce are outlined in Table 3.17. Demand currently exceeds supply and 70% of organic food requirements are imported.

Since 1995 the EU organic market has grown by 15% annually. This does not hold true for Ireland because organic farming is currently insufficiently supported through REPS (Culleton, N., 2001, Teagasc, pers. comm.). This issue is being addressed in the current review of payments.

Irish Organic Farmers and Growers Association (IOFGA)

This association, otherwise known as the IOFGA, has approximately 800 members roughly 200 of whom are involved in crop production, varying in size from 2 to 200 polytunnels. Members of the association are required to use 100% organic products, which have been approved by the IOFGA. In order to achieve IOFGA approval, these products need to meet strict manure management, nutrient and heavy metal criteria. Proof of Genetically Modified Organisms (GMO) free status of all materials brought in from conventional sources will also be required. The above criteria are outlined in the standards developed by the association (IOFGA, 2000).

Potential for Compost Use

This sector could provide a major outlet for PBMW compost. Currently, there remains a nutrient deficit on organic farms after land spreading of manures (Culleton, N., 2001, Teagasc, pers. comm.). This deficit will need to be met by a 100% organic product, which has met IOFGA standards. PBMW would need to meet the standards set by the IOFGA. If PBMW compost were treated as manure, it would need to be approved by a Certification Panel prior to use. PBMW would need to be certified free of GMO. PBMW compost would need to meet IOFGA heavy-metal standards. IOFGA heavy metal standards are higher than typical PBMW compost standards.

If 10% of this land is available annually for PBMW compost application, then approximately 3200 ha/year will be available. Assuming an application rate of approximately 20 t/ha (as is), this sector could potentially utilise 64,000 t of compost annually.

3.4.4.4 Land Remediation

Contaminated Land

Soil contamination generally arises as a result of spillages, leaks and improper handling of raw materials, manufactured goods and waste products. In Ireland the most common types of land contamination are old gasworks, underground storage tanks, waste disposal and mining sites and associated tailing ponds (Brogan *et al.*, 1999). Table A1.12 (Appendix 1) shows the estimated number of historical sites whose activities are likely to

Table 3.17. Markets for organic products in Ireland.

	Value of market (€)	Share of market 2001	Planned market share by 2005
Dairy production	2.3 million	0.3%	5%
Drystock production	5.7 million	1.1%	5%
Vegetable production	8.9 million	2–3%	30% annual
Fruit production	1.3 million		growth

have resulted in soil and/or groundwater contamination. Table A1.13 (Appendix 1) shows existing sites that may pose a risk to soil and groundwater and whose activities are licensed or due to be licensed by the EPA (Brogan *et al.*, 1999). The estimate is based on existing knowledge of land contamination. Many of these activities are now properly managed, thereby reducing the risk to soil and ground water.

In the USA, experience has shown that a wide range of contaminants degrade rapidly in compost (US EPA, 1998). Studies have taken place on old mining sites, brownfield sites and soils contaminated with explosives. Composting techniques have in fact been used to remediate significant quantities of soil contaminated by US Army explosives manufacturing. Composting has achieved TNT reduction of up to 99.9%, resulting in significant cost savings over other methods of waste disposal (Block, 2001).

Compost can be used to remediate contaminated soils as part of a specific process. As part of the land restoration process, compost can be applied and used as a source of organic matter and nutrients. The market specifications for PBMW compost will be less rigorous than for PBMW compost that would be used horticulturally.

The area (hectares) of contaminated lands needs to be determined before an estimate of the magnitude of this potential outlet can be assessed.

Bogland Restoration

Bord Na Móna have plans to rehabilitate 50,000 ha of industrial cutaway bogland. This may represent an outlet for PBMW compost.

Potential for Compost Use

There is considerable potential for PBMW compost use in contaminated land remediation. However, the land area available is not as clearly defined as in other sectors. Estimates were not attempted.

Assuming that 50,000 ha of bogland were restored over 10 years, and that 20% was available annually for compost application, at a rate of 20 t/ha (as is), then this sector could utilise 20,000 t of PBMW compost annually.

3.4.4.5 Forestry

During the 1980s, afforestation objectives were primarily achieved by public forestry. However, expansion of afforestation was achieved in the 1990s through private, and in particular, farmer forestry (NDP, 2000). The Forest Service compiled the most recent statistics, regarding forestry in Ireland, in 2000. These figures indicate that forestry accounts for a total of 634,118 ha of land area in Ireland; 240,579 ha of this represents private forestry, with the remaining 393,539 ha denoting public/ state forestry (The Forest Service, 2000a). In total, in 1999, 12,667 ha of forestry were planted, almost 85% of which consisted of coniferous trees. In general, 2000–2500 conifers can be planted per hectare and between 3300 and 6600 broadleaves per hectare, depending on the species (The Forest Service, 2000b)

Nine percent of Ireland's land area is under forest, in comparison with an average of over 30% in Europe (NDP, 2000). The National provision for forestry for the 2000–2006 period, as outlined in the National Development Plan, is €734 million, of which €633 million will be co-funded under the CAP Rural Development Plan. The latter programme will support a planting agenda of 20,000 ha/year over the period of the plan. The focus will be on farm forestry, with grants for planting and maintenance as well as income support premiums.

Private and Public Forestry

There are currently just less than 400,000 ha of state forestry in Ireland. In addition, just over 13,000 private landowners planted almost 117,000 ha of forestry in the 10-year period from 1990 to 1999 (The Forest Service, 2000a). As mentioned, there are a number of measures in existence to make forestry a realistic option for farmers, and the number of landowners is expected to increase to 20,000 in the next 7 years (Teagasc, 2001b).

The current government target is for forest cover to account for 17% of total land in Ireland by 2035. This equates to the planting of 20,000 ha/year, as outlined in the CAP plan, although presently it is closer to 15,000 ha/ year (Doolan, P., 2001, Coillte, pers. comm.). To date, private planting has all been afforestation whereas state (public) planting has been reforestation, i.e. restocking of existing plantations.

Ballintemple Nursery, Carlow

Ballintemple Nursery in Carlow is operated by Coillte and is the main nursery for the forestry sector in Ireland. From communications with personnel, it appears that there is presently no use of organic amendments during either the nursery or replanting stages. Small amounts of nitrogen, potassium and phosphate are applied to the soil during planting, along with limited amounts of zinc and copper. In general, however, they try to match trees to each individual site and to keep fertiliser use to a minimum.

Coillte Teoranta

Coillte Teoranta is the main body responsible for forestry in Ireland. In the past, Coillte has experimented with organic amendments, i.e. sewage sludge, assessing its value as a soil improver and growing medium for trees. Trials were conducted on shallow impoverished soils, primarily in the Cork, Kerry, Limerick, Tipperary and Waterford regions (Doolan, P., 2001, Coillte, pers. comm.). When it rained, the material became slippery thereby conflicting with other Coillte land uses, i.e. hill walking, etc. and the trials were discontinued for safety reasons. Coillte believe that there is a potential market for composted PBMW compost within the forestry sector but employee concerns in terms of handling a waste-derived product would need to be addressed in advance.

The Forest Service

The Forest Service operates under the umbrella of the Department of the Marine and Natural Resources. In 1996, they published a report on the forestry sector entitled "*Growing for the Future*", which outlined the Government's targets for the development of forestry in Ireland up until 2035. These targets have been outlined in the preceding sections. The Forest Service also publishes forestry statistics on a regular basis, the most recent of which were utilised in this report.

Potential for Compost Use

The planned annual planting of trees represents a significant potential outlet for the utilisation of compost derived from municipal solid waste. The present plantation rate is approximately 15,000 ha/year, and the desired plantation rate is 20,000 ha/year for the next 30+ years. If 10% of this land is available annually for PBMW compost application then approximately 2000 ha/year will be available. Assuming an application rate of approximately 20 t/ha (as is), this sector could potentially utilise 40,000 t of PBMW compost annually.

The Christmas tree industry is also an area where compost could be utilised. A total of 1.5 million trees are harvested (and presumably planted) in Ireland annually, 0.5 million of which are sold in Ireland. These trees traditionally take 6–10 years to grow, depending on the species (Seddon, 2001). If 1 kg of compost was used on 10% of the planted Christmas trees annually, then this sector could potentially use 150 t of PBMW compost annually.

3.4.4.6 Other

Other potential uses of PBMW compost not covered above include an export market and niche uses such as biofilters and acoustic barriers.

Approximately 375,000 t of peat are exported annually. PBMW compost could enter this market as part of a peat extender or as a peat replacement. It should be noted that peat markets are very well established and PBMW compost will typically weigh more per unit volume than peat. If PBMW compost supplants 5% of the peat export market then 18,750 t of compost could be exported annually. It should be noted that this compost would have to be of exceptionally high quality.

3.4.4.7 Assessment

Estimates of the amount of PBMW compost that could be used in a sector were made. Table 3.18 shows these estimates. Estimates generated are based on conjecture. A conservative approach is taken in terms of obtaining existing market shares, available land area, and application rates (20 t/ha). It should be noted that these estimates do not include expanding existing outlets or creating new outlets that could result during the development of a PBMW composting industry.

Based on these estimates, approximately 447,750 t/year of PBMW compost outlets could be developed.

Table 3.18. Estimates of potential annual outlets for PBMW compost.

Sector	Estimated potential outlets (t)	Rationale
Horticulture	55,000	20% of existing horticultural peat and bark compost usage. No allowance made for usage on road verges.
Agriculture		
Conventional	250,000	PBMW compost is best used on cropland. There is an estimated 400,500 ha of cropland. Assumes 12,500 ha (~3%) of crop land available annually and is applied with 20 t/ha PBMW compost (as is)
Organic	64,000	Presently 32,000 ha in production. Assumes 10% of land in organic production available annually and is applied with 20 t/ha PBMW compost (as is)
Land remediation		
Contaminated lands	No estimate made	Need to refine estimate of hectarage requiring remediation Need to refine targets (i.e. timing) for land remediation
Bogland restoration	20,000	At least 50,000ha bogland requiring restoration.
Forestry	40,000	Assumes 10% of land in forestry production available annually and is applied with 20 t/ha PBMW compost (as is)
Other		
Export	18,750	Assumes 5% of annual 375,000 tonnes of horticultural peat exported annually
Total	**447,750**	

4 Applying a Marketing Model to the Marketing of PBMW Compost

4.1 Introduction

A marketing model was developed for PBMW compost. It is attached in Appendix 2.

By the year 2016, up to an estimated 334,000 t of PBMW compost will be produced in Ireland annually (Table 2.2). It was estimated that there are approximately 447,750 t (Table 3.18) of potential annual outlets for PBMW compost. Local authorities and the private sector will be PBMW compost producers.

In general terms, PBMW compost will be distributed into non-market and market outlets by local authorities and the private sector, respectively. Local authorities may in some instances develop market outlets for PBMW compost that they produce. Local authorities will produce PBMW compost through home composter programmes, on-site composting and centralised composting facilities. Additional PBMW can be diverted by means of reduction programmes such as grass recycling. It should be noted that a local authority composting programme does not need to be profitable, in a conventional sense, to be deemed viable and successful. It should however cost the same or less than existing means of waste management.

The private sector will produce PBMW at centralised composting facilities. The private sector will wish to produce PBMW compost profitably.

The resulting model was applied to the marketing of compost produced from PBMW and was completed by applying and synthesising information generated in the literature review, surveys and market study. In this section, the PBMW compost marketing model is applied by employing and synthesising information generated in the literature review, surveys and market study. The formulation of a final strategy emanates from this model application and is presented in Chapter 5.

4.2 Applying the Marketing Model

4.2.1 The Marketing Information System

A considerable portion of the study consisted of collecting baseline information.

4.2.1.1 Internal Information

Relevant literature was reviewed and summarised (Chapter 2). Relevant information included:

- An estimated 287,500–668,000 t of PBMW will need to be diverted from landfill by 2016 (Table 2.2).
- PBMW compost has many established positive attributes and uses.
- The main sectors for PBMW compost use are horticulture, agriculture, land remediation and forestry.
- PBMW compost has some barriers to its use.
- Legal and Market Standards may help PBMW compost overcome barriers to its use.

4.2.1.2 Market Research

The following market research was undertaken:

- Local authority survey
- Private hauliers survey
- Retailers of organic amendments survey
- Sectoral organisations survey
- Wholesale organic amendments survey
- Retail organic amendments survey.

The research focussed on:

- the amount of PBMW compost presently being produced,
- the types of products with which PBMW compost would have to compete,
- the potential sectoral users of PBMW compost.

The information generated was summarised in Chapter 3.

Relevant information included:

- Approximately 11,000 t of PBMW compost are produced in Ireland (2002) – see Table 3.7.

- All compost is produced in conjunction with local authority programmes (i.e. home or centralised composting).
- The main organic amendments with which PBMW compost will need to compete include peat, manure, mushroom compost and bark.
- Wholesale prices (2001) for existing organic amendments ranged from 0.9 to 4.9 c/l (or €9–49/ m^3).
- Retail prices (2001) for existing organic amendments ranged from 4.9 to 10.9 p/l (or €49–110/m^3).
- The estimated quantity of organic amendment type products currently produced (annually) in Ireland is 535,000 t (Table A1.10, Appendix 1).

The value of the horticultural organic amendment (peat and bark) is estimated to be €10,130,000 annually.

4.2.1.3 Market Intelligence

There may be some latitude to work with suppliers of horticultural peat. Although there remains a 30-year supply of peat in Ireland, there is pressure to reduce peat utilisation because of sustainability questions.

There are presently great challenges with regard to utilising spent mushroom compost. There may be latitude to work with producers of spent mushroom compost to develop completed compost products.

In terms of organic amendment usage, it appears that the forestry and land remediation sectors are largely untapped.

4.2.1.4 Information Analysis

Presently any PBMW compost that is produced is done so in the context of local authority programmes. This trend may continue although it is likely that the private sector will also develop a composting infrastructure. The latter will depend on tipping fees for final disposal (i.e. landfilling, thermal treatment).

The most obvious market sectors for PBMW compost are horticulture, agriculture, land remediation and forestry. The most financially lucrative market sector appears to be the horticultural market (i.e. growing media, protected crops and outdoor crops).

It seems inconceivable that PBMW compost will be able to displace all existing horticultural products. Given the homogeneity and cleanliness of the products (i.e. peat and bark), PBMW will have to be collected separately prior to composting for the resultant PBMW compost.

PBMW compost will have to meet relevant legal standards. At present there are no formal standards in Ireland. There are draft standards (i.e. EU), which may be utilised. PBMW compost will have to meet relevant market guidelines, whether formal or informal. Consideration will need to be given to attaining legal and market standards prior to developing a composting facility.

4.2.2 Internal and External Analysis

A SWOT analysis (see Appendix 2) is utilised to describe the internal and external environment.

4.2.2.1 The Internal Environment

Strengths

The strengths of PBMW compost are drawn mostly from use of this product in jurisdictions outside of Ireland.

The main attributes of PBMW compost are that it is a source of:

- organic matter,
- slowly available plant nutrients (variable).

It can be used as:

- a soil conditioner
- a component of a growing media
- mulch.

PBMW compost already has a record of existing uses, including horticulture, agriculture, land reclamation/ remediation and forestry. PBMW compost will be viewed as an ‘environmentally friendly’ product. Although not the main determinant, this may sway consumers towards purchasing and utilising PBMW compost.

Weaknesses

The weaknesses of PBMW compost mostly arise from the fact that the main use of this product occurs in jurisdictions outside of Ireland.

In particular, a significant weakness is the lack of an existing PBMW composting industry/infrastructure in Ireland. However, this weakness can be turned into a strength if the pitfalls encountered by other jurisdictions with regard to PBMW compost production are avoided.

The main potential pitfalls are trying to produce compost from mixed waste, and producing compost without having a clear marketing plan.

A potential weakness is that a nascent PBMW composting industry will produce inferior products that may seriously hinder or irrevocably damage the potential marketing of this product.

PBMW compost is an unproven product in Ireland. The market will need to be convinced in order to purchase this product.

PBMW is a waste-derived product (public perception issues). Although a qualitative assessment, this negative perception may be countered by the positive perception that PBMW compost is **'environmentally friendly'**.

If the PBMW collection or subsequent composting is not properly managed, the compost may not be suitable for general use because of the presence of significant quantities of one or all of the following:

- heavy metals
- pathogens
- phytotoxicity
- non-biodegradable particulate matter (e.g. plastic, glass, metal).

4.2.2.2 The External Environment

Opportunities

There are a number of opportunities for PBMW compost.

- There are aggressive Government targets to divert PBMW from landfill.
- Composting is likely to be a major means of diverting PBMW compost.
- It is an 'environmentally friendly' product.
- It is a product produced from feedstocks generated by one of the main potential users (homeowners) of the product.

Threats

The main threats to marketing PBMW compost include the following:

- price-cutting or discounting of competitor products;
- excessive regulation with regard to PBMW compost production and application, which could result in uncompetitive product costs.

4.2.3 Market Segmentation and Targeting

Compost can be used as a soil conditioner, a component of a growing media, and a mulch. The uses of compost were described in Section 2.4.

Table A1.14 (Appendix 1) describes segments in which PBMW compost may be used. An indication of the general application of organic amendments within a segment is also given. This represents sub-segments in which PBMW compost may be able to compete. Table A1.15 (Appendix 1) describes the potential users within the sub-segments. This yields specific markets in which PBMW may be able to compete. An example of a specific market could be nursery production/private growers/soil conditioner or landscaping/local authorities/mulch. Table A1.16 (Appendix 1) describes the organic amendments presently used within sub-segments. Table A1.10 (Appendix 1) describes the estimated total amount of organic amendments currently produced/utilised in Ireland. Table 3.18 estimates the amount of PBMW compost that could potentially be used in the various segments.

It is useful to discuss the potential of PBMW compost within the various market segments.

4.2.3.1 Organic Amendments used in Horticulture

This segment can be divided into non-market and market outlets. It is likely that local authority programmes will distribute a large portion of PBMW compost into the horticultural amendment market through distribution to residents and internal use. The non-market outlets of PBMW compost will compete successfully with other existing organic amendments because the cost of these

products will likely be below market value. This compost may displace portions of existing organic amendment markets.

In terms of market outlets, PBMW compost will have to compete against the peat, bark and, to a lesser extent, the SMC market. The total annual horticultural peat market is estimated to be 125,000 t. The total annual horticultural bark market is estimated to be 130,000 t. PBMW compost should be able to obtain some of the market share of existing organic amendments.

The main products presently used are described below.

Peat

The horticultural peat market is strong and well established. There is an approximately 30-year reserve supply of horticultural grade peat. Peat is currently relatively inexpensive, but it is non-renewing. There is some pressure on peat producers to reduce peat production. Peat is homogeneous and uncontaminated. PBMW compost will have to be very well composted and uncontaminated, in terms of heavy metals and non-biodegradable particulate matter (plastic, glass and metal) etc., in order to compete with peat. If well composted and uncontaminated, then PBMW compost will have a high level of organic matter and will share some of the same qualities as peat. There has been some research conducted on peat extenders. These are other organic materials, which can replace a portion of peat in a given product. Up to 30% of a peat extender can be used.

- The PBMW compost producing industry should approach the peat industry and explore areas of cooperation.
- PBMW compost may be able to displace an amount of peat.
- It should be noted that PBMW compost will be heavier than peat and may add to transportation costs.

Spent Mushroom Compost

The SMC market is not well developed. At present, some is applied to agricultural land, some is sold into the organic amendment market, and some is disposed of. PBMW will be able to compete with SMC. Both products are composts, although prepared from different feedstocks and using different composting methods. The composts will be similar to each other. SMC has high electrical conductivity and may contain potentially pathogenic organisms from actively growing mushrooms. There has been discussion about setting up composting facilities to complete (i.e. cure) SMC. PBMW compost will have to be very well composted and uncontaminated, in terms of heavy metals and non-biodegradable particulate matter (plastic, glass and metal) etc., in order to compete with SMC. It may be prudent for the PBMW producing industry to approach the mushroom growing industry and explore areas of cooperation. Composting facilities could perhaps be jointly constructed. PBMW and SMC could be blended in order to produce a useful end product

There is some risk that, because SMC occasionally represents a significant disposal issue to the mushroom growing industry, resulting products may be heavily discounted, thus making it difficult for PBMW compost to compete. However, if SMC compost is modified for use as a horticultural amendment, those costs will likely be included in the sale of any product.

- The PBMW compost producing industry should approach the mushroom industry and explore areas of cooperation.
- PBMW will be able to compete with SMC

Bark

Bark is largely used as mulch although it is also used as a soil improver. In the UK large quantities of compost bark are used as a growing media or peat diluting agent. It is a homogeneous and clean product. PBMW compost will have to be very well composted and uncontaminated, in terms of heavy metals and non-biodegradable particulate matter (plastic, glass and metal) etc., in order to compete with bark. Compost mulches produced from green wastes should be able to compete successfully with bark if they are free of plastics and other contaminants.

- PBMW compost mulches will be able to compete with bark mulch.

Other

There is a relatively small market of 'Other' organic amendments. 'Other' organic amendments include manufactured composts such as animal manure composts. PBMW compost will be able to readily compete against this market because the market is not well established and because PBMW compost will be similar to some of the 'Other' existing products.

- PBMW compost will be able to compete effectively against 'Other' organic amendments.

PBMW Compost in the Horticultural Amendment Market

Horticultural amendments tend to be:

- homogeneous
- contaminant-free.

PBMW compost, due to its nature, will not be as homogeneous as existing organic amendments. However, a proper composting process can result in the production of products of consistent standard. Contaminants can be avoided by ensuring that they are not introduced into the feedstock. In order to produce compost that can compete in the horticultural amendment market, PBMW should be collected in a source-separated fashion. The cost of removing visible contaminants can be high and its effectiveness is not perfect. Heavy metal and chemical contamination cannot be removed once it is introduced.

PBMW compost will have a high level of organic matter and will share many of the qualities of peat. In terms of bark, PBMW compost will be able to compete with it as a mulch. PBMW compost can also compete with horticultural amendments by focussing on unique attributes. Unique attributes include:

- higher nutrient content;
- pH close to neutral;
- potential disease suppressive qualities.

To effectively compete against existing horticultural amendments, new amendments need to be developed. These new products should focus on selling the unique attributes of PBMW compost.

PBMW compost can be distributed to non-market and market outlets for horticultural amendments. The horticultural amendment market will be the most financially lucrative market outlet for PBMW compost, but also the outlet with the most demanding specifications.

4.2.3.2 Organic Amendments used in Agriculture

Manure

Manures represent a management issue as opposed to the deliberate manufacture of a product. Manures produced on a farm are almost exclusively reused at the farm. PBMW compost, although it can be used as a soil conditioner on agricultural lands, will not likely have any commercial acceptance for farming operations in which manure is produced. This is because manures require management. Management entails applying manures to agricultural land. It should be noted that manures and other organic amendments are utilised in the organic farming sector.

Spent Mushroom Compost

SMC is similar to PBMW compost although it will need to be utilised in a similar market as PBMW compost because the land-holdings of mushroom producers are not sufficient to handle all that is produced. Some SMC is applied to agricultural land. PBMW compost may have to compete with SMC, in some instances, to be applied to agricultural land.

PBMW Compost in the Agricultural Amendment Market

Manure, the dominant agricultural amendment, is a source of organic matter and available nutrients. Manures often have a high moisture content. Their nutrients are sometimes 'too available' and can result in leaching and groundwater problems. PBMW compost has undergone a stabilisation process. The resultant product is dryer than manure. The nutrients, which are largely incorporated in the organic matter, are released slowly over time.

Agricultural lands can accept slightly lower quality in terms of parameters such as salts and pH compared to its use as a horticultural amendment. PBMW compost will not necessarily have to be as finely screened.

PBMW compost can compete as an agricultural amendment by:

- ensuring that it is free of contaminants.

Relevant attributes of PBMW compost compared to agricultural amendments include:

- lower moisture, and
- nutrients available slowly over time.

PBMW compost may be used in areas where little manure is produced, soil levels of organic matter are naturally low, and where there are groundwater quality issues with regard to applying manures. However, it is important to note that this is not likely to be a financially lucrative market outlet, when compared to the horticultural amendment market.

Organic farming represents a potentially important market outlet for PBMW compost. The demands of this market outlet segment may be higher than for conventional agriculture.

4.2.3.3 Organic Amendments used in Land Remediation

This segment is currently not well developed in Ireland. It includes contaminated sites, bog restoration and landfill cover/capping. It can be seen from Table A1.16 (Appendix 1) that organic amendments are not currently used in this sector to any great extent.

PBMW compost could potentially be used in this sector. The quality demands will not be as great as for other sectors, and inferior PBMW compost could be used.

PBMW has the following relevant attributes:

- Organic matter
- Nutrients available slowly over time
- Relatively low moisture.

This is not likely to be a financially lucrative market although there is the potential to develop lucrative niche markets.

4.2.3.4 Organic Amendments used in Forestry

It can be seen from Table A1.16 (Appendix 1) that organic amendments are not presently used in this sector to any great extent. It is expected that 20,000 ha of forest will be planted annually for the next 30–50 years (until 17% of total land in Ireland is planted). PBMW compost can potentially be used as a soil conditioner on land that will be planted with trees and as a soil conditioner and growing media for seedling growth. It may also be used as mulch. This is a potentially major outlet for PBMW compost. Quality requirements will not be as high as for horticultural amendments and will be similar to those required for agriculture. This segment will require some development. Trials using PBMW compost should be carried out. This is not likely to be a lucrative market although lucrative market niches could be developed (i.e. as a growing amendment). PBMW compost could also be used for the growing of Christmas trees and in the biomass sector.

4.2.3.5 Other Potential Uses

PBMW compost may have other uses. The development of an export market may be a possibility. A considerable portion of Europe, for instance, has soils that are deficient in organic matter (Marmo, 2000). However, most of these countries also face challenges with regard to diversion of PBMW from landfill and would likely produce their own PBMW compost. One may have to look further afield to countries where organic matter is low and production of potentially compostable wastes is also low.

Other non-soil improvement or plant growth uses include biofilters, acoustic barriers, and landfill cover. These are potential uses, and probably localised, and would not result in the use of significant quantities of PBMW use. Other previously unknown uses could also be developed. It is likely that most of these other uses would be developed by the private sector for market outlets.

4.2.3.6 Market Targeting

The market segments for PBMW compost are horticulture, agriculture, land remediation, forestry and other. The sub-segments are soil conditioner, component of a growing media and mulch. The potential users are private growers, semi-state growers, local authorities, government authorities, homeowners, private landscapers, and farmers. PBMW compost will be produced by local authorities and private companies. Local authorities will tend to produce compost for non-

market (i.e. not-for-profit) outlets, whereas private companies will produce compost for market (for profit) outlets.

Local Authorities

Local authorities should target the horticultural market within their jurisdiction. This can be split into internal use and re-distribution to homeowners within their jurisdiction.

Local authorities may wish to examine potential agricultural, land remediation, and forestry markets within or close to their jurisdiction. These markets will not be available in all local authority jurisdictions. It will probably not be feasible to transport PBMW compost to other jurisdictions due to transportation costs. Local authorities should most likely sell compost in bulk.

Private Sector

The private sector may aim to create profit-generating end-market outlets. In terms of targeting, it is prudent to aim for the most lucrative market. The most lucrative market is the horticultural amendment market. A private sector operator may wish to directly target a specific horticultural amendment market (e.g. nursery production).

Alternately a staged approach to entering this market may be taken.

The organic amendment market can be split into:

- bulk market;
- bagged market.

A bagging operation requires additional infrastructure.

All of the segments using horticultural amendments (e.g. greenhouse production, etc.) can accept compost in bulk. For a private operator starting out, the following market segments should be pursued:

- bulk sale to homeowners
- bulk sale to landscapers.

The PBMW compost can then be used for home gardening needs, landscaping needs, and soil amendment needs. Once these markets have been established and proven, the private operator may wish to pursue private and semi-state growers (greenhouse and nursery). With time, a bagged market can be developed. One must have confidence in the product being produced.

Marketing compost in bulk vs. bagged format depends on the return that is expected and the amount available for investment in capital equipment. More importantly though, it involves an assessment of the market prior to developing a composting facility and deciding what type of product(s) will be produced prior to development of the composting facility. Value can potentially be added to PBMW compost by developing specific blends of organic amendments.

Agricultural, land remediation and forestry segments should be examined. It is not likely that these will be lucrative market outlets. However, they may represent markets through which a high volume of compost can be utilised. They may also represent markets in which a niche can be developed (e.g. organic farming, Christmas trees).

Product Position

The customer needs to view PBMW compost as a product comparable to what they are presently using. It is important that they are aware of additional attributes such as nutrients and disease suppressive qualities. The intangible asset of PBMW compost being an ‘Environmentally Friendly’ product whose feedstocks were supplied by those utilising/purchasing the product should not be underestimated.

4.2.4 Market Cycle

PBMW compost is essentially a new product in Ireland. By 2016, up to 334,000 t of PBMW compost could be produced annually (see Table 2.2).

The product/market expansion grid (Ansoff, 1957) is a useful means of identifying growth opportunities. This shows four routes to growth:

1. Market penetration – bringing existing products to existing markets.
2. Market development – bringing existing products to new markets.
3. Product development – bringing new products to existing markets.

4. Diversification – bringing new products to new markets.

Market Penetration

PBMW compost is essentially a new product in this jurisdiction.

Market Development

PBMW compost is essentially a new product in this jurisdiction.

Product Development

PBMW compost is essentially a new product in this jurisdiction. It has been successfully produced and marketed in other jurisdictions. The existing market in this jurisdiction is the horticultural and agricultural amendment market. As discussed in Section 4.2.3, the horticultural amendment market will be more lucrative than the agricultural amendment market.

Diversification

PBMW compost is produced and marketed in other jurisdictions. This fact can be used to introduce PBMW compost to new markets. New markets include soil remediation and forestry. Other potential new markets include the export market, and potential compost uses.

PBMW compost is essentially at the 'Introductory Stage' of the product life cycle.

4.2.5 Determining the Marketing Mix

The core variables of successful marketing include product, price, place and promotion. To successfully market PBMW compost it is necessary to determine the marketing mix that will maximise the probability of exchanges between customers and potential customers with PBMW compost rather than other organic amendments.

Product

PBMW is an organic amendment. It will compete in existing organic amendment markets and will be developed in new organic amendment markets. Existing users of organic amendments will use the product if it is comparable to existing products and in particular if it demonstrates desirable attributes that existing organic amendments do not possess.

New organic amendment markets can potentially be developed. The attributes that PBMW compost will confer to these new markets will be similar to those conferred by existing organic amendments as well as any additional desirable attributes unique to PBMW compost.

There is the potential for non-amendment markets to be developed although they will probably tend to be niche markets. Potential customers will need to be convinced that PBMW compost is useful and that this new market is a real market.

Price

Local authorities that generate PBMW compost will probably use it internally or return it to residents. Internal costs may be applied for PBMW compost (i.e. one department may charge another department). Residents will probably not be charged, or charged a nominal fee. It is suggested that PBMW compost should not be given away, so that even if a nominal fee is charged, users understand that the product has some monetary value.

The value of PBMW compost used in agriculture, land remediation and forestry will vary according to locality and will have to be determined. It is important to assign some monetary value to the product.

The private sector will wish to generate PBMW compost for a profit. These products must be priced similarly to existing horticultural amendments in order to compete. Preferably, PBMW will cost less than existing horticultural amendments whilst the market is being established.

PBMW compost will have a lower price when it is used in potentially large volume applications such as agriculture, land remediation and forestry. It is unlikely that a significant monetary value will be assigned to the product in conventional agriculture, as there are a considerable number of manures that must already be managed. It may be possible to develop more lucrative niche market outlets for the aforementioned (e.g. organic farming, Christmas trees).

In any case it is not likely that the price charged for PBMW compost will be higher than that charged for horticultural amendments.

It should be noted that the development of new products (i.e. blends) might be one manner in which to develop high value PBMW compost products.

Promotion

Potential customers of PBMW compost need to know the following:

- PBMW compost is comparable to existing horticultural amendments.
- PBMW compost has additional attributes that existing horticultural amendments do not have.
- PBMW compost is safe to use.
- PBMW compost is 'Environmentally Friendly'.

Communication with the market can be accomplished by the following methods:

- demonstration projects;
- advertising campaign to discuss/demystify products;
- high profile acceptance of product.

Place

PBMW compost will be most easily marketed within the local jurisdictions in which it is produced. This will also serve to minimise transportation costs. It is likely that local authorities will market compost in this manner.

Smaller private sector generators of PBMW compost will likely market compost in the local jurisdiction within which it is produced. Larger generators of PBMW compost may also want to exploit national markets and perhaps international markets.

5 Strategy for Developing Stable, Adequate and Reliable Outlets for PBMW Compost

5.1 Introduction

This strategy to develop adequate, stable and reliable markets for PBMW compost involves the synthesis of baseline data-gathering as well as the development and application of a marketing model for PBMW compost.

The following facts have been ascertained:

- Up to 334,000 t of PBMW compost will be produced annually by 2016.
- Annual organic amendment (e.g. peat, bark, etc.) production is 535,000 t (Table A1.10, Appendix 1).
- Estimates of potential annual outlets for PBMW compost are 447,750 t (Table 3.18).

The focus of this strategy centres on using PBMW compost in the market segments identified and described in Chapters 2, 3 and 4. Those segments are organic amendment markets in:

- horticulture
- agriculture
- forestry
- land remediation
- other uses (non-organic amendment uses).

The strategy encompasses both market and non-market outlets for compost. In simple terms this refers to profit and not-for profit markets. Many of the elements of the strategy overlap between these two outlets. Elements relating to specific market or non-market outlets are dealt with separately.

Both local authorities and the private sector will be involved in the production of PBMW compost. The local authorities will probably produce PBMW compost for a non-market outlet although some may develop market outlets for their product. The private sector will produce PBMW at centralised composting facilities. The private sector will wish to produce PBMW compost profitably.

A strategy is presented below in a hierarchal format, from a macro to micro-view.

5.2 Strategy

5.2.1 Hierarchy of PBMW Compost Usage

It is useful to develop a hierarchy of how PBMW compost should be used. Figure 5.1 depicts such a hierarchy.

This hierarchy combines elements (i.e. minimisation, re-use and recycling) of the waste hierarchy as described by the EPA (2000), and links them to market segments. Producers of PBMW are at the top of the hierarchy. This is consistent with elements of the waste hierarchy (i.e. minimisation and re-use). Producers of PBMW are likely to use the resultant compost in a horticultural manner. Producers of PBMW include homeowners, and the uses of compost could encompass home use and also amenity use by local authorities from whose jurisdiction the PBMW is collected and composted.

The production of crops includes the horticultural, agricultural and forestry segments. This is consistent with the recycling element of the waste hierarchy. Use of compost as a soil improver can be linked to land remediation. This is consistent with the recycling element of the waste hierarchy. Other uses include using compost as daily cover at landfills. However, this is the least favoured use for PBMW compost. This should be avoided where possible, since the effort to manufacture this product is not commensurate with the return.

Cases where incoming waste is biologically treated at a landfill prior to emplacement should be referred to as ‘treatment’ rather than composting so as not to confuse potential consumers of PBMW compost.

It should be noted that there are some exceptions in the ‘other category’ that do not fit into the hierarchy. Niche uses such as biofilters and acoustic barriers are potentially good uses of PBMW compost. The export market is another potential venue for PBMW compost

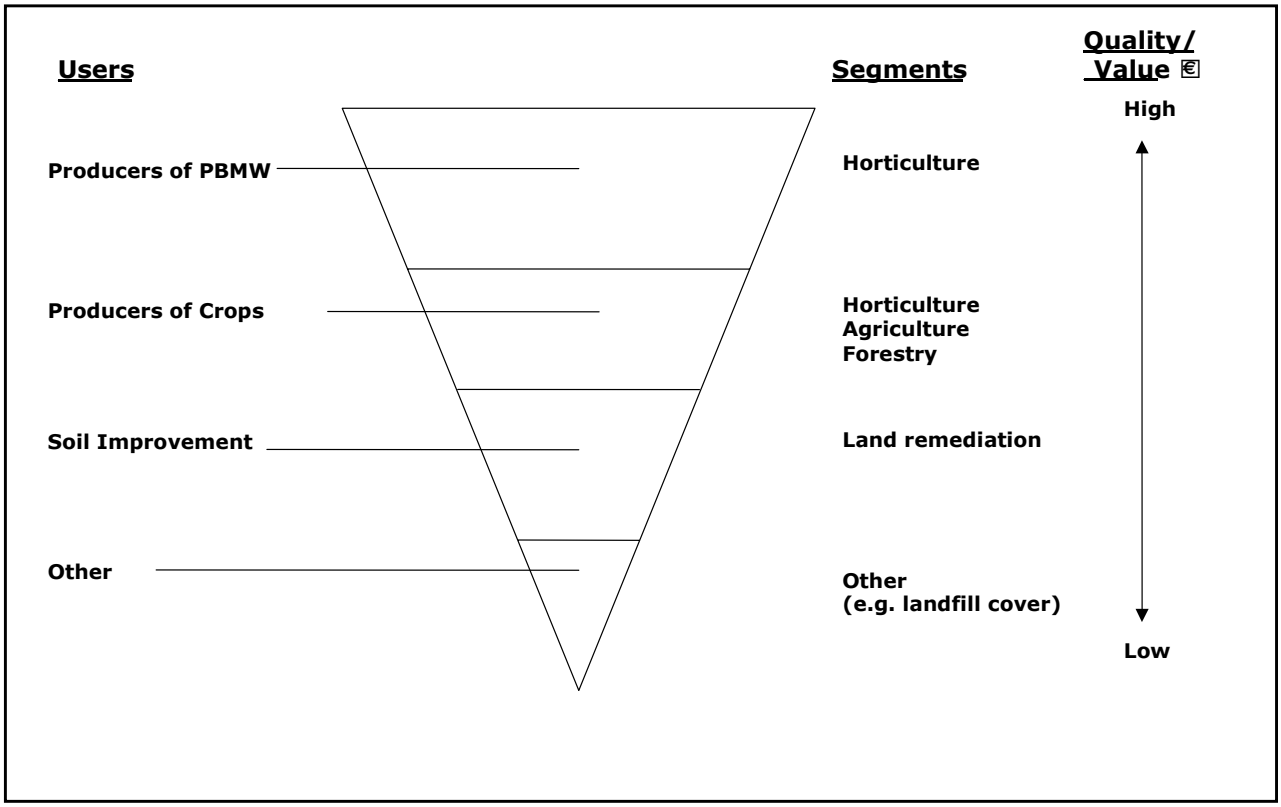

Figure 5.1. Hierarchy of PBMW Compost Utilisation.

although it would require considerable economic investment to develop. Compost sold into an export market would likely be used in a horticultural context.

The hierarchy of PBMW compost utilisation can be correlated with quality requirements and the potential monetary value of PBMW compost. Local authorities or private contractors considering composting PBMW should consider developing markets in the order of the hierarchy. This is logical for local authorities because they are collecting and composting their residents' PBMW. In the case of the private sector, the generators of PBMW (i.e. householders) represent one of the more lucrative markets (i.e. horticulture segment).

Strategy

- **Develop PBMW compost market based on the hierarchy (i.e. Fig. 5.1).**

5.2.2 Order of PBMW Composting Infrastructure Development

PBMW composting infrastructure development should progress in an orderly fashion. The expertise developed during one step should be used to ensure success at the next. In specific terms it would be prudent for local authorities to follow an order of PBMW compost infrastructure development.

Infrastructure development should begin with a home composting programme. The costs of collection and composting are largely avoided. It is relatively easy, and it familiarises the public with the concept of compost and compost use. It is estimated by the authors that 25%, or about 300,000 Irish homes, could have a home composter.

Centralised composting of green wastes could be developed concurrently or after a home composting programme. In terms of centralised composting, the technologies required are typically less sophisticated and the operation easier than for composting a full range of PBMW (including food). Centralised composting of a full range of PBMW (including food) should be developed once the requisite expertise has been developed.

Taking incremental steps ensures that the public develops a familiarity with PBMW compost and composting. It also allows for the development of the expertise necessary to produce high quality PBMW compost.

Strategy

- **Local authorities should initiate PBMW compost infrastructure development with home composting and then proceed to centralised green waste composting and, finally, centralised composting of a full range of PBMW (including food wastes).**

5.2.3 Economic Value of PBMW Compost

In many respects the composting of PBMW must be thought of as product manufacturing rather than a waste diversion activity.

5.2.3.1 General

If one views composting simply as a waste diversion activity then little attention may be paid to ensuring the quality of the product. If little attention is paid to ensuring the quality of the product then the value of the product, in both a utilisation as well as a monetary sense, will be low.

Many have taken the view that PBMW compost will only be suitable for low-grade uses such as for landfill daily cover or as part of final site remediation. This may very well be a use for PBMW but should be far from the first line of attack in terms of developing markets for PBMW compost. Marketing for the lowest common denominator will inevitably result in that type of compost being the best quality compost that is produced. Quality is described in Section 5.2.4.

The strategy should be to strive to produce PBMW compost for the 'highest common denominator' – which means for the highest quality and potential monetary value. This translates into the horticultural segment as described in Chapter 4 and the producers of PBMW as described in Section 5.2.1.

Strategy

- **Strive to produce PBMW compost suitable for producers of PBMW (i.e. horticultural uses).**

5.2.3.2 Local Authorities

Local authorities are required by legislation to manage waste on behalf of their residents. Their goal is to manage this waste in a cost-effective manner. Composting by local authorities will be feasible if the costs are the same or less than conventional waste management. The compost product could help defray some of the costs of composting. Regardless, it is important that local authorities cultivate an appreciation of some monetary value for PBMW compost in their residents. A common model for communities with a PBMW diversion and composting programme is to give away the compost to their residents. Although this is a useful way in which to thank residents, it does not make them appreciate that this product has some monetary value. A fee of some sort should be assigned to the distribution of the product. An alternative to the local authorities receiving the fee would be to involve local community groups in a 'compost value' day whereby the community groups would be the recipients of the proceeds of compost distributed to residents.

Strategy

- **Give value to PBMW compost by assigning a monetary fee for this product.**

5.2.3.3 Private sector

The composting of PBMW should be viewed as product manufacturing. However, there are two potential revenue streams:

1. A tipping fee assigned to handle a waste product
2. Product sale.

This document has focussed on the marketing of the product. However, it is very important to note that a tipping fee can defray a considerable portion of facility capital and operating costs. The sale of the product can defray any remaining capital and operating costs and make the operation profitable.

It is also important to produce a product for which the highest possible monetary value can be attained. Recognising that this will be commensurate with the level of inputs (i.e. into product manufacturing), a balance will need to be struck between the amount of capital infrastructure and practical operating costs and

the product that one wishes to produce. The highest quality compost, in terms of product and packaging, will cost more to produce.

Strategy

- **Ensure that both revenue streams (tipping fee and product sale) are exploited.**
- **Strive to produce PBMW compost that will have the highest possible monetary value.**

5.2.4 Quality

To produce a product that has monetary value requires that the product has certain qualities that will facilitate 'exchange relationships'.

5.2.4.1 Quality of PBMW Feedstock

A high-quality feedstock is necessary for manufacturing a high quality product. It is clear from other jurisdictions that the only way to meet the relevant standards in a practical manner is through source-separated collection of PBMW.

Home composting programmes naturally focus on composting source-separated PBMW. New centralised programmes will have to ensure that PBMW is source-separated. In this regard, it would be advantageous to preferentially develop the infrastructure to compost source-separated PBMW, which is outlined in many Regional Waste-Management Plans.

Strategy

- **Collect and treat only source-separated PBMW for composting.**

5.2.4.2 Quality of PBMW Compost

PBMW compost will be a new product in this jurisdiction. There is no shortage of organic amendments in this jurisdiction. In order for PBMW compost to compete with existing organic amendments, it must exhibit similar qualities. In particular PBMW compost must be contaminant free, i.e. free of chemical contaminants such as heavy metals, biological contaminants such as pathogens, and non-biodegradable particulate matter (e.g. glass, metal and plastic). In addition, it will be important to accentuate the unique attributes of PBMW compost, including:

- its use as a soil conditioner,
- its use as a source of plant nutrients (released slowly over time), and
- its potential plant disease suppressive qualities.

Formal compost standards are not in place although limits for various parameters are entrenched within relevant waste licences. A European Commission "Biological Treatment of Biowaste" working document has been developed. It is critical that compost standards be developed and adopted.

Given a high-quality source-separated feedstock (See Section 5.2.3.1), it is important to ensure that the composting process will result in compost that has similar qualities to existing organic amendments, as well as the ability to develop unique and potentially marketable attributes. Reasonable process management requirements, monitoring and end-product requirements should be developed. It may be useful to develop a guide to assist producers of compost in making a high-quality product.

It should be noted that any legislative requirements will focus on ensuring environmental protection. Market-driven quality requirements will focus on addressing various market needs. PBMW compost manufacturers will have to understand and address both legislative and market-driven requirements. It may be useful to develop a guide for producers describing market-driven quality requirements.

Strategy

- **Develop Irish compost standards in line with international best practice.**
- **Develop reasonable compost facility process management requirements.**
- **Ascertain and disseminate market-driven quality requirements to PBMW compost producers.**
- **Inform public of compost standards and compost quality, pointing out the differences.**

5.2.5 Facilitating Outlet Development

The production of PBMW compost will not be due to natural market forces, i.e. the market has not previously considered that PBMW compost would create sufficient 'exchange relationships' to make it a viable product. The

production of PBMW compost will be largely due to complying with government policy. This government policy may result in up to 334,000 t of PBMW compost being produced by 2016 (see Table 2.2). Although in reality there are sufficient potential outlets for PBMW compost to be utilised, in many cases they need to be facilitated.

5.2.5.1 National Procurement Policy

In the same manner that waste diversion is promoted through policy, the utilisation of the product can be facilitated via policy. The policy can be simple or comprehensive. A simple policy would dictate that government bodies utilise PBMW compost in relevant areas. Relevant areas and amounts of compost to be utilised would have to be defined. A more comprehensive policy would be to enlarge the scope of the procurement policy. A policy should be predicated on a product of acceptable quality (Section 5.2.3).

Strategy

- **Develop a government procurement policy for compost produced from PBMW.**

5.2.5.2 Local Authority Procurement Policy

Local authorities will probably produce a significant quantity of the PBMW compost. It will be prudent for them to set up systems whereby the finished product is utilised. This procurement policy can be developed on a local authority or regional basis. A policy should be predicated on a product of acceptable quality (Section 5.2.3).

Strategy

- **Local authorities or regions developing composting programmes should develop a procurement policy for compost produced from PBMW.**

5.2.5.3 Horticultural Peat Replacement Policy

In the UK, 40% of current peat-based products used horticulturally are targeted to be replaced by non-peat products by 2004 (DETR, 1998). Ireland should develop a similar policy. Peat is a non-renewable, and therefore finite, resource. Good quality PBMW compost can potentially be used as a 'peat extender' (i.e. mixed with peat).

Strategy

- **The government should develop a horticultural peat replacement policy for Ireland in which 25% of current peat-based products are targeted to be replaced by non-peat products within a prescribed time period.**

5.2.6 Marketing Strategies

National policy will potentially result in the production of a significant quantity of PBMW compost. To create exchange relationships, the consumer must be confident that this is a product worth trying (i.e. one exchange) and the product should be developed such that the consumer will want to purchase it on a regular basis (i.e. multiple exchanges).

5.2.6.1 Certification

Consumers of products need to have some level of confidence as regards product consistency. A certification programme should be developed to facilitate the development of consistent PBMW compost. The focus of the certification should be on environmental and market standards. A seal or certificate could be awarded to producers whose compost conforms to the certification programme.

Strategy

- **Develop certification programme for compost produced from PBMW.**

5.2.6.2 Marketing Plan

The marketing of a product has to be a very conscious act, not an afterthought. All producers of compost, whether they be local authorities or the private sector, should develop a marketing plan prior to the setting up of a composting facility. The marketing plan should be an integral part of decision-making with regard to developing a composting facility. It would be useful for the government to develop a guide that could be used to help those considering developing a composting facility. The guide should present means to at least:

- Determine potential markets,
- Determine the quality requirements of potential markets,
- Determine the value of potential markets,

- Determine the distance to potential markets.

Strategy

- **Develop a handbook for the development of a marketing plan for those wishing to develop a compost facility that composts PBMW.**
- **Develop a marketing plan for PBMW compost prior to developing a composting facility.**

5.2.6.3 Linkages with Producers and Potential Users of Organic Amendments

Horticulture

Peat Producers

Peat is by far the dominant organic amendment used in the horticultural segment. In 2001, approximately 125,000 t of horticultural peat were used in the Republic of Ireland. A considerable amount of peat is exported. The peat industry is under some pressure because peat is not self-renewing and is therefore a finite resource. There may be scope to work with the peat industry to develop 'peat extenders', i.e. products that can be mixed with peat without detracting and possibly enhancing the quality of the final product. The specifications that would be required by peat producers would be very rigorous. If PBMW compost is to be used as a peat extender, it will have to conform to the same rigorous specifications. Elements of the peat industry are undertaking research-based work on peat extenders.

Strategy

- **Investigate working with the peat industry to develop 'peat extenders'.**

Agriculture

Conventional Agriculture

The application of manures, in some instances, may result in leaching of nutrients to the detriment of the ground water. The nutrients in compost are released slowly over time. Compost utilisation may be preferable in certain instances.

Strategy

- **Investigate working with the agricultural industry to identify possible uses of PBMW compost.**

Organic Farming

The organic farming industry is growing rapidly in Ireland. At present, there are an estimated 32,000 ha in production. This is expected to increase with time. There may be some scope to work with this industry sector.

Strategy

- **Investigate working with organic farming industry to identify possible uses of PBMW compost.**

Spent Mushroom Compost Producers

At present there are approximately 280,000 t of compost being produced annually, requiring management. In some cases the spent mushroom compost is not being managed properly. There may be some scope for working with the mushroom industry. It may be possible to set up composting facilities for PBMW that could also be used to 'finish' spent mushroom compost. The resultant compost or compost blends could be marketed together.

Strategy

- **Investigate working with the mushroom industry to co-market compost.**
- **Investigate working with the mushroom industry to co-compost PBMW with spent mushroom compost.**

Land Remediation

Composting and compost utilisation can be employed in the remediation of lands. From a compost utilisation perspective this is probably the least defined segment identified. However, there are historic (395–429) and operational (1580–1942) contaminated sites in Ireland. There are at least 50,000 ha of bogland requiring restoration. There may be some scope for utilising PBMW compost for land remediation.

Strategy

- **Investigate working with the land remediation industry to identify possible uses of PBMW compost.**

Forestry

It is estimated that 20,000 ha of land will need to be planted with trees annually in order to meet afforestation targets. Nurseries will need to grow the trees. Both

potentially represent a viable market for PBMW compost.

There may be some scope for working with the forestry sector.

Strategy

- **Investigate working with the forestry industry to identify possible uses of PBMW compost.**

5.2.6.4 Promotion and Education

PBMW composting is relatively new in Ireland. To produce an acceptable product that will meet the quality requirements described in Section 5.2.3, it will be necessary to educate those that are going to produce PBMW compost. Given that PBMW compost is of an acceptable quality (Section 5.2.3), it still faces two significant barriers to its use:

1. It is a waste-derived product.
2. It is a new product in this jurisdiction.

It will be important to develop national and regional (i.e. close to where composting facilities will be developed) promotion and education programmes. It should be noted that PBMW is composted and successfully used in many jurisdictions outside of Ireland. A considerable amount of existing promotional and education information can be adapted to Ireland. It will be important to develop some 'Ireland-Specific' information.

Possible programmes include:

- A series of composting articles in the National media
- A 'how-to compost' and 'how-to use' compost section on radio and television gardening shows
- Composting/compost use awards as part of the 'Tidy Towns' competition
- Set up national multi-stakeholder group to promote proper composting
- Establish telephone hotlines to provide information on the availability, location, price and use of compost.

Strategy

- **Develop educational programmes for producers of PBMW.**
- **Develop promotion and education programmes for consumers.**

5.2.7 Conclusions

The development of stable, adequate and reliable market and non-market outlets for compost produced from PBMW has been suggested by the authors in developing a hierarchy of users (Fig. 5.1). Producers of PBMW present the most stable outlet for PBMW compost. Producers of biomass (i.e. crops), land remediation, and other uses will create sufficient demand to ensure that, in conjunction with PBMW producers, there are adequate outlets for PBMW compost. The development of PBMW composting infrastructure must take place in an orderly and incremental fashion so that public acceptability of PBMW composting and compost utilisation can develop.

Reliable and stable outlets can be developed if PBMW is produced in such a manner that it can be ascribed some value – monetary or otherwise. This can be brought about by ensuring that PBMW and the resultant compost are of the highest possible quality. Given this, there is an urgent need for environmental and marketing compost standards.

Given that the generation of PBMW composting is being driven by legislation as opposed to market forces, it would be useful to develop national and regional procurement policies.

Since there are considerable sources of existing organic amendments, as well as some potential large users of PBMW compost, it may be prudent to develop linkages with relevant industries that may be able to assist in developing outlets for PBMW compost.

Finally, PBMW composting and PBMW compost are relatively new to Ireland. Promotion and education will be necessary to ensure that good-quality compost is produced and that consumers will utilise PBMW compost.

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Appendix 1: Tables

Table A1.1. Attributes of compost produced from PBMW.

Attribute	Definition	References**
1. Soil Conditioner	A soil conditioner may enhance the quality of the soil. This is largely due to the amount of organic matter contained in compost.*	
Organic matter	Organic matter consists of animal and plant residues.* Compost contains a greater quantity of organic matter than is found in soils. Compost applications can result in an increase in organic matter content in soils. Most of the soil conditioning attributes are as a result of organic matter addition.	Farrell (2001) Le Villio *et al.* (2001) Mamo *et al*. (2000) Marmo (2000) Maynard (2000) Alexander (1999) DETR (1999) McConnell *et al*. (1994)
Soil aeration	The process by which air in the soil is replaced by air from the atmosphere.* Compost enhances soil porosity and aeration particularly in heavy clay soils.	Corti *et al.* (1998) McConnell *et al*. (1994) NRAES (1992)
Water-holding capacity	The ability of a soil to hold water. Compost addition can result in increased water-holding capacity especially in light soils.	Marmo (2000) Alexander (1999) Corti *et al.* (1998) McConnell *et al*. (1994)
Soil stability and aggregation	The cementing or binding together of several soil particles into a secondary unit, aggregate or granule.* Compost addition can result in increased soil stability and aggregation.	Rodrigues (1999)
Soil bulk density	The mass of dry soil per unit bulk volume.* Compost is typically less dense than soil and can result in a reduced soil bulk density.	Mamo *et al*. (2000) Alexander (1999) Corti *et al.* (1998) Rodd *et al.* (1998) McConnell *et al*. (1994) NRAES (1992)
Erosion prevention	The wearing away of the land surface by water, wind, ice or other geological agents.* The addition of compost can reduce erosion.	Codner (2001) Le Villio *et al*. (2001) McCoy & Cogburn (2001) Tyler (2001) Alexander (1999) Agassi *et al*. (1998) US EPA (1997) Maynard (2000) Corti *et al.* (1998) McConnell *et al.* (1994)
Soil pH	A numerical measure of the acidity or hydrogen ion activity of a soil.* Compost addition can increase soil buffering capacity regarding nutrients and pH.	Maynard (2000) Corti *et al.* (1998) McConnell *et al*. (1994)

Table A1.1 *(contd.)*. Attributes of compost produced from PBMW.

Attribute	Definition	References**
Cation exchange capacity	The sum total of exchangeable cations that a soil can absorb.* Compost application can result in an increased soil cation exchange capacity. Many plant nutrients are cations. Increased cation exchange capacity may result in additional nutrients being held in the soil rather than leaching out of the soil.	Raviv *et al*. (1998) Saharinen (1998) McConnell *et al*. (1994) NRAES (1992)
2. Nutrients	Major plant nutrients (macronutrients) include nitrogen, phosphorus and potassium. Micronutrients include copper, iron and zinc. Macronutrients and micronutrients are required for various aspects of plant growth. Compost can provide variable amounts of nutrients and micronutrients.	Cuevas et al. (2000) Maynard (2000) Spiers & Fretje (2000) Zhang *et al*. (2000) Alexander (1999) Grey & Henry (1999) Sikora (1999) Dublin Corporation (1999) Hicklenton (1998) Sullivan *et al*. (1998) Li *et al*. (1997) Rodd *et al*. (1996)
3. Disease Suppression	Composts may confer disease-suppressive attributes. Mechanisms of disease suppression include microbial antagonism (i.e. microorganisms in compost attacking disease microorganisms).	Hoitink & Krause (2001) Suárez-Estrella *et al*. (2001) Wickland *et al*. (2001) DETR (2000) Maynard & Hill (2000) Maynard (2000) De Ceuster & Hoitink (1999) DETR (1999) McCartney & Holden (1999) Ryckeboer *et al*. (1999) Widmer *et al*. (1999) Corti *et al*. (1998) US EPA (1998) Marull *et al*. (1997) Hoitink & Grebus (1994) NRAES (1992)

*Adapted from Miller & Donahue (1990).

**References that provide examples of the various PBMW compost attributes.

Table A1.2. Uses of PBMW Compost.

End Use	Reference	Type of Compost	Application	Application Rate (dry)	Nitrogen (units)
Horticulture	Prasad & Maher, 2001a	Greenwaste – peat compost	Component of peat-based growing media	Up to 20%	Not given
	Suárez-Estrella *et al.*, 2001	Greenwaste compost	Disease suppression. (Infected greenwaste was composted to kill off pathogens, making it suitable for re-use within industry)	Not given	Not given
	Block, 1999	Greenwaste compost	Growth of container shrubs and trees	Not given	Not given
	Chong, 1999	MSW* compost mixed with peat or perlite	Use of compost as a rooting medium amendment	Not given	Not given
	McCartney & Holden, 1999	Greenwaste – MSW compost	Disease suppression	A total 0.7 yd^3 / 1000 ft^2 over 6 months	0.84%
	O'Brien & Barker, 1995	MSW compost; Greenwaste compost	Production of turfgrass and mixed wildflower sods	5-cm thick layers on plastic	1%; 0.4–0.8%
	Ryckeboer *et al*., 1999	Greenwaste compost	Disease suppression at potting stage	90:5 – 80:20 v/v mixture	0.8–1.4%
	Smith, 1999	Greenwaste compost	Topdressing of turf areas and for disease suppression on the golf course	25, 50 & 100 lbs/ 1000 ft^2 over 3 weeks	Not given
	Corti *et al.*, 1998	MSW compost Greenwaste compost	Plant nursery use	Not given	Not given
	Hicklenton, 1998	MSW compost	Growing media for landscapers and nurseries	25, 50, 75 and 100% of volume	Not given
	Maynard, 1998	MSW – biosolids compost	Production of nursery stock	0, 25 and 50 t/acre (Soil amendment experiment) 100 t/acre (mulch experiment)	1.11%
	Klock, 1997	Greenwaste – biosolids compost	Growth of salt-sensitive bedding plants	Not given	15–152 µg/g
	Marull *et al.*, 1997	MSW compost	Disease suppression in tomato and pepper plants	33% of total dry weight	1.49%
	McConnell *et al*., 1994	MSW compost	Production of agronomic, horticultural and silvicultural crops	At least 15 t/acre	Depends on feedstock and technology
Agriculture	Alvarez *et al*., 2001	Greenwaste – sewage sludge – MSW compost	Crop, vegetable and fruit production	270–13,500 kg/ha	0.6–1.5%
	Burgos *et al*., 2001	MSW compost	Fruit production	40,000 kg/ha/year	Not clear
	Le Villio *et al*., 2001	MSW compost	Erosion prevention on agricultural land	1.25 t/ha/year	Not given
	Madrid *et al*., 2001	MSW compost	Growth of ryegrass plants	25 g/kg	Not given

Table A1.2 *(contd.)*. Uses of PBMW Compost.

End Use	Reference	Type of Compost	Application	Application Rate (dry)	Nitrogen (units)
	Humbert, 2000	Greenwaste compost	Vinegrowth crop growth	2 t/acre 3–4 t/acre	Not given
	Mamo *et al*., 2000	MSW compost	Crop production in well-drained soil	270 Mg/ha either all at once or in 3× 90 Mg/ha applications over 3 years	0.9%
	Maynard, 2000	Greenwaste compost	Tomato production	50 t/acre	Not given
	Maynard & Hill, 2000	Greenwaste compost	Onion production	50 t/acre	Not given
	Zhang *et al*., 2000	MSW-Biosolids compost	Crop production	50, 100 and 200 t/ha	0.5%
	Erhart *et al*., 1999	Biowaste compost	Fruit production	28–56 t/ha	1.06%
	Kirsch & Franken, 1999	MSW compost	Crop production	0–15 t/ha	1.13–1.25%
	Ozores-Hampton *et al*., 1999	Greenwaste – biosolids compost	Vegetable transplant medium in tomato transplant production	200-cell Styrofoam transplant flats (26 cm^3)	2.0–2.13%
	Parkinson *et al*., 1999	Greenwaste compost	Production of forage maize	0–50 t/ha	$\simeq$ 1.19%
	Sikora, 1999	MSW compost Dairy manure compost	For use as a fertiliser in agriculture	Test only – not applied	1.01$\pm$ 0.02% 1.42$\pm$ 0.01%
	Sikora & Enkiri, 1999	MSW compost fertiliser blends	To match the inorganic N requirement for tall fescue.	40–100 mt/ha	1–2%
	Widmer *et al*., 1999	MSW compost; MSW–wastewater residuals compost	Disease suppression	20% of total soil volume	10.7–17.1%
	Agassi *et al*., 1998	MSW compost	Mulching material to control erosion and soil runoff	100 m^3, 200 m^3 or 300 m^3/ha depending on treatment	1.05%
	Conrad, 1998	MSW compost	Crop production	100–400 t/ha	Not given
	Neilsen *et al*. 1998	Greenwaste compost	Fruit and vegetable production	45–90 mt/ha	Not given
	Rodd *et al*., 1998	MSW compost	Production of wheat and barley	0, 50, 100, 500 kg of plant available N per hectare	Not given
	Warman & Rodd, 1998	MSW compost	Vegetable production	6.2–26.7 t/ha	32. 6g/kg
	Li *et al*., 1997	MSW–biosolids compost	Crop production	25–250 Mg/ha	9.1–12.8 g/kg
	Henry, 1996	MSW compost	Potato production	11–21 t/ha	Not given
	Rodd *et al*., 1996	MSW compost	Crop production	0, 50, 100, 150 kg of available N per hectare	20.2 g/kg

Table A1.2 *(contd.)*. Uses of PBMW Compost.

End Use	Reference	Type of Compost	Application	Application Rate (dry)	Nitrogen (units)
Land Remediation	Block, 2001	Greenwaste – animal manure compost	Remediation of contaminated land	Not given	Not given
	Alexander, 1999	MSW compost	Reclamation of low-quality soils and contaminated land	25–175 t/acre	Not given
	Alexander, 1999	MSW compost	Revegetating wetlands	6–24 inch layer spread over a 62-acre site	Not given
	Gwinn, 1999	MSW compost with cow or chicken manure	Treatment of land contaminated with explosives	Not given	Not given
	Abiola & Olenyk, 1998	Cattle manure, wood clippings and straw	Reduction of hydrocarbons present in contaminated soil	Not given	Not given
	Stehouwer, 1997	Greenwaste compost	Direct revegetation of hyper - acidic coal refuse	Compost was mixed with coal refuse at rates of 0, 56, 112, 224 and 448 mg/ha	1.18%
	US EPA, 1997	Greenwaste compost	Remediation of a site contaminated with heavy minerals for crop production	20 t/acre for corn crops and 120 t/acre for peanut crops	Not given
Forestry	Alvarez *et al*., 2001	Greenwaste – Sewage sludge – MSW compost	Growth stage in nurseries and reforestation	8–26 litres per tree	0.6–1.5%
	Stuckey & Hudak, 2001	MSW compost	Pine tree growth	5, 25 and 50 t/acre	0.13%
	US EPA, 1997	Greenwaste, biosolids and MSW composts	Tree seedling in reforestation projects	2 inch mulch	Not given
Other	Humer & Lechner, 2001	MSW/Sewage sludge compost mixed with loam	Landfill cover to reduce methane emissions	30–90 cm depth	0.97–1.11
	Block, 2000	MSW compost	Landfill cover	60 cm layer	Not given
	Humer & Lechner, 1999	MSW compost	Landfill cover to reduce methane emissions	60 cm layer	Not given

*Municipal Solid Waste compost is the same as PBMW compost.

Table A1.3. Specific Uses of Compost.

Sector	Application	
1. Horticulture		
Nurseries		
	• Potting mixes	• Nutrient replenishment
	• Plant growth	• Sod production
	• Topsoil blend	• Tree production
Landscaping	• Sports fields	• Lawns
	• Cemeteries	• Garden areas
	• Topsoil supply	• Golf courses
Residential retail	• Vegetable gardens	• Flower beds
	• Community projects	• Window boxes
	• School play areas	• Lawns
Local authority	• Flower gardens	• Parks
	• Road development	• Picnic areas
Road development	• Roundabouts	• Motorway & dual carriageway verges
(soil amendment)	• Other planted areas	• Embankments
2. Agriculture	• Vegetable crops	• Land reclamation
	• Field crops	• Seeding
	• Nutrient replenishment	• Grass growth
3. Land Remediation	• Landfill cover/capping	• Contaminated sites
	• Nutrient-deficient sites	• Bogland remediation
4. Forestry	• Nutrient replenishment	• Land preparation
	• Weed reduction	• Sapling growth
		• Biomass crops
5. Other	• Acoustic barriers	• Export
	• Landfill cover/capping	• Biofilters

Table A1.4. Potential Barriers to Using PBMW Compost.

Barrier	Definition	References*
1. Heavy Metals	Compost may become contaminated by dissolved metals. The origin of these metals is largely from non-compostable materials in the compost feedstock (e.g. household hazardous waste).	McCartney *et al*., 2001 Zhang *et al*., 2000 Alexander, 1999 Hicklenton, 1998 Otten *et al*., 1998 Rodd *et al*., 1998 Ozores-Hampton *et al*., 1997 Bourque and Allard, 1996 Otten & Halet 1996
2. Pathogens	An agent causing a disease – plant or animal.	DETR, 1998
3. Phytotoxicity	Toxicity to plants. This can be caused by salts and organic acids that are generated during the composting process. Seedlings are most susceptible to phytotoxicity.	García-Gómez *et al*., 2001 Helfrich *et al*., 1998
Salts (Electrical Conductivity)	A by-product of the decomposition process that is largely dependent on salt concentrations of the incoming feedstock.	Cuevas *et al*., 2000 Mamo *et al*., 2000 Spiers & Fretje, 2000 Corti *et al*., 1998 Hicklenton, 1998 Otten *et al*., 1998 Klock, 1997
Organic Acids	A by-product of the decomposition process. Includes acids such as acetic acid (vinegar).	Helfrich *et al*., 1998 Brinton, 1998 Shiralipour *et al*., 1997
Pesticide Contamination	Pesticides will normally degrade during composting. If they do not degrade they may concentrate and result in phytotoxicity. This is not a common problem.	Strom, 2000 Alexander, 1999 Otten *et al*., 1998

*References that provide examples of possible barriers to compost use.

Table A1.5. Heavy Metals Limits (mg/kg) for European Countries with Compost Regulations or Standards.

Element	Countries[a]											
	A	**A[b] Class 2[c]**	**B Agr**	**B Park**	**CH**	**DK**	**F**	**D**	**I**	**NL**	**NL**	**SP**
Arsenic	–	–	–	–	–	25	–	–	10	25	15	–
Boron	100	–	–	–	–	–	–	–	–	–	–	–
Cadmium	4	1	5	5	3	1.2	8	105	105	2	1	40
Chromium	150	70	150	200	150	–	–	100	100	200	70	750
Cobalt	–	–	10	20	25	–	–	–	–	–	–	–
Copper	400	100	100	500	150	–	–	100	300	300	90	1750
Lead	500	150	600	1000	150	120	800	150	140	200	120	1200
Mercury	4	1	5	5	3	1.2	8	1.0	1.5	2	0.7	25
Nickel	100	60	50	100	50	45	200	50	50	50	20	400
Selenium	–	–	–	–	–	–	–	–	–	–	–	–
Zinc	1000	400	1000	1500	500	–	–	400	500	900	280	4000

Source: Adapted from Brinton, 2001

[a]**Country codes:** A: Austria; B: Belgium; CH: Switzerland; DK: Denmark; F: France; D: Germany; I: Italy; NL: Netherlands; SP: Spain.

[b]Calculated on 30% organic matter basis.

[c]**Notes:** Class-2 versus class 1 or class A versus AA; Agr: agricultural use; Park: horticultural use.

Table A1.6. Comparing "Biological Treatment of Biowaste" (2nd Draft) Proposed Environmental Quality Classes with the Canadian Bureau de Normalisation du Quebec (BNQ) Standard.

Parameter	Compost/Digestate		BNQ mg/kg dm	Stabilised biowaste (mg/kg dm)	BNQ
	Class 1	Class 2	AA, A		B
As			13		75
Cd	0.7	1.5	3	5	20
Co			34		150
Cr	100	150	210	600	1060
Cu	100	150	100	600	757
Hg	0.5	1	0.8	5	5
Mo			5		20
Ni	50	75	62	150	180
Pb	100	150	150	500	500
Se			2		14
Zn	200	400	500	1,500	1850
PCBs	–	–		0.4	
PAHs	–	–		3	
Impurities	<0.5% >2 mm	<0.5% >2 mm	≤ 0.01% (AA), 0.5 % (A) on an oven-dried basis Maximum dimension 12.5 mm	<3	≤ 0.01, 0.5% on an oven-dried basis Maximum dimension 25 mm
Gravel and stones >5 mm	<5%	<5%	–	–	–

Table A1.7. Draft Marketing Classifications.

Use	Salt Index	Particle Size (mm)	pH	C/N	Moisture (%)	Na (%)
Landscaping	<6	<12.5	6-7	12-22	<50	<1
Potting Soil	<2	<12.5	6-7	12-22	<25	<0.5
Greenhouse Soil Seeding	<2	<6.25	6-7	12-22	<25	<0.5
Greenhouse Soil Established	2-3.5	<12.5	6-7	12-22	<30	<0.5
Top Dressing	<5	<12.5	6-8	12-22	<30	<1
Home Owner use Amendment	<6	<12.5	6-7.5	10-30	<40	<1
Home Owner use Planting Media	<3.5	<12.5	6-7	12-22	<30	<0.5
Field Nursery	<3.5	<12.5	5.8-8	10-30	<50	<1
Soil Amendment	<20	<12.5	5.8-8	10-30		
Bulk	<20	<12.5	5.5-8	10-30		
Agricultural Soil Amendment	<20	<12.5	6-8	10-30	<50	<1
Remediation	<20	<12.5	5.8-8	10-40		

Source: Adapted from The Composting Council of Canada.

Table A1.8. Regional Waste Management Plans for composting.

Region	Home Composting	Greenwaste Composting	Organic Waste Composting/ Anaerobic Digestion
Dublin		Two additional facilities planned for composting green waste from parks and garden waste delivered to recycling centres by residents. Implementation 2000–2001	Source separation and collection of household organic waste to ultimately cover 80–90% of households. Use of composting or biological digestion to deal with waste. Implementation 2,002
Limerick/Clare/Kerry	Expansion of existing home composting schemes commencing 2001–2002 and continuing through to 2014		Dual collection of waste in towns with populations greater than 1000. Biological treatment plant to be constructed to deal with waste
North-East		Two greenwaste composting facilities to be constructed 2002–2003 to be expanded through to 2015	Biological Treatment Plant to be constructed 2,004–2,007. Scheme to be expanded through to 2,015
Connaught		Six facilities to be developed within duration of the plan for composting of green waste	Source separation and collection of organic waste in all urban areas from 2,003. This will extend to cover 50% of all rural areas. Two biological treatment plants will be developed to deal with waste
Midlands	Home composting to be initiated in rural areas 2001–2002 and expanded through to 2014	One new composting plant 2001–2002 increasing to 3 in 2003–2006	One biological treatment plant to be constructed for kitchen waste 2003–2006
Wicklow	To be initiated in rural areas 2003–2005. Expansion of scheme through to 2013		Separate collection for organics in urban areas – composting or biogas treatment to be implemented in 2003–2005. Expansion of scheme through to 2013
Kildare	Continued encouragement of home composting	The introduction of community-based composting	
South-East	Implementation of home composting with region seeking to divert 25% of household organic waste annually in the period 2002–2017. This target involves the provision of 40,000 composters in the region	A recycling target of 50% is proposed for green waste to be achieved by 2002 with provision of a central green waste composting facility	
Cork	Expansion of existing scheme distributing 1000 composters each year until 2004	Investigation into the possibility of establishing a composting facility	Facility to accept 60,000– 65,000 tonnes of waste per annum
North-West	In 2001, 5000 home composters will be distributed. Target of supplying 50% of households with gardens with home composters by 2005	By 2005, 2000 tonnes diversion, 10000 tonnes by 2013 and 20000 tonnes by 2020	

Table A1.9. Organisations Contacted - Production

Sector	Organisation
Peat Production	• Bord Glás • Bord Na Mona • The Peat Producers Association • The Irish Peatland Conservation Council • Central Statistics Office
Manure Production	• Department of Agriculture, Food and Rural Development • Teagasc • Central Statistics Office • Irish Organic Farmers and Growers Association
Mushroom Production	• Bord Glás • Teagasc • Irish Commercial Horticultural Association
Bark Production	• Teagasc • Department of Marine & Natural Resources • Coillte Teoranta • National Parks and Wildlife Services

Table A1.10. Annual Organic Amendment Production in Ireland.

Sector	Organic Amendments	Tonnes	Comments
Horticulture	Peat	125,000	Peat and bark are produced and sold commercially to the horticultural sector
	Bark	130,000	
Agriculture	Animal Manure	40,000,000	Manures that require management. Majority managed at the farm
	Spent Mushroom Compost	280,000	Requires management. Some used in horticultural and agricultural sectors
Land Remediation		Not applicable	
Forestry		See bark	
Total		**40,535,000**	
Production of Organic Amendments (Excluding manures)		**535,000**	

Table A1.11. Organisations Contacted – Utilisation.

Seector	Organisation
Horticulture	• Irish Commercial Horticultural Association • Irish Peatland Conservation Council • Bord na Móna • Erin Horticulture • Peat Producers Assocaition • Association of Landscape Contractors of Ireland • Irish Landscape Institute • Gardeners and Landscape Designers Association • Bord Glás • Teagasc • Central Statistics Office • Silvan Spawn Mushrooms
Agriculture (including organic farming)	• Dept. of Agriculture • Teagasc • Irish Organic Farmers and Growers Association • Irish Farmers Association • Central Statistics Office
Land Remediation	• National Roads Authority • EPA
Forestry	• Coillte Teoranta • Forestry Service (DoMNR) • Teagasc • National Parks and Wildlife Services • Dúchas – The Heritage Service

Table A1.12. Estimates of the Number of Historic Industrial Activities that may Pose a Risk to Soil and Groundwater. Source: Brogan *et al.*, 1999.

Historic Industrial Activities	Estimated Number of Activities
Old Gasworks Sites	50-80
Closed Non-Hazardous and Hazardous Waste Disposal Sites	203
Closed Mining Sites	128*
Old Fertiliser Plants (Manufacturing and Blending)	4-6
Closed Tanneries	10-12

*38 of these have tailing ponds.

Table A1.13. Estimates of the Number of Present Activities that may Pose a Risk to Soil and Groundwater. Source: Brogan *et al*., 1999.

Current Industrial Activities	Estimated Number of Activities
Existing Local Authority Landfills that are unlined or partially lined	74
On-site landfill sites under IPC Control	10
Mining sites in operation	4
Chemical Industry	150–160
Petroleum Import Terminals*	22
Petroleum Retail Stations with underground storage tanks**	900–1200
Tanneries	3
Timber Treatment Yards	150
Dockyards	14–16
Military Sites	1
Railway Depots	80–100
Scrap Yards and Dismantlers	180–200
Airports with Maintenance Facilities	2

*Does not include on-site industrial storage facilities.

**30–35% were constructed prior to 1979 Dangerous Substances Retail and Private Petroleum Stores Regulations.

Table A1.14 Market Segments and Sub-segments.

	Soil Conditioner	Component of Growing Media	Mulch
Horticulture			
Greenhouse production		√	
Nursery Production	√	√	√
Gardening	√	√	√
Landscaping	√		√
Soil Amendment (e.g. road development)	√		
Agriculture			
Crop Production	√		
Pastureland and Rough Grazing Production	√		
Organic Farming	√		
Land Remediation			
Contaminated Sites	√		
Bogland Restoration			
Landfill Cover/Capping	√		
Forestry			
Seedling Growth	√	√	
Planting	√		√
Christmas Trees	√	√	√
Other			
Export	√	√	
Potential uses (acoustic barriers, biofilters, etc.) – new sub-segments			

Table A1.15. Market Segments and User(s) of Organic Amendment(s) used in Sub-segments.

Segment	General Applications (Sub-segments)		
	Soil Conditioner	**Component of Growing Media**	**Mulch**
Horticulture			
Greenhouse Production		• Private growers	
Nursery Production	• Private growers • Semi-state growers • Local Authorities	• Private growers • Semi-state growers • Local Authorities	• Private growers • Semi-state growers • Local Authorities
Gardening	• Local Authorities • Home gardeners	• Local Authorities • Home gardeners	• Local Authorities • Home gardeners
Landscaping	• Private landscapers • Local Authorities • Home gardeners		• Private landscapers • Local Authorities • Home gardeners
Soil Amendment (e.g. road development)	• Local Authorities • Government bodies • Private firms		
Agriculture			
Crop Production	• Farmers		
Pastureland and Rough Grazing Production	• Farmers		
Organic Farming	• Farmers		
Land Remediation			
Contaminated Sites	• Government bodies • Local Authorities • Private firms		
Bog Restoration	• Government bodies • Local Authorities • Private firms		
Landfill Cover/Capping	• Local Authorities • Private firms		
Forestry			
Seedling Growth	• Semi-State Growers • Private Growers	• Semi-State Growers • Private Growers	
Planting	• Semi-State Growers • Private Growers		• Semi-State Growers • Private Growers
Christmas Trees	• Private Growers		• Private Growers
Other			
Export Market	• Private growers • Home gardeners	• Private growers • Home gardeners	
Potential Uses (acoustic barriers, biofilters, landfill cover, etc.) – new sub-segments	• Potential various	• Potential various	• Potential various

Table A1.16. Market Segments and Type(s) of Organic Amendment(s) used in Sub-segments.

Segment	General Applications		
	Soil Conditioner	**Component of Growing Media**	**Mulch**
Horticulture			
Greenhouse Production		• Peat	
Nursery Production	• Peat	• Peat	• Bark
Gardening	• Peat • SMC • Bark	• Peat • SMC • Bark	• Bark
Landscaping	• Peat • Bark		• Bark
Soil Amendment (e.g. road development)	• None		
Agriculture			
Crop Production	• Manures		
Pastureland and Rough Grazing Production	• Manures		
Organic Farming	• Manures		
Land Remediation			
Contaminated Sites	• None		
Forestry			
Seedling growth	• None	• None	
Planting	• None		• None
Christmas Trees	• None		• None
Other			
Export market	• Various	• Various	
Potential uses (acoustic barriers, biofilters etc) – new sub-segments	• Unknown	• Unknown	• Unknown

Appendix 2: Development of a Marketing Model for PBMW Compost

A2.1 Introduction

The development of adequate, reliable and stable outlets for PBMW compost requires the development of a marketing strategy. This chapter serves to:

- Define marketing
- Present a market development model.

It is clearly recognised that a marketing model will have to address market outlets (i.e. for profit) and non-market outlets (i.e. not for profit). This marketing model was applied to developing a National/Global marketing strategy (Chapter 4).

A2.2 Marketing Defined

A number of definitions of marketing have been developed.

- Understanding and anticipating customer needs, providing benefits and satisfactions to meet those needs, ensuring consistent quality and customer satisfaction, retaining existing customers, attracting new ones while achieving organisational goals (Woodruffe, 1995).
- The process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchanges that satisfy individual and organisational objectives (Marketing News, 1985).
- The performance of activities that seek to accomplish an organisation's objectives by anticipating customer or client needs and directing a flow of need-satisfying goods and services from producer to customer or client (McCarthy and Perreault 1987).
- The set of individual and social activities concerned with the initiation, resolution, and/or acceptance of exchange relationships (Bagozzi, 1986).
- Individual and organisational activities that facilitate and expedite satisfying exchange relationships in a dynamic environment through the creation, distribution, promotion and pricing of goods, services and ideas (Pride and Ferrell, 1989).

More simply, marketing can be defined as:

- **"The process of *creating, resolving* and *maintaining mutually rewarding* exchange relationships."**

The goal of the marketer is to develop a strategy to maximise the probability of mutually rewarding exchange relationships among customers and potential customers with their own product, rather than with a competing product.

It is important to add a caveat to the above definition. The compost produced from PBMW will in many cases be produced by public entities who may not sell compost in market outlets. Because their mandate is different to, e.g., that of a private entity, they will be creating non-market outlets to distribute this compost. This marketing strategy encompasses this important reality.

A2.3 Market Strategy Development

A2.3.1 Introduction

The market strategy can be developed using the model in Fig. A2.1.

A2.3.2 Steps to Develop a Marketing Model

The following steps were used to develop a model for marketing PBMW compost.

Step 1. The Marketing Information System

The marketing information system involves the collection of existing and readily available information that may have a future bearing on the exchange relationship.

The information can be obtained from any of the following sources:

1. Internal information – existing sources of information within an industry (i.e. composting) that may have some bearing on introducing a product into a new

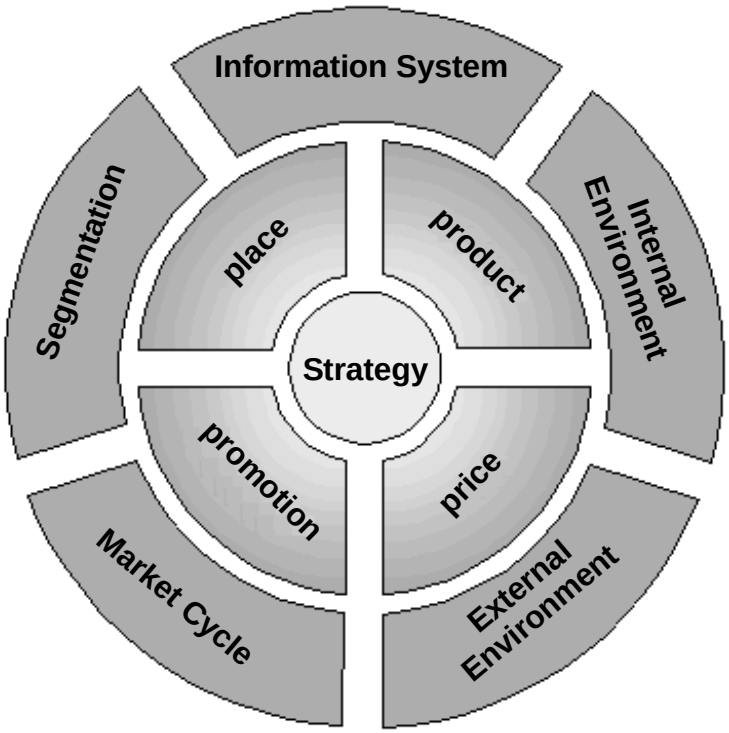

Figure A2.1. The marketing strategy.

jurisdiction. Internal information, although readily accessible, may lack relevancy in other jurisdictions.

2. Market research – the function that links the consumer, customer and public to the marketer through investigating existing and potential customer needs, wants and market opportunities. Research can involve finding out about market potential, market share, etc.
3. Market intelligence – information about the relevant business environment that will facilitate the development of a product marketing strategy.
4. Information analysis – the information that comes from the previous categories that may need further analysis or probing.

Step 2. Internal and External Analysis

A SWOT analysis is an analytical tool used to examine both the internal and external environments. SWOT is an acronym for examining the *strengths*, *weaknesses*, *opportunities* and *threats* of a product. This tool provides a good overview of whether a product's position is fundamentally viable or unviable. A product market strategy will use the **strengths** to exploit opportunities and manage **weaknesses** so that it is not exposed to threats. It is illustrated in Figure A2.2.

This situation analysis can be divided into two main areas:

1. The **internal analysis** examines the strengths and weaknesses associated with the product. A **strength** is a product attribute or an advantage over a competitive product that may enhance its competitiveness A **weakness** is a barrier to product utilisation and may detract from its competitiveness, although this may be largely rectified if the barrier is addressed
2. The **external analysis** examines the opportunities and threats associated with the product. An **opportunity** is an avenue open to the product for profitable growth and is a big factor in shaping strategy. A **threat** is an external event that may have a negative impact on a product's profitability, market standing or competitive strategy.

Step 3. Market Segmentation and Targeting

Setting the marketing strategy requires skilful and thoughtful dissection of the market in order to ascertain the potential customers most likely to be responsive to the marketing strategy. The most crucial task is to achieve synergy among the market selection and the elements of

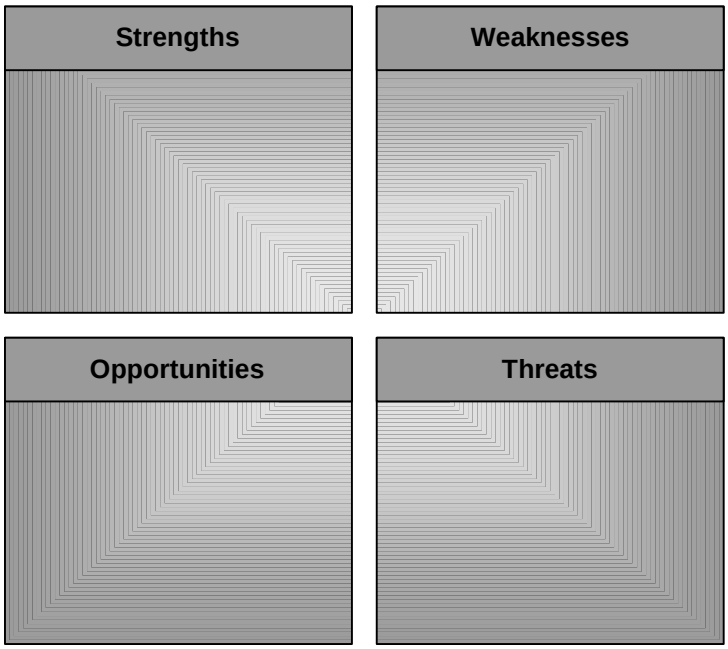

Figure A2.2. SWOT analysis.

the mix so that the maximum number of product–consumer exchanges will be produced. To accomplish this, one needs to segment the market, identify the target market(s), and attempt to make the product dominant in the mind of the customer.

Market segmentation is the process of dividing the market into distinct groups of buyers with different needs, characteristics or behaviour, who might require separate products or marketing mixes. Market targeting is the process of evaluating each market segment's attractiveness and selecting one or more segments to enter. The target market should be one where the firm has a differential advantage over the competitor. Product position is the way in which the product is defined by the customer, based on important attributes – the place the product occupies in the mind of the consumer relative to competing products.

Step 4. Market Cycle

The product/market expansion grid (Ansoff, 1957) shown in Fig. A2.3 is useful for identifying growth opportunities. This shows four routes to growth:

1. market penetration – bringing existing products to existing markets;
2. market development – bringing existing products to new markets;
3. product development – bringing new products to existing markets;
4. diversification – bringing new products to new markets.

This is illustrated in Fig. A2.3.

Markets are not static, as the volume and nature of customer demand changes over time. It has been suggested that the development of any market follows a common pattern, called the product life cycle (Fig. A2.4). Customers, and their tastes, will evolve with the market. As the market matures, it may begin to stagnate or decline. The marketer must constantly examine and adapt the marketing mix to prolong the product life.

Step 5. Determining the Marketing Mix

Theorists have long advocated the '4 Ps' – product, price, place and promotion – as the core variables of successful marketing. The combination of these variables is known as the marketing mix. Essentially, marketers seek to choose the marketing mix that will maximise the probability of exchanges among customers and potential customers using their product, rather than competing products.

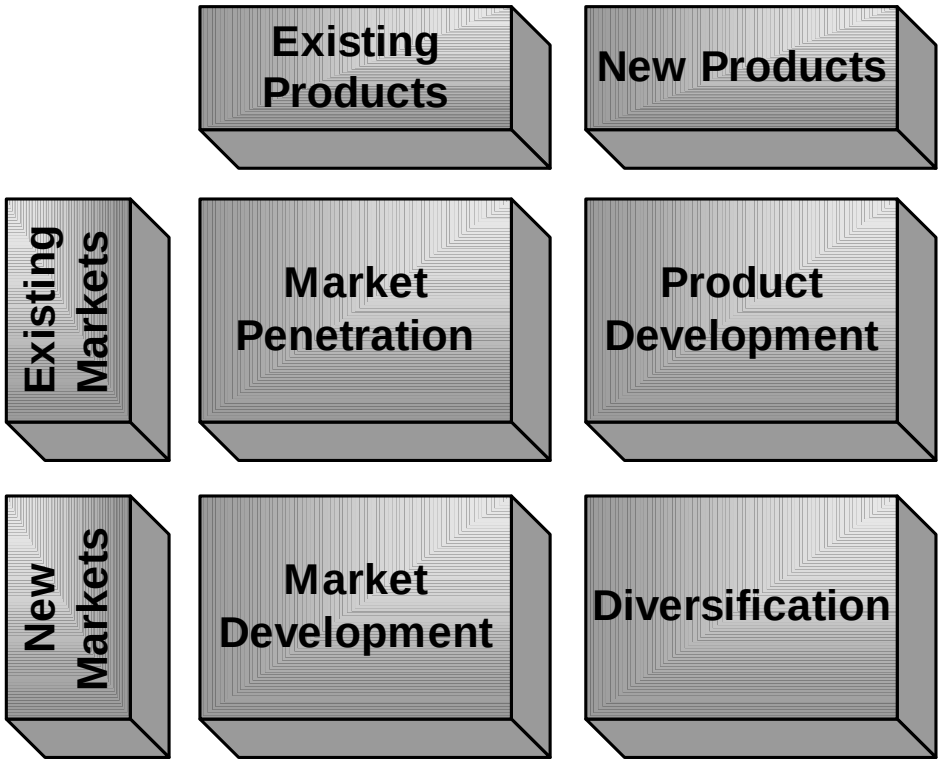

Figure A2.3. The market expansion grid.

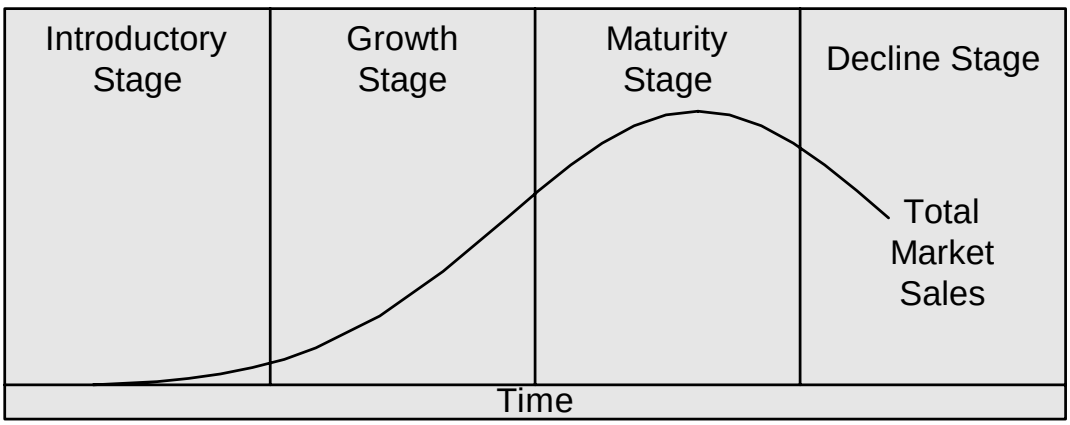

Figure A2.4 The four stages of the product life cycle.

- Product means the totality of products offered to the target market.
- Price is what customers pay to get the product or service.
- Place includes company activities that make the product available to the target consumers.
- Promotion means the activities that communicate the merits of the product and persuade target consumers to buy it.

To understand the marketing mix more clearly, one needs to consider the 'how' and 'what' questions for each individual element. Bonoma (1989) (modified) produced the following table (Table A2.1) to consider these questions.

Table A2.1. The marketing mix (modified from Bonoma, 1989).

Element	Questions of What to Do	Questions of How to Do It
Product	What product(s) do we produce?	How do we gain the co-operation of others to use this product?
Price	What price do we set for the product?	How do we deal with competition?
Promotion	What do we need to tell customers about our product?	How do we communicate with the market?
Place	What combination of direct and indirect distribution will sell most products to the market?	How do we gain the outlets we need?