



Ontario Agricultural Waste Characterization Study

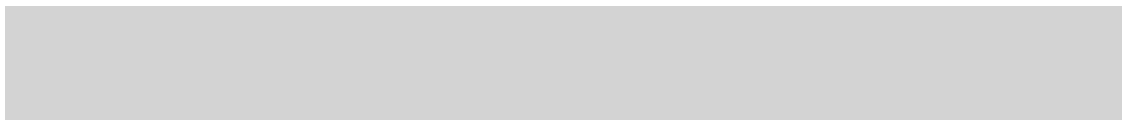
Prepared by:



451 Ferndale Avenue, London, ON N6C 2Z2
Paul van der Werf Tel: 519-645-7733, email: paulv@2cg.ca

In partnership with CleanFARMS Inc. with funding provided by
Canada-Ontario Agreement Respecting the Great Lakes Basin
Ecosystem and OMAFRA's Great Lakes Program

June 6, 2011



Page left intentionally blank

Table of Contents

Executive Summary.....	i
1.0 Introduction	i
2.0 Summary of Results	i
1.0 Introduction	1
2.0 Methodology	2
2.1 Waste Characterization.....	2
2.1.1 Desktop Audit.....	3
2.2 Farm Visits (Field Verification).....	4
2.3 Identify Stewards.....	5
3.0 Results.....	6
3.1 Description of Waste Types	6
3.1.1 Seed	6
3.1.2 Feed	6
3.1.3 Fertilizer	6
3.1.4 Pesticides	6
3.1.5 Silage/Bale Wrap	8
3.1.6 Twine and Net Wrap.....	8
3.1.7 Sanitation Products	8
3.1.8 Animal Health Products	8
3.1.9 Sharps.....	8
3.1.10 Engine and Hydraulic Oil	8
3.1.11 Plant Pots, Trays, Liners and Flats.....	8
3.1.12 Greenhouse and Field Fruit and Vegetables	9
3.2 Estimate of Annual Tonnage of Various Packaging Materials	9
3.2.1 Plastic	9
3.2.1.1 Film Plastic.....	9
3.2.1.2 Woven Plastic Bags	10
3.2.1.3 Twine	11
3.2.1.4 Plastic Jugs, Pails and Drums.....	12
3.2.1.5 Greenhouse Plant Pots, Inserts, Flats, Liners and Nursery Pots	13
3.2.1.6 Potted Plant Sleeves (PP, LDPE, PS).....	15
3.2.1.7 Animal Health Products	16
3.2.2 Paper.....	16
3.2.2.1 Unlined Paper Bags.....	16
3.2.2.2 Lined Paper Bags	17
3.2.2.3 Animal Health Products	18
3.2.2.4 Cardboard Boxes	18
3.2.2.5 Cardboard Boxes-waxed	19
3.2.3 Animal Health Products-Glass and Other Wastes.....	19
3.2.4 Animal Health Products-Sharps	19

3.2.5	Summary	21
4.0	Farm Visits	23
4.1	Grain and Oilseed	24
4.2	Livestock	28
4.2.1	Pig	28
4.2.2	Dairy	32
4.2.3	Poultry	36
4.3	Greenhouse Vegetable	42
4.4	Field Vegetable	59
4.5	Fruit and Tender Fruit	66
4.6	Field Nursery	73
4.7	Summary	76
5.0	References and Bibliography	79

Appendix 1	Background Information on Calculations.
Appendix 2	Ontario Agricultural Film Plastic Waste Characterization Study Blacksheep Strategy Inc., December 2010.
Appendix 3	List of Subject Matter Experts and Industry Contacts Interviewed

Key Acronyms used in report

HDPE	high density polyethylene
LDPE	low density polyethylene
OCC	old corrugated cardboard
PP	polypropylene
PS	polystyrene

Executive Summary

1.0 Introduction

CleanFARMS™ is a non-profit industry stewardship organization committed to environmental responsibility through the proper management and disposal of agricultural waste.

CleanFARMS™ was awarded a grant from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) to complete an agricultural waste study in Ontario. In addition to the funding provided by OMAFRA, the Canadian Animal Health Institute (CAHI) and CleanFARMS™ provided additional funding towards the project. As well different organizations are provided in-kind support.

2cg Inc. (2cg) was retained to conduct a waste characterization study (Study) of certain non-organic materials used in agriculture in the province of Ontario. The focus of this Study was on packaging wastes. It also included an overview of sharps generation (e.g. needles etc.).

The Study involved considerable desktop research and field research. It focussed on collecting and summarizing existing sources of information and interviewing various subject matter experts and collecting/confirming data on farm visits. All data collected was summarized and estimates of the annual generation of various wastes were made. It should be noted that the results of this Study represent the development of baseline data and the start of an iterative process to refine and expand these estimates.

As well 2cg was retained to consolidate and incorporate the results from two other Ontario-based waste characterization studies that looked at other non-organic materials.

The intention is to use this information to assess the feasibility and opportunity for the development of recycling programs for these products.

This report presents the results of the following non-organic waste characterization studies:

- Agricultural film and twine (bale wrap, mulch wrap, greenhouse film, grain storage and baling twine) completed by Blacksheep Strategy (summary of data);
- Animal Health Products(summary of data) - (a separate standalone report has been prepared by the Canadian Animal Health Institute (CAHI)); and
- Detail on all other non-organic agricultural waste completed by 2cg.

2.0 Summary of Results

Desktop Research

Table 1 presents an overview of the different types of packaging wastes generated by different farm types.

Table 1 Packaging waste types by type of production

Farm Type	Inputs	Waste Types	Output	Waste Types
Crops				
Field Crops and Seed Production	Seed	Woven plastic bags, paper bags	Harvested crops	Plastic packaging materials (e.g. bale wrap).
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Fruit and Vegetable Production	Seed/Propagation	Plastic trays, Film plastic bags, Woven plastic bags, packaging materials	Harvested crops	Paper packaging materials (e.g. cardboard), plastic packaging materials.
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Greenhouse Production	Seed	Film plastic bags, Woven plastic bags	Harvested crops	Paper packaging materials (e.g. cardboard), plastic packaging materials (e.g. pots)
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
	Other	Plastic twine and plant clips		
Nursery Production	Seed/Propagation	Plastic trays, Film plastic bags, Woven plastic bags, packaging materials	Harvested crops	Paper packaging materials (e.g. cardboard), plastic packaging materials (e.g. pots)
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Sod Production	Seed	Film plastic bags, Woven plastic bags	Harvested crops	
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Livestock and Livestock products (e.g. milk and eggs)	Feed	Film plastic bags, Woven plastic bags	Livestock Livestock products	Paper or plastic packaging materials (eggs)
	Supplements	Film plastic bags, woven plastic bags, paper bags, plastic jugs, plastic pails		
	Sanitation products	Plastic jugs, pails and drums		

Possible waste generation has been broken into **inputs** required for farm production and **outputs** required to ship products to market.

Inputs will create wastes that need to be managed at the farms. Inputs are the key focus of this Study. It is important to note that many key farm inputs are sold primarily in bulk and therefore generate no packaging waste. When these inputs are packaged they generate wastes.

Outputs generate wastes that are managed by customers be they wholesalers, retailers or consumers. While outputs are beyond the scope of this Study, they have been included when data has been readily available.

Table 2 presents a summary of non-organic wastes generated on Ontario farms (i.e. inputs). These are essentially all packaging materials. An estimated 14,500 tonnes/year of non-organic wastes are generated on Ontario farms.

Table 2 Summary of Non-organic Waste Generated on Ontario Farms

Plastic	tonnes/year	Comments
LDPE	3,510	Fertilizer bags, grow bags, greenhouse film, silage, bale wrap and mulch film
PP	1,495	Feed and seed bags (woven), twine, plant pots, inserts, flats, liners , pot sleeves
PS	90	Plant pots, inserts, flats, liners
HDPE	1,750	Pesticide, sanitation products, oil jugs, pails, drums
Other Plastic	67	Animal health products
Sub-total	6,912	
Paper		
Unlined Kraft Paper	400	Seed (corn) bags
Lined Kraft Paper	240	Feed bags
Other Paper	9	Animal health products
Cardboard	4,780	Plant pots, inserts, flats, liners (receipt), waste packaging fruit and vegetables (does not include baskets)
Cardboard (waxed)	1,000	Waste packaging fruit and vegetables (does not include baskets)
Sub-total	6,429	
Glass		
Glass Bottles	1,100	Animal health products
Other	12	Animal health products (foil pouches, tubes), sharps
Total	14,453	

Figure 1 provides an overview of the estimated waste composition of non-organic wastes generated on Ontario farms.

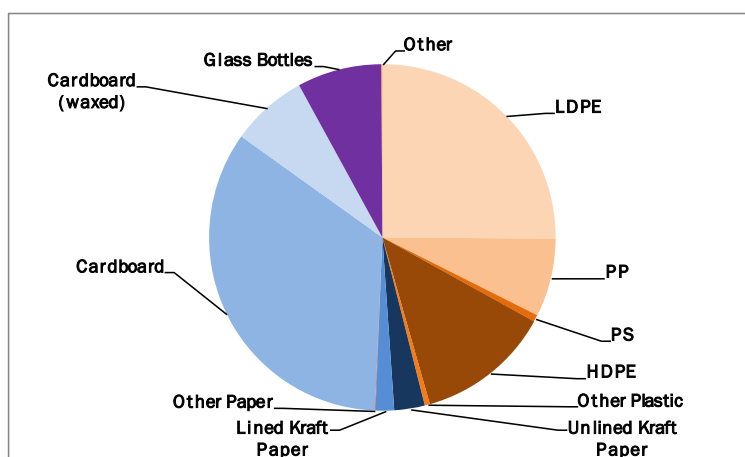


Figure 1 Estimated Waste Composition

Table 3 presents a summary of key waste producing packaging materials that are used to convey farm products to the marketplace. An estimated 97,000 tonnes/year of packaging wastes leave Ontario farms.

Table 3 Summary of Key Waste Producing Packaging Materials used to Convey Farm Products to the Marketplace

Plastic	tonnes/year	Comments
LDPE		
PP	9,455	Plant pots, inserts, flats, liners , pot sleeves
PS	1,750	Plant pots, inserts, flats, liners
HDPE		
Other		
Sub-total	11,205	
Paper		
Unlined Kraft Paper		
Lined Kraft Paper		
Other		
Cardboard	66,000	Packaging fruit and vegetables (does not include baskets)
Cardboard (waxed)	20,000	Packaging fruit and vegetables (does not include baskets)
Sub-total	86,000	
Total	97,205	

This is only a partial estimate. It does not include plastic packaging materials used to package fruit and vegetables for sale to the marketplace. The agricultural sector is not responsible for the management of these wastes.

Farm Visits

Table 4 presents an overview of how various non-organic waste streams are managed on different farm types.

A mixture of landfilling, recycling, re-use and on-site burning are used to manage wastes. There were a considerable number of examples of recycling programs (either

May 2011

through the Blue Box or retailers). It is clear that both farmers and retailers are making efforts to avoid the landfilling of wastes

Key findings include:

- Most key inputs (e.g. fertilizer, seed, feed) are sold in bulk and do not generate any non-organic waste at the farm;
- Most farms visited had an Environmental Farm Plan and all farms visited had a genuine interest in managing their non-organic wastes in an environmentally responsible manner;
- There were a number of examples of return to retail programs for some waste streams (e.g. jugs, pails, drums);
- Return to retail programs were inconsistent and not available across the Province;
- There were essentially no recycling programs and limited recycling opportunities for low density polyethylene (LDPE) bags and unlined and lined paper bags; and
- There were a number of examples of farmers using the Blue Box program to divert wastes (e.g. paper bags, jugs, pails). It is unknown if steward fees have been paid for these waste materials (i.e. from the manufacturer).

Some of the data collected was used to help calculate total wastes generated in the Province.

It would be useful to undertake more farm visits to be able to gather more data and use this data to refine waste generation estimates.

Table 4 Management of various input waste streams by farm type

	Grain and Oilseed	Livestock	Greenhouse Vegetable, Potted Plants, Bedding Plants	Field Vegetable	Fruit and Tender Fruit	Nursery
Low density polyethylene (LDPE) bags and other film	Landfill	Landfill Some recycling of bale and silage wrap	Landfill	Landfill	Landfill	Landfill
Woven polypropylene (PP) bags	Landfill Limited take back programs	Landfill Limited take back programs	na	na	na	na
Twine (PP)	na	na	na	na	na	na

	Grain and Oilseed	Livestock	Greenhouse Vegetable, Potted Plants, Bedding Plants	Field Vegetable	Fruit and Tender Fruit	Nursery
Pots, trays, inserts and flats (PP, PS, HDPE)	na	na	Landfill Recycling programs	na	na	na
High density polyethylene (HDPE) jugs, pails, drums	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Take back to retail programs (pesticides, some sanitation and oil products) Re-use (oil, sanitation) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging
Unlined and lined paper bags	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box
Cardboard	Recycled Blue Box	Recycled Blue Box	Recycled Baler	na	Recycled Blue Box	Na
Animal Health Waste	na	Removed from the farm by vets Cardboard recycled Glass ampoules recycled or disposed	na	na	na	na

	Grain and Oilseed	Livestock	Greenhouse Vegetable, Potted Plants, Bedding Plants	Field Vegetable	Fruit and Tender Fruit	Nursery
Animal Health Waste-sharps	na	Removed from the farm by vets Take back programs Landfill	na	na	na	na

Page left intentionally blank

1.0 Introduction

CleanFARMS™ is a non-profit industry stewardship organization committed to environmental responsibility through the proper management and disposal of agricultural waste.

CleanFARMS™ was awarded a grant from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) to complete an agricultural waste study in Ontario. In addition to the funding provided by OMAFRA, the Canadian Animal Health Institute (CAHI) and CleanFARMS™ provided additional funding towards the project. As well different organizations are provided in-kind support.

2cg Inc. (2cg) was retained to conduct a waste characterization study (Study) of certain non-organic materials used in agriculture in the province of Ontario. The focus of this Study was on packaging wastes. It also included an overview of sharps generation.

The Study involved considerable desktop research and field research. It focussed on collecting and summarizing existing sources of information and interviewing various subject matter experts/industry contacts and collecting/confirming data on farm visits. All data collected was summarized and estimates of the annual generation of various wastes were made. It should be noted that the results of this Study represent the development of baseline data and the start of an iterative process to refine and expand these estimates.

As well 2cg was retained to consolidate and incorporate the results from two other Ontario-based waste characterization studies that looked at other non-organic materials.

The intention is to use this information to assess the feasibility and opportunity for the development of recycling programs for these products.

This report presents the results of the following non-organic waste characterization studies:

- Agricultural film and twine (bale wrap, mulch wrap, greenhouse film, grain storage and baling twine) completed by Blacksheep Strategy (summary of data);
- Animal Health Products (summary of data)- (a separate standalone report has been prepared by the Canadian Animal Health Institute (CAHI)); and
- Detail on all other non-organic agricultural waste completed by 2cg.

2.0 Methodology

2.1 Waste Characterization

Waste characterization is essentially a combination of determining waste generation and then using that data to estimate the overall composition of the waste stream.

The following list of general waste categories and sub-categories were considered:

Category	Examples of Sub Categories
Plastic	Plastic bags (LDPE) Woven plastic bags and bulk bags (PP) Twine (PP) Jugs, Pails and Drums (HDPE) Pots, trays, inserts, flats (PP, PS, HDPE)
Paper packaging	Kraft Paper bags (unlined) Kraft Paper bags (lined) Corrugated cardboard (OCC)
Glass	Animal health products
Sharps	Needles, syringes, scalpels, lancets

These categories were adapted from current Stewardship Ontario/Waste Diversion Ontario waste categories used for residential waste audits. Most of the wastes noted are packaging wastes.

This waste characterization was developed through a combination of the following methods: 1. Estimate of material consumption and waste generated by consumption; 2. Estimate of waste generated per unit of production; and 3. Existing farm waste generation data.

Estimate of Material Consumption and Waste Generated by Consumption

This was accomplished by estimating how much of various materials are consumed on Ontario farms. An estimate of the amount of waste generated per unit consumption was developed.

This involved identifying the major materials used on Ontario farms and then through research attempt to identify manufacturers and/or distributors that could provide relevant sales/quantity data.

Estimate of Waste Generated Per Unit of Production

This was accomplished by estimating inputs for various farm level activities. For instance, knowing the per hectare (ha) inputs (e.g. fertilizer, seed, pesticides, feed) for various crops and livestock and understanding how these inputs are packaged was used to help develop an estimate of the kilogram (kg) of waste generated per ha of production or per livestock unit. This was applied to the total area in production for each crop (i.e. kg of input/ha * kg waste/kg of input * ha production) and per head of livestock.

Existing Farm Waste Generation Data

Waste generation on Ontario farms is already partially estimated. Available data was collected from a variety of sources.

Data Compilation

Waste characterization data, which come from different sources, was compiled into Excel spreadsheet tables. To the extent possible estimates of waste generation were developed from two sources of data to help maximize the reliability of the estimate. The compiled data was analyzed and the results of this analysis expressed in tables and figures. This resulted in the presentation of an estimate of waste generation and waste composition.

Gaps in the data were also identified and recommendations will be made on how to develop and gather this data in the future.

As this is the first Study of this type (i.e. for “other agricultural waste”) undertaken by CleanFARMS™ in Ontario it is important to understand that a baseline waste characterization data set has been created. It was developed in such a way so that it can be easily updated so that new sources of data can be added as they become available or are developed.

2.1.1 Desktop Audit

Most of this Study was undertaken as a desktop audit. This data collection exercise focused on collecting data including: 1. Estimate of material consumption and waste generated by consumption; 2. Estimate of waste generated per unit of production; and 3. Existing farm waste generation data.

The desktop audit consisted of: 1. Research; 2. Data Collection; and 3. Data Analysis.

The data came from a number of sources. The following methods were used to gather data:

Subject Matter Experts

Key agricultural subject matter experts were contacted and interviewed to help identify a list of data sources and industry contacts. Most subject matter contacts were provided by the OMAFRA. The subject matter experts were contacted by email and by telephone to extract relevant information. Subject matter experts did not always respond to these communications.

A list of subject matter experts and industry contacts that were interviewed (by telephone, email) can be found in Appendix 3.

Industry Contacts

Industry contacts (e.g. manufacturers, suppliers, first importers) were contacted and interviewed to gather various data on material sales/quantities to help understand the market size for various materials. This included collecting data on the weight of packaging material used to help convey these materials. The industry contacts were

contacted by email and by telephone to extract relevant information. Industry experts did not always respond to these communications.

A list of subject matter experts and industry contacts that were interviewed (by telephone, email) can be found in Appendix 3.

Internet Search

A detailed internet search was undertaken to help identify possible data sources of Ontario farm waste generation. The internet search also attempted to uncover other relevant sources of information outside of Ontario that could be used to help develop estimates.

Section 5, References and Bibliography, presents a list of resource material used for this Study.

Literature Review

A literature review was undertaken to identify similar studies. The literature review provided some insight into how to develop estimates of waste generation and composition.

Section 5, References and Bibliography, presents a list of resource material used for this Study.

There was limited information available regarding previous agricultural waste characterization studies.

CleanFARMS™

CleanFARMS™ already has a number of Ontario stewardship programs and collects weight based data for these materials. This data was collected and analyzed. Staff was interviewed to develop a sense of current capture rates of these materials.

2.2 Farm Visits (Field Verification)

Farm visits (field verification) involved: 1. Site visits at a number of representative farms and surveying farmers on waste generation and waste management habits; and 2. Confirmation of weight of various packaging and other materials.

Site Visits to Farms

The purpose of site visits was to gauge current farm waste generation and waste management (including on-site disposal) per farm type. This data supplemented data gathered as part of the desk top audit. This included a tour of each farm to see waste generation and waste management first hand. Twenty-seven farms and 1 recycling facility were visited.

Table 2.1 presents an overview of the various farms visited. Twenty-seven farms and one recycling facility were visited. The primary activity of each farm is noted. Many farms visited included at least one other activity (livestock and mixed crop). This is noted in the text of each farm visit summary.

Table 2.1 Overview of Farm Visits

Region	County	Farm Type (Primary operation)
Southwestern Ontario	Chatham-Kent	Grain and Oilseed
Southwestern Ontario	Lambton	Grain and Oilseed
Southwestern Ontario	Middlesex	Grain and Oilseed
Southwestern Ontario	Chatham-Kent	Pig
Southwestern Ontario	Middlesex	Pig
Southwestern Ontario	Chatham-Kent	Dairy
Southwestern Ontario	Middlesex	Poultry (Broiler)
Southwestern Ontario	Middlesex	Poultry (Turkey)
Southwestern Ontario	Chatham-Kent	Greenhouse Cucumber
Southwestern Ontario	Chatham-Kent	Greenhouse Tomato and Pepper
Southwestern Ontario	Chatham-Kent	Greenhouse Plastic Recycling Facility
Southwestern Ontario	Elgin	Field Vegetable
Southwestern Ontario	Norfolk	Field Vegetable
Southwestern Ontario	Middlesex	Field Vegetable, Grain and Oilseed
Southwestern Ontario	Lambton	Fruit (Apple and Tender Fruit)
Southwestern Ontario	Lambton	Apple, Tender Fruit Orchard and Field Vegetable
Southwestern Ontario	Norfolk	Apple
Southwestern Ontario	Norfolk	Tree Nursery
Niagara Region	Niagara Region	Greenhouse Cut Flower, Potted Plant and Cut Flower Packaging
Niagara Region	Niagara Region	Greenhouse Bedding Plants and Potted Plant Farm
Niagara Region	Niagara Region	Greenhouse Potted Plant and Peach
Central Ontario	Simcoe	Potato and Grain (corn, wheat, soybean),
Eastern Ontario	Northumberland	Pig
Eastern Ontario	Northumberland	Dairy
Eastern Ontario	Northumberland	Poultry (Broiler)
Eastern Ontario	Northumberland	Poultry (Layer)
Eastern Ontario	Northumberland	Vegetable
Eastern Ontario	Northumberland	Tender Fruit

Confirmation of Weight of Various Packaging and Other Materials

A number of sites were visited to confirm the weight of various packaging and other materials.

2.3 Identify Stewards

During the Desktop Audit the various suppliers and potential stewards were identified. These included manufacturers, first importers and in some cases retailers. A scoped list was developed per waste type.

3.0 Results

3.1 Description of Waste Types

Table 3.1 presents an overview of the different types of packaging wastes generated by different farm types.

Possible waste generation has been broken into **inputs** required for farm production and **outputs** required to ship products to market.

Inputs will create wastes that need to be managed at the farms. Inputs are the key focus of this Study. It is important to note that many key farm inputs are sold primarily in bulk and therefore generate no packaging waste. When these inputs are packaged they generate wastes.

Outputs generate wastes that are managed by customers be they wholesalers, retailers or consumers. While outputs are beyond the scope of this Study, they have been included when data has been readily available.

3.1.1 Seed

Seed is sold in bulk and in packages. When sold in packages it is typically sold in unlined and lined kraft paper bags (20-25 kg of product) and larger woven polypropylene (PP) bags (<1,000 kg of product). Estimates focussed on wastes generated from corn and soybean seeds.

3.1.2 Feed

Feed is sold bulk and in packages. When it is sold in packages it is typically sold in lined kraft paper bags and woven polypropylene (PP) bags (20-25 kg of product).

3.1.3 Fertilizer

Feed is sold bulk (solid and liquid) and in packages. When it is sold in packages it is typically sold in low density polyethylene (LDPE) plastic bags (25-40 kg of product). It can also be sold in high density polyethylene (HDPE) pails.

3.1.4 Pesticides

Pesticide products are often sold in 1 litre, 4 litre, 10 litre, 20 litre, 110 litre or 205 litre HDPE jugs, pails or drums. They are also sold in lined paper bags.

Table 3.1 Packaging waste types by type of production

Farm Type	Inputs	Waste Types	Output	Waste Types
Crops				
Field Crops and Seed Production	Seed	Woven plastic bags, paper bags	Harvested crops	Plastic packaging materials (e.g. bale wrap).
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Fruit and Vegetable Production	Seed/Propagation	Plastic trays, Film plastic bags, Woven plastic bags, packaging materials	Harvested crops	Paper packaging materials (e.g. cardboard), plastic packaging materials.
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Greenhouse Production	Seed	Film plastic bags, Woven plastic bags	Harvested crops	Paper packaging materials (e.g. cardboard), plastic packaging materials (e.g. pots)
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
	Other	Plastic twine and plant clips		
Nursery Production	Seed/Propagation	Plastic trays, Film plastic bags, Woven plastic bags, packaging materials	Harvested crops	Paper packaging materials (e.g. cardboard), plastic packaging materials (e.g. pots)
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Sod Production	Seed	Film plastic bags, Woven plastic bags	Harvested crops	
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails		
Livestock and Livestock products (e.g. milk and eggs)	Feed	Film plastic bags, Woven plastic bags	Livestock Livestock products	Paper or plastic packaging materials (eggs)
	Supplements	Film plastic bags, woven plastic bags, paper bags, plastic jugs, plastic pails		
	Sanitation products	Plastic jugs, pails and drums		

3.1.5 Agricultural Film

Agricultural film includes greenhouse film and mulch film. The use of greenhouse film and mulch film was considered by Blacksheep Strategy. A full copy of their report is included in Appendix 2. These products are typically manufactured from LDPE.

3.1.6 Silage/Bale Wrap

Silage/bale wrap are used to contain hay, silage and straw. The use of silage/bale wrap was considered by Blacksheep Strategy. A full copy of their report is included in Appendix 2. These products are typically manufactured from LDPE.

3.1.7 Twine and Net Wrap

Twine and net wrap are used to contain hay and straw. The use of twine and net wrap was considered by Blacksheep Strategy. A full copy of their report is included in Appendix 2. These products are typically manufactured from PP.

Twine is also used in the greenhouse vegetable growing industry. These products are typically manufactured from PP.

3.1.8 Sanitation Products

Sanitation products, used primarily in dairy, hog and poultry production, are typically sold in 4 litre, 10 litre, 20 litre, 110 litre or 205 litre HDPE jugs, pails or drums. The sanitation products can come in liquid or solid forms.

3.1.9 Animal Health Products

Animal health products include various medicines used to treat livestock. The use of animal health products was considered by the CAHI. Limited summary data was provided for this report. A separate report has been prepared by CAHI. The product packaging is manufactured from a number of materials including paper, plastics and glass which are then packaged in boxboard and cardboard for distribution to veterinary clinics and farms.

3.1.10 Sharps

Sharps include needles, syringes, lancets and scalpels. They are used to administer medicines and undertake medical procedures on farm animals. These products are typically made from steel. Weight estimates also include packaging materials.

3.1.11 Engine and Hydraulic Oil

Oils are often sold in 1 litre, 4 litre or 20 litre HDPE jugs or pails. They are also sold in larger containers and in bulk.

3.1.12 Plant Pots, Trays, Liners and Flats

Potted plants and bedding plants produced as an output from greenhouses and the nursery sector are produced and shipped in a variety of Plastic Pots, Trays, Inserts and Flats. These items are typically made from PP, polystyrene (PS) and HDPE. They also generate some on-farm waste.

3.1.13 Greenhouse and Field Fruit and Vegetables

Fruit and vegetables are produced as an output from greenhouse and field production. A variety of cardboard (OCC) boxes (unwaxed and waxed) are used to ship this produce to market. They also generate some on-farm waste. A large quantity is shipped in reusable plastic and wood crates.

3.2 Estimate of Annual Tonnage of Various Packaging Materials

Packaging wastes have been divided into plastic and paper. Each key waste type is discussed in the following sections. Background information on calculations is provided in Appendix 1.

3.2.1 Plastic

3.2.1.1 Film Plastic

LDPE film plastic bags are used primarily for packaging fertilizers and for grow bags used in the greenhouse vegetable growing industry.

An industry organization provided an estimate of the amount of fertilizers sold into the Ontario agricultural market annually. It is estimated that about 39 million kg/year of fertilizer is sold in bags. This translates into about 310 tonnes/year of film plastic.

An estimate was developed of the annual amount of plastic used in grow bags (Photo 1) for the production of greenhouse vegetables. It should be noted that grow bags are contaminated with growing media. They are not readily recyclable without considerable processing. Agricultural Technologies Incorporated (ATI) out of Kingsville operates a facility to recycle these wastes.



Photo 1 Grow Bag

Other film plastic including greenhouse film, silage film, bale wrap and mulch film are detailed in the Ontario Agricultural Film Plastic Waste Characterization Study (Blacksheep Strategy report) (Appendix 2).

It is estimated that close to 3,500 tonnes/year of film plastic waste are generated on Ontario farms.

Sector	Estimated Weight
	Tonnes/year
Fertilizer	310
Grow Bags (greenhouse vegetable production)	75
Greenhouse film*	265
Silage Film and Bale Wrap*	2,400
Mulch Film*	460
Total	3,510

* Blacksheep Strategy Report (Appendix 2)

3.2.1.2 Woven Plastic Bags

Woven PP plastic bags are typically used for packaging feed and seed. These bags range in size. Common sizes include bags that hold 25kg (used for feed) (Photo 2) and larger bulk bags (used for seeds such as soybean) (Photo 3).



Photo 2 Woven Plastic Feed Bag



Photo 3 Woven Plastic Bulk Seed Bag

An industry organization provided an estimate of the annual amount of feed sold into the Ontario agricultural market in bags. It is estimated that about 4.7 million bags of feed are sold annually. It is estimated that 50% are sold in woven plastic bags and 50% is sold in lined paper bags. This translates into about 240 tonnes/year of woven plastic film bags.

Data provided by an industry organization and data collected from farm visits were used to develop an estimate of the annual tonnage of woven PP bulk bags used for soybean seed. It was estimated that about 250 tonnes/year were generated.

On the basis of these estimates about 490 tonnes/year of woven PP plastic bags are generated on Ontario farms.

Sector	Estimated Weight
	Tonnes/year
Feed	240
Seed (Soybean)	250
Total	490

3.2.1.3 Twine

Twine is used to hold together bales of forage crops. The use of twine and net wrap was considered by Blacksheep Strategy. A full copy of their report is included in Appendix 2. It is estimated that about 475 tonnes/year of twine are used for this purpose.

Twine is also used in the greenhouse vegetable growing industry, specifically for tomatoes and peppers (biodegradable jute is used for cucumbers). An estimated 55 tonnes of twine are used in this industry.

On the basis of these estimates about 530 tonnes/year of PP twine are generated on Ontario farms.

Sector	Estimated Weight
	Tonnes/year
Forage crops	475
Greenhouse vegetable growing	55
Total	530

Suppliers and potential stewards of PP twine are detailed in the Blacksheep Strategy report (Appendix 2).

3.2.1.4 Plastic Jugs, Pails and Drums

HDPE plastic jugs, pails and drums of various sizes are used for the sale of various products including pesticides, sanitation products and oil (engine and hydraulic). Small amount of fertilizers are also sold in plastic pails (not calculated).

CleanFARMS™ operates an “Empty Pesticide Recycling Program” across the country. In 2010, about 220 tonnes of plastic jugs and pails were collected. Using an assumed 80% capture rate it is estimated that about 275 tonnes of plastic jugs and pails were sold in Ontario in 2010.

Sanitation products are used in the dairy, hog and poultry industries. It was challenging to obtain sufficient data to develop estimates. Ultimately estimates were developed from data collected from retailers and during farm visits and then extrapolated for Ontario production. Based on available data it was estimated that approximately 1,100 tonnes/year of jugs, pails and drums are generated on farms. It is likely that this is an overestimation. There are some limited return programs for these wastes.

Oil and hydraulic oil is used at almost all farms across Ontario. It was challenging to obtain industry wide data. Ultimately estimates were developed from data collected on farm and extrapolating for Ontario production. It was assumed that large (> 162 ha, as defined in OMAFRA, 2009) farms receive oil in bulk (in tank or reusable drums) and do not generate any packaging wastes. It was assumed that on average each small (< 53 ha) and medium (53-162 ha) sized farm uses/generates 5-20 litre pails/year (or equivalent smaller jugs). This estimate was based on farm visits. This is likely a conservative estimate. On this basis it is estimated that at least 360 tonnes/year of waste is generated. There are some limited return programs for these wastes.

On this basis it is estimated that about 1,750 tonnes/year of jugs, pails and drums are generated. While there are recycling programs available for some products a considerable amount of these jugs, pails and drums are either re-used or require disposal.

Sector	Estimated Weight Tonnes/year
Pesticides	275
Sanitation	
Sanitation products (Dairy)	1,100
Sanitation products (Hog)	5
Sanitation products (Poultry)	10
Oil	360
Total	1,750

3.2.1.5 Greenhouse Plant Pots, Inserts, Flats, Liners and Nursery Pots

Polystyrene (PS, #6) Polypropylene (PP, #5) and high density polyethylene (HDPE, #2) pots, trays, inserts and liners (trays) are used in the greenhouse industry (Photo 4). Pots are also used in the nursery industry (Photo 5).



Pot



Tray



Insert



Flat

Photo 4 Pots, Trays, Inserts and Flats



Photo 5 Nursery Pots

An estimate of the amount of these pots, inserts, trays and flats was developed using the following information:

- Statistics Canada 2009 greenhouse and nursery production estimates;
- Weight based information provided by a manufacturers (from web site);
- Discussions with OMAFRA staff; and
- Farm visits.

Greenhouse Ornamental and Bedding Plant Production

It is assumed that containers are made from PS or PP and that for the purposes of calculations equal amounts are made from each material for smaller pots and made exclusively from PP for larger pots.

It was assumed that potted plants were either grown in 1 litre, 2.4 litre, 11cm, 15cm, 30cm or hanging pots. Some potted plants are shipped in trays. Weight estimates consider total usage and apply a factor for on-site (i.e. greenhouse) waste generation. Most pots leave the greenhouse and enter the waste stream at a later time. A small percentage of pots used at a greenhouse become waste.

Some bedding plants are grown in inserts (40 plants/insert). It was assumed that inserts were placed in a flat (also referred to as tray) for transportation and marketing purposes. Weight estimates consider total usage and apply a factor for on-site (i.e. greenhouse) waste generation. Most inserts and flats leave the greenhouse and enter the waste stream at a later time. A small percentage of inserts and flats used at a greenhouse become waste.

Nursery Production

It is assumed that containers are made from PP, with some made from HDPE. For the purposes of calculations it was assumed that all are made from PP.

Polystyrene (Output)

Item	Estimated Weight
	Tonnes/year
Potted plants	1,100
Bedding plants- Inserts	590
Bedding plants-Trays	60
Total	1,750

Polypropylene (Output)

Item	Estimated Weight
	Tonnes/year
Potted plants	7,500
Bedding plants- Inserts	590
Bedding plants-Trays	60
Nursery Pots	150
Total	8,300

Therefore approximately 10,000 tonnes/year of plastic are generated from the greenhouse ornamental and vegetable production. From farm visits it was clear that only a small percentage of pots, inserts, trays and flats are broken during production. It is estimated that approximately 5% are broken and would constitute waste.

On the basis of these estimates about 505 tonnes/year of pots, trays, inserts and flats are generated on Ontario farms.

Polystyrene and Polypropylene (Input)

Item	Estimated Weight Tonnes/year
Polystyrene	90
Polypropylene	415
Total	505

These wastes are either disposed in a garbage bin or recycled.

A number of retailers and organizations have started return-to-retailer programs or other recycling programs. It should also be noted that some greenhouses receive pots, inserts, trays and flats from return to retail programs. These are sorted, reused where possible and further recycled through existing programs.

3.2.1.6 Potted Plant Sleeves (PP, LDPE, PS)

Most potted plants are fitted with a sleeve (Photo 6) prior to shipment. This is to protect the plant and for decoration. Plant sleeves appear to be largely made from PP as well as LDPE and HDPE. For calculation purposes it was assumed that they are all made from PP. These sleeves leave the farm and enter the waste stream at a later time. A small percentage of these plant sleeves become waste at the greenhouse and are disposed.



Photo 6 Potted Plant Sleeves

Polypropylene (Output)

Item	Estimated Weight
	Tonnes/year
Potted plant sleeves	1,155
Total	1,155

It is estimated that approximately 5% of plant sleeves become waste that needs to be managed at the greenhouse. These wastes are typically disposed in a garbage bin.

Polypropylene (Input)

Item	Estimated Weight
	Tonnes/year
Potted plant sleeves	60
Total	60

When adding this total, woven plastic bags (Section 3.2.1.2), twine (Section 3.2.1.3) and plant pots, trays, inserts and liners (Section 3.2.1.5) about 1,500 tonnes of PP waste are generated on Ontario farms.

3.2.1.7 Animal Health Products

Approximately 67 tonnes of plastic bottles are generated through animal health products. They consist of a variety of plastics. A separate standalone report has been prepared by the CAHI.

3.2.2 Paper

3.2.2.1 Unlined Paper Bags

Some products such as corn seed are sold in unlined kraft paper bags (Photo 7).



Photo 7 Unlined Kraft Paper Bag

Data collected from farm visits helped develop an estimate of unlined paper bags generated annually. This resulted in an estimate of about 410 tonnes of bags produced annually. There may be other products that use unlined paper bags so this estimate is likely underestimated.

Sector	Estimated Weight
	Tonnes/year
Seed (corn)	400
Total	400

Waste bags are disposed, in some cases recycled and often burned on the farm.

3.2.2.2 Lined Paper Bags

Lined (plastic liner) paper bags are commonly used to sell feed and seed products (Photo 8). It should be noted that much of these products are sold in bulk.



Photo 8 Lined Kraft Paper Bag

Item	Estimated Weight
Sector	Tonnes/year
Animal feed	240
Total	240

Waste bags are disposed, in some cases recycled and often burned on the farm.

3.2.2.3 Animal Health Products

Approximately 9 tonnes of paper waste are generated through animal health products. They consist of a variety of papers. A separate standalone report has been prepared by the CAHI.

3.2.2.4 Cardboard Boxes

Cardboard (OCC) boxes are used for the sale of various products including plant pots, trays, flats and inserts and pesticides. OCC boxes are also used as outbound packaging materials for many fruits and vegetables.

The amount of OCC boxes received from plant pots, trays, insert and liners was estimated based on the estimated number used annually in Ontario. It was challenging to unequivocally estimate this number because not all of these are received in cardboard boxes. Some are palletized and covered with stretch wrap and cardboard inserts.

The amount of OCC boxes received from the sale of pesticides was estimated.

Various field fruit and vegetable crops utilize OCC boxes to pack and transport product from the field (not always) and then to market. It should be noted that these are not agricultural wastes *per se* as they are managed at the wholesaler, retailer or consumer level. A portion of the OCC boxes used to pack fruit and vegetables on the farm become waste (e.g. breakage). From industry contacts and farm visits it is estimated that 5% of boxes end up as waste. This equals about 3,300 tonnes/year.

The outbound OCC from fruit and vegetable crops is about 66,000 tonnes/year. Much of this OCC is managed at the wholesale and retail level and it is likely that most of it is recycled.

Cardboard Boxes (Input)

Item	Estimated Weight
	Tonnes/year
Plant Pots, Trays, Inserts and Flats (receipt)	1,100
Pesticides (receipt)	380
Fruit and Vegetable Packing (on farm)	3,300
Total	4,780

Cardboard Boxes (Output)

Item	Estimated Weight
	Tonnes/year
Fruit and Vegetable Packing (outbound)	66,000
Total	66,000

3.2.2.5 Cardboard Boxes-waxed

Various field fruit and vegetable crops utilize waxed OCC boxes to transport product from the field (not always) and then to market.

From discussions with industry contacts and farm visits it is estimated that 5% of boxes end up as waste. This equals about 1,000 tonnes/year. Much of this waxed OCC is managed at the wholesale and retail level. It is unknown how much is recycled.

Sector	Estimated Weight
	Tonnes/year
Fruit and Vegetable Packing (on farm)	1,050
Fruit and Vegetable Packing (outbound)	20,000
Total	21,050

3.2.3 Animal Health Products-Glass and Other Wastes

Approximately 1,100 tonnes of glass bottles and two tonnes of other waste are generated through animal health products. A separate standalone report has been prepared by the CAHI.

3.2.4 Animal Health Products-Sharps

Sharps include needles and syringes but also scalpels and lancets. They are sold through veterinary clinics and licensed farm supply retailers.

An estimate of the weight of needles was made by working with industry contacts representing veterinary clinics, animal health product manufacturers and farm supply retailers. There was insufficient data available to make an estimate of syringes, scalpels and lancets.

These organizations gathered information from their members. Weight based data includes the weight of the box and the packaging around the needle.

Sector	Tonnes/year
Veterinary Clinics	8
Farm Supply Retailers	1
Total	9

It was estimated (prior to data collection) that veterinary clinics were responsible for 70% of the sales of sharps with farm retailers selling the balance. On this basis it appears that veterinary clinics are responsible for about 90% of the sales of needles.

There are a number of points that need to be made regarding this data:

- Not all needles purchased by Veterinary clinics are used on the farm. The proportion not used on farm is unknown; and
- Needles purchased in a given year are not necessarily all used in that given year.

Thus, this data provides a rough estimate of the amount of needles used on farm annually. It is estimated that the amount of syringes, scalpels and lancets would be much lower than this total.

It should be noted that additional research would need to be undertaken, particularly from the farm supply retailers, to refine this data.

3.2.5 Summary

Table 3.2 presents a summary of non-organic wastes generated on Ontario farms. These are essentially all packaging materials. An estimated 14,500 tonnes/year of non-organic wastes are generated on Ontario farms.

Table 3.2 Summary of Non-organic Waste Generated on Ontario Farms

Plastic	tonnes/year	Comments
LDPE	3,510	Fertilizer bags, grow bags, greenhouse film, silage, bale wrap and mulch film
PP	1,495	Feed and seed bags (woven), twine, plant pots, inserts, flats, liners , pot sleeves
PS	90	Plant pots, inserts, flats, liners
HDPE	1,750	Pesticide, sanitation products, oil jugs, pails, drums
Other Plastic	67	Animal health products
Sub-total	6,912	
Paper		
Unlined Kraft Paper	400	Seed (corn) bags
Lined Kraft Paper	240	Feed bags
Other Paper	9	Animal health products
Cardboard	4,780	Plant pots, inserts, flats, liners (receipt), waste packaging fruit and vegetables (does not include baskets)
Cardboard (waxed)	1,000	Waste packaging fruit and vegetables (does not include baskets)
Sub-total	6,429	
Glass		
Glass Bottles	1,100	Animal health products
Other	12	Animal health products (foil pouches, tubes), sharps
Total	14,453	

Figure 3.1 provides an overview of the estimated waste composition of non-organic wastes generated on Ontario farms.

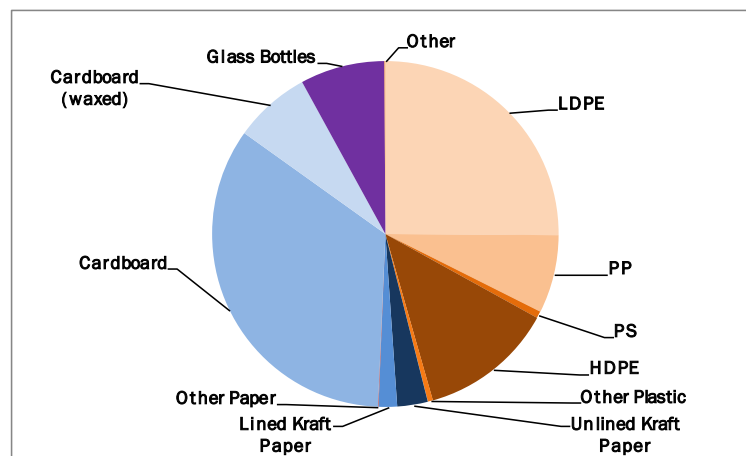


Figure 3.1 Estimated Waste Composition

Table 3.3 presents a summary of key waste producing packaging materials that are used to convey farm products to the marketplace. An estimated 97,000 tonnes/year of packaging wastes leave Ontario farms.

Table 3.3 Summary of Key Waste Producing Packaging Materials used to Convey Farm Products to the Marketplace

Plastic	tonnes/year	Comments
LDPE		
PP	9,455	Plant pots, inserts, flats, liners , pot sleeves
PS	1,750	Plant pots, inserts, flats, liners
HDPE		
Other		
Sub-total	11,205	
Paper		
Unlined Kraft Paper		
Lined Kraft Paper		
Other		
Cardboard	66,000	Packaging fruit and vegetables (does not include baskets)
Cardboard (waxed)	20,000	Packaging fruit and vegetables (does not include baskets)
Sub-total	86,000	
Total	97,205	

This is only a partial estimate. It does not include plastic packaging materials used to package fruit and vegetables for sale to the marketplace. The agricultural sector is not responsible for the management of these wastes.

4.0 Farm Visits

Farm visits were undertaken to help gather information and develop a better understanding of the generation and management of non-organic wastes on the farm.

Table 4.1 presents an overview of the various farms visited. Twenty-seven farms and one recycling facility were visited. The primary activity of each farm is noted. Many farms visited included at least one other activity (livestock and mixed crop). This is noted in the text of each farm visit summary.

Table 4.1 Overview of Farm Visits

Region	County	Farm Type (Primary operation)
Southwestern Ontario	Chatham-Kent	Grain and Oilseed
Southwestern Ontario	Lambton	Grain and Oilseed
Southwestern Ontario	Middlesex	Grain and Oilseed
Southwestern Ontario	Chatham-Kent	Pig
Southwestern Ontario	Middlesex	Pig
Southwestern Ontario	Chatham-Kent	Dairy
Southwestern Ontario	Middlesex	Poultry (Broiler)
Southwestern Ontario	Middlesex	Poultry (Turkey)
Southwestern Ontario	Chatham-Kent	Greenhouse Cucumber
Southwestern Ontario	Chatham-Kent	Greenhouse Tomato and Pepper
Southwestern Ontario	Chatham-Kent	Greenhouse Plastic Recycling Facility
Southwestern Ontario	Elgin	Field Vegetable
Southwestern Ontario	Norfolk	Field Vegetable
Southwestern Ontario	Middlesex	Field Vegetable, Grain and Oilseed
Southwestern Ontario	Lambton	Fruit (Apple and Tender Fruit)
Southwestern Ontario	Lambton	Apple, Tender Fruit Orchard and Field Vegetable
Southwestern Ontario	Norfolk	Apple
Southwestern Ontario	Norfolk	Tree Nursery
Niagara Region	Niagara Region	Greenhouse Cut Flower, Potted Plant and Cut Flower Packaging
Niagara Region	Niagara Region	Greenhouse Bedding Plants and Potted Plant Farm
Niagara Region	Niagara Region	Greenhouse Potted Plant and Peach
Central Ontario	Simcoe	Potato and Grain (corn, wheat, soybean),
Eastern Ontario	Northumberland	Pig
Eastern Ontario	Northumberland	Dairy
Eastern Ontario	Northumberland	Poultry (Broiler)
Eastern Ontario	Northumberland	Poultry (Layer)
Eastern Ontario	Northumberland	Vegetable
Eastern Ontario	Northumberland	Tender Fruit

An overview of each farm visit is presented in the following sections, which are divided into the various primary farming operations. Most farms visited undertook additional farming activities over and above their primary farming operation.

4.1 Grain and Oilseed

1. Farm Type- Grain and Oilseed, Southwestern Ontario

Overview of Operations

A 1,500 acre grain and oilseed farm was visited. Of this about 300 acres are owned and the balance is rented. They grow corn, soybeans and wheat. Annually, about 800 acres of soybeans, 500 acres of corn and 200 acres of wheat is grown. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seed bags

Corn seed comes in paper bags (unlined) (Photo 9). Each bag provides seed for about 2.5 acres. On this farm about 200 bags are used annually. The bags are made from kraft paper. This generates about 65 kg of waste per year. The bags are burned.



Photo 9 Unlined Seed Bag

Seed bulk bags

Soybean seed comes in large bulk bags. On this farm about 45 bulk bags are used per year. The bulk bags are made from woven PP. This generates about 80 kg of waste per year. The bags are taken to the local landfill for disposal.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Pesticides

Pesticides used come in 2 gallon containers. They are triple rinsed and taken back to the retailer (Agris) for recycling.

Engine Oil/Hydraulic Oil

This farm uses about 30-20 litre (5 gallon) oil pails per year (Photo 10). There is no opportunity to recycle these pails.



Photo 10 5 Gallon HDPE Pail

Outputs

No wastes are generated from the sale of grains and oilseeds.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Some of this waste is burned (paper) and plastic packaging is returned to the retailer, re-used on-site or disposed at landfill. There are no recycling opportunities for HDPE “5 gallon pails” and woven PP bulk bags.

2. Farm Type- Grain and Oilseed, Southwestern Ontario

Overview of Operations

A 250 acre grain and oilseed cash crop farm was visited. They grow soybeans and wheat and a small amount of corn. Annually about 150 acres of soybeans, 75 acres of wheat and 25 acres of corn are grown. The farm has an Environmental Farm Plan but it has not been updated recently.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seed

Corn seed comes in paper bags (multi-layer). On this farm about 4-10 bags are used annually. The bags are made from kraft paper. This generates about 1-3 kg of waste per year. The bags are burned on the farm. All other seed comes in bulk.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Pesticides

Pesticides used come in 55 litre totes. They are refillable at the retailer.

Oil

Hydraulic oil and engine oil are purchased in “5 gallon pails”. Approximately 5 pails of engine oil are used annually. The pails are made from HDPE. Used engine oil is stored in the pails and taken to Petrolia (Waddick Fuels) for recycling. It is unknown what happens to the pails. Hydraulic oil is changed during regular machine maintenance at a dealership.

Oil filters are left to drain, packaged in bags and taken to the local Hazardous Waste Depot Days annually.

Outputs

No wastes are generated from the sale of grains and oilseeds.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Some of this waste is burned (paper) and plastic packaging is returned to the retailer. “5 gallon” HDPE pails are used to take oil for recycling. It is unknown what happens to the pails.

3. Farm Type- Grain and Oilseed, Southwestern Ontario

Overview of Operations

A 1,200 acre grain and oilseed (cash crop) farm was visited. They grow corn, soybeans and wheat. Annually about 400 acres of each crop is grown. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seed bags

Corn seed comes in paper bags (multi-layer). On this farm about 300-400 bags are used annually. The bags are made from kraft paper. This generates about 90-120 kg of waste per year. The bags are burned on the farm.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Pesticides

Pesticides used come in 10 litre containers. They are triple rinsed and taken back to the retailer for recycling. The farm uses about 200 containers annually. Containers are shipped in OCC boxes (Photo 11). These are broken down and recycled in the household Blue Box.



Photo 11 Packaging Cardboard

Oil

Hydraulic oil and engine oil are purchased in bulk (approximately 400 litre/year). Used engine oil is stored in an oil drum behind the barn and is collected by Safety Kleen on a regular basis. Some oil is burned by a neighbour in a waste oil furnace.

Outputs

No wastes are generated from the sale of crops.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Some of this waste is burned (paper), some placed in the Blue Box and plastic packaging is returned to the retailer. There are no recycling opportunities for multi-layer paper bags containing seed treatment residue.

4.2 Livestock

4.2.1 Pig

1. Farm Type - Pig Farm, Southwestern Ontario

Overview of Operations

A 1,500 per year farrow to finish farm was visited. At any one time there are about 450 pigs on-site. In addition this farm had about 270 acres of cropland on which corn, soybeans and wheat are grown as cash crops. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seed

Corn and soybean seeds are purchased in bags while most wheat is planted from seed kept from the previous harvest and is supplemented with some bagged seed. Approximately 30 bags of corn, 100 bags of soybeans and 20 bags of wheat are used annually. This generates approximately 50 kg/year of waste. Bags are multi-layer paper and are burned on the farm.

Feed

All feed is premixed and purchased in bulk.

Sanitation

Sanitation products are used to clean the barn and crates. The farm uses tablets that are dissolved in water. Tablets come in 500 ml HDPE bottles. One bottle has lasted the farm 4 years. These bottles are recycled in the Blue Box.

Oil

Hydraulic oil is used for various equipment. Approximately 4 “5 gallon pails” are used annually. The pails are made from HDPE. These pails are re-used on the farm and at other farms. Oil filters are disposed at the landfill.

Scrap Metal and Batteries

Scrap metal and farm equipment batteries are taken to a scrap yard for recycling. Currently scrap yards pay \$0.25/lb for batteries.

Animal Health Products

Some animal health products are used on-site including vaccines and antibiotics. The small OCC boxes that the medications are packaged in are recycled in the Blue Box. The glass ampoules of vaccine are discarded in the garbage. The plastic antibiotic

bottles are burned. Sharps generated on-site are collected and given to a vet for disposal. Any animal health product wastes generated during a vet's visit are removed by the vet when they leave the farm.

Outputs

No wastes are generated from the sale of livestock.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Most of this waste is recycled or reused. There are no recycling opportunities for HDPE "5 gallon pails".

2. Farm Type - Pig Farm, Southwestern Ontario

Overview of Operations

A 2,500 per year farrow to finish farm was visited. At any one time there about 1,800 pigs on-site in a number of barns. In addition this farm had about 200 acres of cropland on which corn, soybeans and wheat are grown. The soybeans are sold. The corn and wheat are used to feed the pigs throughout the year. The farm did not have an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Feed pre-mix

This is used to feed piglets. Approximately 125 bags/month or 1,500/year are used at this farm (Photo 11). The bags include a plastic liner. This generates approximately 360kg/year of waste. These bags are placed in residential Blue Boxes and taken away for recycling.



Photo 11 Lined Feed Bag

Sanitation

Sanitation products are used to clean the barns, crates and weaner rooms. Approximately 3-4 “5 gallon pails” are used annually. The pails are made from HDPE. This generates approximately 5kg/year of waste. These pails are re-used on the farm and at other farms.

Hydraulic Oil

Hydraulic oil is used for various equipment. Approximately 2-3 “5 gallon pails” are used annually. The pails are made from HDPE. These pails are re-used on the farm and at other farms.

Animal Health Products

Some animal health products are used on-site including sow vaccine. The small OCC boxes that the vaccines are packaged in are recycled in the Blue Box. Sharps generated on-site are recycled when possible. The ampoules of vaccine are discarded in the garbage. Any animal health product wastes generated during a vet’s visit are removed by the vet when they leave the farm.

Outputs

No wastes are generated from the sale of livestock.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Most of this waste is recycled or reused. There are no recycling opportunities for HDPE “5 gallon pails.”

3. Farm Type - Pig Farm, Eastern Ontario

Overview of Operations

A 350 per year weaner to finish farm was visited (Photo 12). Every six weeks, 40 hybrid pre-vaccinated and de-wormed weaner pigs arrive on-site (50-60 lbs/pig). Two six week cycles of pigs are on-site at any one time (80 pigs) in one barn (24’ x 76’). Finish pigs average 255 lbs/pig (12 weeks). The feed is grown on the farm as a mixed crop (oats, peas, barley) on 25 acres. Corn, soybeans and wheat are grown for cash crop and are not part of the pig operations. The farm has a Nutrient Management Plan (2007) and an Environmental Farm Plan (1996).



Photo 12 Pig Farm

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Mineral Supplement

Swine mineral supplement (40kg bags) is added during the on-site grinding of the high moisture mixed crop. Approximately 40 bags per year are used (Photo 13). The bags are a woven plastic. This generates approximately 5kg/year of waste. The bags are reused on-site for outside calf pens to protect animals from weather. The majority of the bags are repurposed (Photo 14) for this use and eventually deteriorate over time and become a smaller waste material that can be placed into a shopping size bag per year for disposal.



Photo 13 Woven Polypropylene Bag



Photo 14 Example of Reuse

Seed Bags

Seed bags for the mixed crop (2-25kg bags per acre) are made from brown paper with no plastic or waxed liners. These bags are recycled through the curbside Blue Box program. Approximately 50 bags per year are generated and recycled. This generates approximately 15kg/year of waste.

Fertilizer and Pesticides

Fertilizers and pesticide spraying of crops is done by contracted services and does not generate packaging wastes.

Sanitation

Spray powdered lime (whitewash) is used annually on for the barn interior. This has recently become a contracted service. Prior to contracting (2009), approximately 2-25kg paper bags per year were used. The bags had a wax liner and were burned on-site.

Motor and Hydraulic Oil

Approximately 1-45 gallon metal drum filled with motor oil was used annually. The drums have a \$45 deposit for return. Drums are returned to supplier for reuse. Hydraulic oil is in 5 gallon pails made from HDPE (approximately 10 pails per year). This generates approximately 15kg/year of waste. These pails are re-used on the farm or triple rinsed and recycled at the local farm Co-op.

Animal Health Products

Pigs are pre-vaccinated prior to delivery. No animal health products are used on site specific to the pigs. As required, local veterinarians are contracted to the site.

Outputs

No packaging wastes were generated from the sale of livestock.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Most of this waste is recycled or reused.

4.2.2 Dairy

1. Farm Type - Dairy Farm, Southwestern Ontario

Overview of Operations

A 220 head dairy farm was visited (Photo 15). In addition this farm has about 650 acres of cropland in production on which corn, soybeans, wheat and alfalfa are grown. The crops are primarily used to feed the cows throughout the year. Approximately 10% of this farm's annual revenue comes from the sale of cash crops. The farm did not have an Environmental Farm Plan.



Photo 15 Dairy Farm

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Feed additives and Milk replacer

Sodium bicarbonate, heifer minerals and milk replacer is sold in paper bags that are for the most part lined with plastic. Approximately 30 bags/month or 360/year are used at this farm. This generates about 110 kg of waste. These bags are burned on-site.

Hay

Hay comes in bale wrap, net wrap or twine. Approximately 1,000 round straw bales (twine), 220 round hay bales (net wrap), 200 round hay bales (bale wrap), and 1,500 small square (twine) bales are used annually at this farm. The bale wrap, net wrap and twine are disposed. There are limited recycling opportunities for bale wrap. The farmer considered this a major waste management issue.

Sanitation

A number of sanitation products are used at this dairy farm. Approximately 12-205 litre plastic drums of *teat dip*, 12-205 litre plastic drums of *soap*, and 1-205 litre plastic drum of *foot bath* are used annually. The drums are made from HDPE. Approximately 12-205 litre plastic drums of *Chlorine* and 12-105 litre drums of *Acid* are used. The drums are made from HDPE. Approximately 500 kg of waste (HDPE) is generated annually at this farm. The plastic drums are currently not recyclable and are a disposal issue. Some are rinsed and re-used.

Engine Oil and Hydraulic Oil

Engine oil and hydraulic oil is used for various equipment. A few “5 gallon pails” are used annually. The pails are made from HDPE. There is no recycling program for these pails. Where possible the pails are re-used on the farm.

Animal Health Products

Some animal health products are used on-site. Vets take back their own sharps and medical waste. There is a storage area for medicines at the farm. Some containers go back to the supplier. A small amount ends up in the garbage.

Outputs

No wastes are generated from the sale of milk.

Insights

A considerable quantity of packaging waste, primarily plastic, is generated on the farm annually. This consists of 45 and 20 gallon HDPE drums. There are no obvious recycling programs for these drums.

A considerable quantity of bale wrap, net wrap and twine are also generated on this farm annually with limited recycling opportunities.

2. Farm Type - Dairy Farm, Eastern Ontario

Overview of Operations

A 63 head dairy farm was visited (Photo 16). In addition this farm has about 900 acres of cropland in production on which oats, barley, corn and alfalfa, soybeans, and fall wheat are grown. Approximately 400 acres are used for cash crops (soybeans, fall wheat). The remaining 500 acres are used to feed the cows throughout the year. Approximately 25% of this farm's annual revenue comes from the sale of cash crops. The farm has been operating under an Environmental Farm Plan since 2001.



Photo 16 Dairy Farm

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Feed additives and Milk replacer

Approximately 60% of feed supplements are blown into the barn loose by contracted services. The remaining 50% of feed supplements (heifer minerals and milk replacer) is purchased in paper bags that are for the most part lined with plastic or waxy coating. Approximately 12 bags/month or 144/year are used at this farm. These bags are returned to local feed mill (5 km from site).

Hay

Hay is wrapped in plastic bale wrap for high moisture feeding. Approximately 365 round bales year are used on this farm (one per day). The bale wrap is recycled through the municipal curbside collection program providing it is clean. This material has been placed curbside for recycling collection since 2001. Approximately 30 small square bales using plastic baling twine are used for dry feeding per day. Annually, 20 boxes of plastic twine are used (1 box = 20,000 feet of plastic twine).

Sanitation

A number of sanitation products are used at this dairy farm. Approximately 4-50 litre plastic pails of *teat dip*, 12-50 litre plastic pails of soap, 6-50 litre plastic pails of cleaning acid for the milk bulk tank, and 1-50 litre plastic pail of foot bath are used annually. The pails are made from HDPE. Approximately 12-10 litre plastic pails of *Chlorine* are used annually to sterilize the pipelines. These pails are made from HDPE. In addition to cleaning supplies, the barn is sprayed seasonally with 'Bug Whacker' fly killer aerosol, (12-750ml cans per year). The plastic pails are either reused on the farm for feeding calves or recycled through the curbside Blue Box program. Empty aerosol cans are included in the Blue Box.

Engine Oil and Hydraulic Oil

Approximately 3-20 litre pails are used annually. The pails are made from HDPE. These pails are triple rinsed and taken back to local farm Co-op for recycling.

Animal Health Products

Dairy herd vaccination is conducted on-site twice per year. The small OCC boxes that the vaccines are packaged in are recycled through the Blue Box program. Sharps generated on-site are recycled through the local 'take-back-program' at the farm Co-op. Approximately 20 glass ampoules are generated per year (50cc bottles). The bottles are rinsed and recycled through the Blue Box program.

Outputs

No wastes are generated from the sale of milk.

Insights

A considerable quantity of plastic packaging waste is generated on the farm annually. This consists of mainly 50 litre HDPE pails. The majority of these pails are either recycled (Blue Box program, local farm Co-op) or reused on-site. Bale wrap is currently recycled through the Blue Box program. Efforts have been made to manage the bale wrap on a regular basis by not leaving material outside or on the ground. Bale wrap is bagged into clear plastic bags and stored in equipment shed (away from animals) until the scheduled collection day. Plastic baling twine is not recycled and is disposed of in landfill (Photo 17).



Photo 17 Plastic Baling Twine

4.2.3 Poultry

1. Farm Type - Poultry (Broiler) Farm, Southwestern Ontario

Overview of Operations

A 100,000 bird per year poultry (broiler) farm was visited. At any one time there are about 20,000 chickens on-site. In addition this farm had about 140 acres of cropland which is rented out to another farmer for cash crop. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Supplements

Various vitamin supplements come in 4 litre containers. These containers are made from HDPE. Approximately 20 containers are used annually. Containers are rinsed and returned to the retailer for recycling.

Feed

All feed is premixed and purchased in bulk.

Sanitation

Sanitation products are used to clean the barn and feeding equipment. Approximately 10-4 litre plastic jugs are used annually. These jugs are burned on the farm.

Animal Health Products

Some animal health products are used on-site including vaccines. The small OCC boxes that the vaccines are packaged in as well as the glass ampoules of vaccine are burned on the farm.

Outputs

No wastes are generated from the sale of livestock.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Most of this waste is recycled or burned.

2. Farm Type - Poultry (Turkey) Farm, Southwestern Ontario

Overview of Operations

A turkey breeding company with 20 farms was visited. Annually, about 310,000 breeder turkeys and 200,000 turkeys for commercial consumption are raised in approximately 100 barns. The company has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Hatchery

The hatchery receives eggs in OCC boxes on plastic flats. The flats are washed and reused. OCC boxes are recycled if dirty. Clean boxes are flattened and stored in a warehouse for reuse when eggs are shipped out. Employees are allowed to use boxes for personal use and the general public can purchase boxes.

The hatchery uses hatch pads made from paper. Once chicks are shipped to other farms, the hatch pads are removed and landfilled (i.e. contaminated with feces). This generates approximately 800 kg of paper waste annually.

Supplements

Vitamins are purchased in bulk and distributed to farms. They are then mixed into the water supply.

Insemination

Insemination requires the use of syringes and pipettes. Approximately 9 tonnes of plastic waste is produced annually and landfilled.

Lighting

Light bulbs (mainly fluorescent tubes) are replaced in barns on a regular basis. Approximately 1,000 tubes are landfilled annually.

Sanitation

Sanitation products are used to clean the barns, nests and feeding equipment. Approximately 3,000 4 litre plastic jugs are used annually. The jugs are made from HDPE. These jugs are picked up for recycling by a local recycling company. Chlorine is also used for sanitation and is purchased in bulk totes that are reusable.

Animal Health Products

All turkeys are vaccinated. Vaccines are packaged in small OCC boxes that are recycled as are the glass ampoules (i.e. that contained vaccines). Sharps generated on-site are collected and picked up by a vet for recycling.

Outputs

Eggs

Eggs are packaged in OCC boxes on plastic reusable flats.

Turkeys

Turkeys are shipped out in plastic pullet boxes that are returned to the farms, cleaned and reused.

Insights

A substantial amount of packaging waste is generated on the site annually. A large quantity of this waste is recycled or reused. There are no recycling opportunities for plastic used for insemination purposes.

3. Farm Type - Poultry Farm (Broiler), Eastern Ontario

Overview of Operations

A 160,000 bird per year poultry (broiler) farm was visited. The production cycle is 24,000 birds every 6.5 weeks. At any one time there are 24,000 chickens on-site. Chickens roam loose in the barn (20,800 ft²). This farm also rents out 500 acres of cropland for cash crops. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Feed and Supplements

All feed and supplements are premixed and blown into the barn by contracted services. No waste is generated from this activity.

Sanitation

After each production cycle, the barn is steam cleaned by contracted services. As part of the Ontario Farm Safety Assurance Program, access to the inside of the barn is limited to specialized services. A foot bath is used at the entrance of the barn (6-4 litre jugs per year). The jugs are recycled in the municipal Blue Box collection program.

Animal Health Products

All vaccines and animal health products are administered by contracted veterinary services off site or prior to delivery of a new flock.

Outputs

No wastes are generated from the sale of livestock.

Insights

A relatively small quantity of packaging waste is generated on the site annually due to bulk delivery by contracted services and to the municipal curbside program.

4. Farm Type - Poultry Farm (Layers), Eastern Ontario

Overview of Operations

A poultry farm (layers) with a flock of 15,000 hens was visited (Photo 18). Hens are caged (6 hens per cage). At the end of each year, hens are collected by a food rendering company. In addition to egg production, the farm conducts on-site egg grading. Crops are not grown for feed production of this farm. The farm has an Environmental Farm Plan.



Photo 18 Poultry (Layer) Farm

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Feed

Feed and feed supplement is blown into the barn through local contracted services (corn, soybean, minerals, limestone and oyster shell mixture). This process does not generate packaging wastes.

Sanitation

The entrance to the hen barn uses foot bath disinfectant, approximately 1-4 litre HDPE jug every two years. These are recycled in the Blue Box. The barn is cleaned with steam at the end of the annual production. The egg grading room uses 1- 10 kg pail of all purpose chlorine based cleaner (HD-10) per year for the grading equipment and floor (Photo 19). The HDPE pail is triple rinsed and recycled at a local farm Co-op.

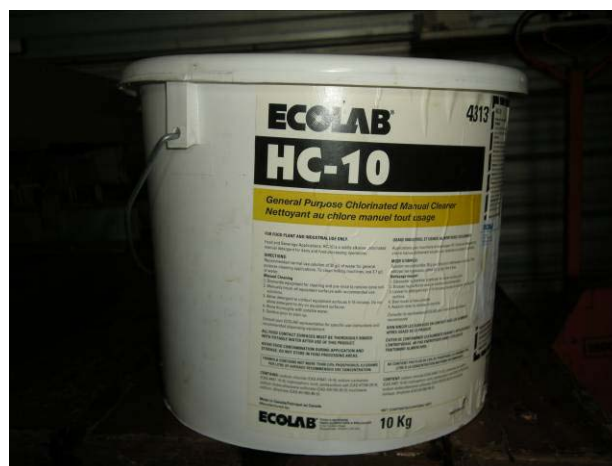


Photo 19 10kg HDPE Pail

Egg Grading Station

Weekly egg grading occurs at this site in a separate 1,000 ft² building equipped with 40 foot by 40 foot egg cooler. Graded eggs are stored in the cooler in fibre board flats (30 eggs per flat by 6 flats per stack) with a reusable HDPE base flat (Photo 20). The fibre board and reusable base flats are provided by the egg purchasing company.



Photo 20 Eggs on Fibre Board

Animal Health Products

No animal health products are used on-site.

Outputs

Eggs are sold direct to distributors in recyclable fibre board egg cartons and reusable base plate crates. The reusable base plates minimize carton damage. If a carton is damaged, it is recycled through the Blue Box program. Eggs are not sold on site.

Insights

A minimal amount of packaging waste is generated at this site primarily due to contracted services of feed products and supplements. Plastic pails are either recycled or reused on-site. Some paper fibre waste is generated from the sale of eggs.

4.3 Greenhouse Vegetable

1. Farm Type - Cucumber Farm (Greenhouse), Southwestern Ontario

Overview of Operations

An 18 acre greenhouse cucumber farm was visited. Three crops of cucumbers are grown annually. They package and ship cucumbers to markets from this farm. Approximately 8.4 million cucumbers are grown annually. The farm has an Environmental Farm Plan. The farm appears to actively recycle most of its wastes. A variety of local contractors provide recycling services to this and other local farms.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Fertilizer

Calcium is received in bulk containers. All other fertilizers are received in 25kg bags. About 60 bags/week or about 3,000 bags/year are generated. This generates about 900kg of waste per year. These are disposed and sent landfill.

Plants are grown hydroponically and fertilizer in solution is directed using irrigation hoses (ca. 4-6mm in diameter). These plastic hoses are replaced every 6-8 years.

Pesticides

Pesticides used come in 4 litre or less HDPE plastic containers. A few 205 litre drums of product are also used. They are triple rinsed and taken back to the retailer (MGS) for recycling. Biological control agents are used for much of their pest control. They generate little waste.

Ground Cover

The soil is covered with LDPE film (Photo 21). This film is removed annually and recycled.



Photo 21 Ground Cover LDPE Film

Grow Bags

Cocoa filled grow bags are used to grow cucumbers (Photo 22). Growing blocks are inserted in these grow bags. This generates an estimated 13 tonnes/acre of waste (i.e. the plastic part of the grow bags). The plants are held into place with jute string. This is an organic material and does not generate any waste (i.e. removed with vines at end of season and composted).



Photo 22 Grow Bags

Packing boxes

An unknown quantity of damaged packaging boxes (Photo 23) are directed to an on-site baler. A third party waste contactor collects bales for recycling. The farm receives some revenue from this recycling.



Photo 23 Undamaged Cardboard Shipping Boxes

Packing plastic

There is considerable LDPE stretch film used to prepare cucumbers for market. This is used to seal each individual cucumber. This results in considerable wastage. Approximately 2-40 cubic yard bins are directed to landfill annually.

Outputs

Packaging sleeves

Each cucumber is packaged in a stretch film sleeve. Each sleeve weighs about 1 gram. This generates about 8.4 tonnes of off-farm waste per year.

Packing boxes

Cucumbers are packed in packing boxes (12, 18 and 24 cucumber box sizes) and shipped to market. Each box weighs about 1 kilogram on average and about 700,000 boxes are shipped annually from this facility. This generates about 700 tonnes of off-farm waste per year.

Insights

Many of the inputs used at this farm come in bulk and generate no wastes. Some inputs such as pesticides have return to retailer recycling programs. The preparation of cucumbers for market results in the generation of a considerable amount of packaging waste (OCC, stretch film). Most OCC is recycled. Much of the plastic packaging is landfilled.

There are recycling and composting programs in place to deal with many of the other non-packaging and organic wastes generated at this farm.

2. Farm Type - Tomato and Pepper Farm (Greenhouse), Southwestern Ontario

Overview of Operations

An 18 acre greenhouse tomato (9 acre) and pepper (9 acre) farm was visited. They package and ship tomatoes and peppers from this farm. The farm has an Environmental Farm Plan. The farm appears to actively recycle most of its wastes. A variety of local contractors provide recycling services to this and other local farms.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Fertilizer

Most fertilizer is received in bulk. Micronutrients are received in bags. These bags are disposed.

Plants are grown hydroponically and fertilizer in solution is directed using irrigation hoses (ca. 4-6mm in diameter). Approximately 150,000 feet/acre is used. These plastic hoses are replaced every 5-10 years.

Carbon Dioxide

Carbon dioxide is added to the greenhouse atmosphere using LDPE plastic piping. Approximately 8,000 feet/acre is used. This piping is replaced every 2-4 years.

Pesticides

Pesticides used come in a variety of sizes (up to 2 gallon/10 litre). They are mostly triple rinsed and taken back to the retailer (MGS) for recycling. Biological control agents are used for much of their pest control. They generate little waste.

Acids and Cleaners

Large (205 litre) drums of acids and cleaners are used on the farm. They include a deposit and returned to the retailer (MGS).

Sanitizers

Approximately 55- 20 litre pails/year of sanitizer are used to sanitize the greenhouse (Photo 24). These pails are rinsed out and returned to the retailer or re-used on-site.



Photo 24 HDPE Pail

Ground Cover

The soil is covered with LDPE film annually. This film is not removed but is cleaned at the end of the growing season. A new layer is added each year. No waste is generated.

Grow Bags

Cocoa filled grow bags are used to grow tomatoes and peppers. Growing blocks (rockwool) are inserted in these grow bags. This generates an estimated 18 tonnes/acre (i.e. plastic grow bags and growing media) of waste. This is collected and recycled (ATI) once per year.

String

Each tomato plant is held in place with 30 feet of plastic string (300,000 feet/acre) (Photo 25). Each pepper plant is held with 12 feet (120,000 feet/acre) of plastic string. This is collected (with vines) and recycled (ATI) once per year.



Photo 25 Truss Supports in a Greenhouse

Clips and Truss Supports

Plastic clips and HDPE truss supports are used to hold the tomato plants in place and support the plant (Photo 26). About 300,000 clips/acre are used for tomato plants. Each clip weighs about 1 gram. About 300 kg/acre of clips are generated. This is collected (with vines) and recycled (ATI) once per year. No clips or truss supports are used for pepper plants.



Photo 26 Clips

Packing boxes

An estimated 275,000 OCC boxes/year are used to pack tomatoes (i.e. 50 kg/m² production; 6.5 kg tomatoes/box). An estimated 375,000 OCC boxes/year are used to pack peppers (i.e. 125 unit/m² production; 12 units/box).

An unknown quantity of damaged packaging boxes are recycled annually. A third party waste contactor collects cardboard for recycling.

Outputs

Packing boxes

An estimated 275,000 OCC boxes/year are used to pack tomatoes (i.e. 50 kg/m² production; 6.5 kg tomatoes/box). An estimated 375,000 OCC boxes/year are used to pack peppers (i.e. 125 unit/m² production; 12 units/box).

Each box weighs 1 kilogram on average and about 650,000 boxes are shipped annually from this facility. This generates about 650 tonnes of off-farm waste per year.

Insights

Many of the inputs used at this farm come in bulk and generate no wastes. Some inputs such as pesticides have return to retailer recycling programs. The preparation of tomatoes and peppers for market results in the generation of a considerable amount of packaging waste (OCC). Most OCC is recycled.

There are recycling and composting programs in place to deal with many of the other non-packaging and organic wastes generated at this farm.

3. Farm Type - Greenhouse plastic recycling. Agricultural Technology Incorporated (ATI), Kingsville, ON

Overview of Operations

This business services the greenhouse industry in the Leamington area. They remove grow bags (Photo 27) from greenhouses at the end of the season and process them at their facility. They also receive grow bags from contractors. Grow bags are made from LDPE and are white on the outside and black on the inside. The inside layer is designed to hold moisture.



Photo 27 Recycling of Grow Bags

Key Waste Generating Activities and Waste Management

The key waste activities include:

Receipt of Waste

Wastes are received and stockpiled in a number of large fabric tension structures (Photo 28). Greenhouses are cleaned out in November-December of each year so these wastes are received in a very short window of time.



Photo 28 Removal of Growing Media

Removal of Growing Media from

A proprietary process (reciprocating conveyors, specialized trommel screens) are used to remove growing media from the bags

Grinding

The plastic film is ground. (Photo 29)



Photo 29 Ground Plastic Film

Washing

The plastic film is washed.

Densification

The plastic film is further size reduced through a densification process. Approximately 20 tonnes of plastic film is shipped out per week.

Growing Media Recycling

The growing media (coco and rockwool) are recycled. The coco is sold in bulk as a growing media/soil amendment (but not back to the greenhouse industry). The

rockwool is used for a variety of purposes including as an ingredient for the manufacture of bricks.

There is some on-site composting of the fibrous parts of the growing media (e.g. roots, parts of vines).

Insights

There is approximately 2,000 acres of greenhouse space devoted to vegetable growing in the Leamington area. ATI services a number of growers. There are few other recycling opportunities. A considerable amount of this material still ends up in local landfills.

This facility presents a solution to the recycling of grow bags from the greenhouse industry. Their technology, which removes organic (growing media) from inorganic (film plastic) could be used in other applications. They could also potentially address other plastic recycling issues (e.g. bale wrap).

4. Farm Type - Greenhouse Cut Flower, Potted Plant and Cut Flower Packaging Farm, Niagara Region, Ontario

Overview of Operations

A 7.5 acre greenhouse (over 3 locations) that grows cut flowers and potted plants was visited. This farm also includes a large packaging facility. The farm receives, repackages (i.e. bouquets) and adds value (e.g. includes decorative vases etc.) to imported and other local cut flowers. These bouquets and other products are sold to grocery store chains and other customers. About 70% of this farms products are exported to the US. The farm does have an Environmental Farm Plan. The farm has a number of recycling programs.

Key Waste Generating Activities and Waste Management

The key waste generating activities included:

Inputs

Production of Cut flowers/Potted plants

Fertilizer

All fertilizers are received in 10-25kg bags. An unknown quantity are generated annually. These are disposed and sent landfill.

Pesticides

Essentially no chemical pesticides are used. Most pest control is affected through various biological control agents.

Grow Bags

Coco or rockwool (i.e. processed coconut waste) filled grow bags are used to grow cut flowers and potted plants.

Packaging area

Packing boxes

An unknown quantity of packaging boxes (Photo 30) and inserts are received from imported flowers. This is directed to an on-site OCC compactor. A third party waste contractor services this compactor. Annually about 30 tonnes of OCC is generated. The farm receives some revenue from this recycling.



Photo 30 Cardboard Packaging Boxes

Pails

Twenty litre pails (Photo 31) are used to transport local cut flowers to the packaging facility. These HDPE pails are reused for the same purpose on an ongoing basis.



Photo 31 Pails for Transporting Cut Flowers

Waste

Waste consisting of mostly plastic packaging is generated in the packaging area. This includes plastic sleeves that all flowers are received in as well as plastic film and other wastes. This is directed to an on-site waste compactor. A third party waste contactor services this compactor. Approximately 90 tonnes/year of waste are directed to landfill from this farm.

Outputs

Production of Cut flowers/Potted plants

Pots and Trays

Potted plants are sent to market in the pots they were grown in. These pots are either PP or PS. The pots are often inserted into trays (which hold the pots).

Packaging Boxes

Potted plants can also be packed in OCC boxes.

Packaging area

Packaging sleeves

Each bouquet of flowers is packaged in a plastic film sleeve (Photo 32). Each sleeve weighs about 4 grams. Information on the number of cut flowers shipped annually was not available. Cut flowers are also placed in shipping boxes.



Photo 32 Plastic Sleeves

Packaging Boxes

All products are shipped out in OCC boxes (various sizes) and wrapped in shrink wrap (Photo 33).



Photo 33 Product Ready for Shipping

Insights

The cut flower and potted plant parts of the farming operation are similar to other facilities visited in terms of production techniques, inputs and outputs.

The packaging facility was unique. It generates considerable wastes from the receipt of imported cut flowers and the repackaging and distribution of these cut flowers. OCC is fully recycled. Various plastic packaging and other waste is directed to a compactor. There appear to be no recycling opportunities for the plastic packaging generated at this farm. Key issues include the different types of plastic packaging and that it may be contaminated with plant material.

5. Farm Type - Greenhouse Bedding Plants and Potted Plant Farm, Niagara Region, Ontario

Overview of Operations

A 9.5 acre greenhouse that grows primarily bedding plants but also potted plants was visited. This farm also included a large packaging facility for shipping out finished products. There is also another 9.5 acre greenhouse nearby that produces the same products.

Approximately 1.3 million plants are produced annually. This includes about 400,000 potted plants and 5.4 million bedding plants (in six plant cell packs).

The farm also receives and redistributes imported plants to a large retailer in Canada and the US.

About 50% of these farms products are exported to the US. The farm has an Environmental Farm Plan. The farm has a number of recycling programs.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Fertilizer

All other fertilizers are received in 10-25kg bags. An unknown quantity is generated annually. These are disposed and sent landfill.

Pesticides

Essentially no chemical pesticides are used. Most pest control is affected through various biological control agents.

Cuttings

A considerable amount of planting material comes into the greenhouse as cuttings. These cuttings typically come in OCC boxes but can also come in PS boxes. The OCC is recycled.

A third party contractor removes this OCC in a rear packer (collection vehicle) for recycling.

Plug Trays

Plug trays are used for propagating plants. They tend to be manufactured from PP. They are sterilized and reused many times. When they are manufactured from PS they can only be used on one occasion as they melt during sterilization.

Peat

Peat comes in large bales that are wrapped in white LDPE plastic. A single bale is transported on a pallet (Photo 34).



Photo 34 Peat Wrapped in LDPE Film

Cells, Pots and Trays

A variety of pots (4" and 6" are common) are used to grow bedding and potted plants. Cells tend to be made from PS while pots and trays are made from PP and PS. The stronger and more rigid pots are made from PP.

Approximately 900,000 cell packs are used annually. Approximately 400,000 plant pots are used annually.

The pots and trays tend to be received on pallets. Some come in a large box (i.e. one box per pallet).

The pots and trays do not create significant quantities of waste during production.

OCC is recycled. Stretch wrap and any film plastic are disposed.

Hanging Baskets

A variety of hanging baskets (typically 10-12") are used (Photo 35).



Photo 35 Hanging Baskets

Waste

Waste is collected in a 35 cubic yard compactor about once per month. It is estimated that about 70 tonnes/year of waste is generated. This includes mostly various plastic packaging and other wastes including limited plant/soil material and soiled OCC.

Outputs

Packaging Boxes

An estimated 65,000 boxes (6 potted plants per box) are used to ship outgoing potted plants. Each packing box weighs about 1 kg. Approximately 65 tonnes of OCC is shipped out annually.

Packaging sleeves

Many potted plants are packaged in a plastic film sleeve. Each sleeve weighs about 4 grams. Approximately 400,000 potted plants are produced annually. Approximately 1,600 kg of sleeves are shipped out annually.

Cells, Pots and Trays

About 900,000 cells are shipped out annually. Each cell weighs about 10g. Approximately 9 tonnes of cells are shipped out annually.

About 400,000 pots are shipped out annually. Most of those are shipped in trays. Each pot weighs approximately 30 grams. Approximately 12 tonnes of pots are shipped out annually. About 65,000 trays are used annually. Each tray weighs about 100 grams. Approximately 6 tonnes of trays are shipped out annually.

It should be noted that this farm participates in a return to retail program with a large multinational retailer. They receive and sort through pots and trays to salvage what they can use themselves. The balance is directed to recycling (two tractor trailer loads in last year) and waste disposal.

Insights

The key waste types generated include OCC and plastic packaging. Essentially all of the OCC is recycled. Much of the plastic packaging waste is film plastic generated from receipt of inputs and from propagation. Much of the plastic packaging that is disposed (and a considerable amount is recycled) has been returned from retail.

This farm pays stewardship fees to Stewardship Ontario for about 50 tonnes of material annually.

6. Farm Type - Greenhouse Potted Plant and Peach Farm, Niagara Region, Ontario

Overview of Operations

A 13.5 acre greenhouse that grows primarily potted plants was visited. This farm also included 400 acres of peaches and grapes. The focus of the site tour was on the greenhouse production of potted plants.

About 90% of this farm's products are exported to the US. The farm has an Environmental Farm Plan. The farm has a number of recycling programs.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Cuttings

A considerable amount of planting material comes into the greenhouse as cuttings. These cuttings typically come in cardboard boxes but can also come in PS boxes. The OCC is recycled.

About 25 tonnes of OCC is recycled at this farm (i.e. from all activities). A small baler is used to bale OCC. A third party contractor removes this OCC at no cost.

Fertilizer

All fertilizers are received in 11kg LDPE bags. About 15 tonnes or 1,200 bags of fertilizer are used annually. These are disposed and sent landfill.

Pesticides

Essentially no chemical pesticides are used. Most pest control is affected through various biological control agents.

Plug Trays

Plug trays are used for propagating plants. They tend to be manufactured from PP.

Peat

Peat comes in large bales that are wrapped in white LDPE plastic. A single bale is transported on a pallet. About 500-3,000 litre bales are used annually. The wrap is a waste product and disposed. Each wrap weighs about 1kg and therefore about 0.5 tonnes of wrap is disposed annually.

Plastic Sheeting

During the propagation process some pots are covered with plastic sheeting for a period of time (Photo 36). About 1,000 kg of this plastic sheeting is used annually. This plastic sheeting is disposed.



Photo 36 Plastic Ground Cover

Cells, Pots and Trays

A variety of pots (4" most common) are used to grow potted plants. Pots and trays (which hold a number of pots) are made from PP.

The pots (Photo 37) and trays (Photo 38) tend to be received on pallets. Some come in a large box (i.e. one box per pallet).



Photo 37 Plant Pots



Photo 38 Plant Trays

The pots and trays do not create significant quantities of waste during production.

OCC is recycled. Stretch wrap and any film plastic are disposed.

Waste

Waste directed to landfill consists largely of plastic packaging. It is stored in a bin and emptied as required. A third party waste contactor services this bin.

Outputs

Packaging Boxes

Products are shipped out in 165,000 OCC boxes and wrapped in shrink wrap. Each packing box weighs about 1 kg. Approximately 165 tonnes of OCC is shipped out annually.

Packaging sleeves

Many potted plants are packaged in a plastic film sleeve. Each sleeve weighs about 4 gram. Approximately 1,300,000 potted plants are produced annually. Approximately 5 tonnes of sleeves are shipped out annually.

Pots and Trays

About 1,300,000 pots are shipped out annually. Most of those are shipped in trays.

Each pot weighs approximately 30 grams. Approximately 40 tonnes of pots are shipped out annually.

Insights

The key waste types generated include OCC and plastic packaging. Essentially all of the OCC is recycled. Much of the plastic packaging waste is film plastic generated from receipt of inputs and from propagation.

4.4 Field Vegetable

1. Farm Type - Field Vegetable, Southwestern Ontario

Overview of Operations

A field vegetable farm was visited. The farm has a total of 470 acres. The farm annually grows 120 acres of cabbage, 30 acres sweet corn, 25 acres each of cauliflower, broccoli and onions and 20 acres of squash. The remainder of the farm is used to grow soybeans and wheat. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seeds

The majority of vegetable seeds come in small OCC boxes. OCC boxes are cut up and used for signage.

Sweet corn and soybeans come in multi-layer paper bags. Approximately 100 kg of waste are produced annually. The bags are burned on the farm.

Pesticides

Pesticides come in 10 litre containers. They are triple rinsed and taken back to the retailer for recycling. Containers are shipped in OCC boxes. Most of this OCC is burned.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Packaging

OCC boxes are purchased to package produce. Boxes come flattened, on skids and shrink wrapped. The shrink wrap is landfilled. Skids are reused to ship out produce.

Oil

Hydraulic oil and engine oil comes in 1 litre, 4 litre and 5 gallon pails. The 1 and 4 litre jugs are recycled and the 5 gallon pails are burned.

Outputs

A substantial amount of vegetables are packaged in plastic crates (Photo 39) and shipped to stores. The crates are returned to the farm and reused. The remainder of the produce is packaged in OCC boxes.

Sweet corn is shipped in 20 bushel bins made of wood and stamped with the farm name. They are returned and reused.



Photo 39 Plastic Shipping Crates

Plastic crates and OCC boxes are stacked on wood pallets for shipping and wrapped with shrink wrap. Approximately 120 rolls of shrink wrap are used annually. The OCC cores are burned in a wood stove.

Insights

Some packaging waste is generated on the site annually. The majority of paper waste is burned and plastic packaging is returned to the retailer for recycling or landfilled. Shipping and storage containers are returned to the farm and reused.

2. Farm Type - Vegetable (carrots and sweet potatoes), Southwestern Ontario

Overview of Operations

A 460 acre carrot (370 acres) and sweet potato (90 acres) farm was visited. The farm has an Environmental Farm Plan but it has not been updated in some years. Essentially all produce is sold into local markets.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seeds/Cuttings

Carrot seeds come in “5 gallon” pails. Approximately 75 pails are used annually. Each pail weighs about 1.5 kg and therefore about 110 kg are generated annually. These pails are given to a local and unrelated business and they are reused.

Sweet potato slips (cuttings) are received in OCC boxes. Approximately 1,250 boxes are received annually. Each box weighs about 1 kg and therefore about 1.3 tonnes are generated annually. OCC is taken to a local landfill recycling depot.

Fertilizers

All fertilizers used come in bulk and no waste is generated.

Pesticides

A variety of pesticides are used for crop production. The number of containers used is unknown but pesticide usage costs this farm about \$40,000/year. Rinsed out pesticide containers are placed in large plastic bags (supplied by retailers) and returned to the retailer (Cargill, Agrispray).

Engine Oil/Hydraulic Oil

Oil is received in 45 gallon drums. Used oil is taken to a facility for recycling. Empty drums are collected by a waste contractor for recycling.

Oil Filters/Air Filters

About 30 oil filters and 40 air filters are generated annually. They are taken to a local retailer for recycling.

This farm uses about 250 litres of oil per year. The oil itself is recycled at a local Petro Canada. The oil is received in containers that are 10 litres or smaller. There is no opportunity to recycle these pails and they are placed in the residential garbage and placed at the curb for pick-up.

Waste Disposal

On average this farm places one bag with residential garbage at the curb for pick-up per week.

Outputs

Cardboard Boxes

Carrots are shipped to a processor in reusable plastic totes.

Sweet potatoes are collected from the field in wooden bins. They are transferred into OCC boxes after curing. Each box holds about 40 pounds of sweet potatoes and about 20,000 are used annually. Each box weighs about 1.5 kg and therefore about 30 tonnes of cardboard leaves the farm annually.

Insights

A moderate quantity of packaging waste is generated on the site annually. Most of these wastes are reused by others, recycled at local recycling facilities and/or returned to retailer. There appear to be recycling opportunities for all packaging wastes generated on the farm.

3. Farm Type - Field Vegetable, Grain and Oilseed, Southwestern Ontario

Overview of Operations

A field vegetable farming operation was visited that grows approximately 5,500 acres of vegetables on numerous fields. Crops grown include sweet corn, squash, peas, carrots, green beans and lima beans. This farm also grows corn, soybeans and wheat. The farming operation has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Vegetables

The majority of vegetable seeds come in 25kg paper (multi-layer) bags. Pea seeds are delivered in bulk. Approximately 1,500 bags of seed are used per year. This generates about 500 kg of waste per year. This packaging material is burned.

Pesticides

Pesticides used come in 10 litre containers or 450L bulk totes. They are triple rinsed and taken back to the retailer for recycling. Containers are shipped in OCC boxes. Most of this OCC is burned.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Oil

Hydraulic oil and engine oil comes in bulk totes that are returned to the supplier for refilling. Oil filters are sent to the main maintenance garage where the oil is drained and the filters are sent for recycling.

Outputs

No wastes are generated from the sale of vegetable and cash crops.

Insights

A substantial quantity of packaging waste is generated on the site annually. Some of this waste is burned (paper) and plastic packaging is returned to the retailer.

4. Farm Type - Potato and Grain (corn, wheat, soybean), Midwestern Ontario

Overview of Operations

A 200 acre potato farm was visited. In addition to potatoes, this farm also grows corn, soybeans and wheat. Annually about 200 acres of each of these types of crop are grown. The remainder of the acreage is harvested for hay or rented out. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities included:

Inputs

Potatoes

Seed potatoes are purchased in bulk and no waste is generated.

Pesticides

Pesticides used come in 4 litre – 10 litre containers. They are triple rinsed, labels removed and tops cut off and taken back to the retailer for recycling. Containers are shipped in OCC boxes. These are broken down and recycled in the Blue Box.

Grain Crops

Seed

Corn seed comes in paper bags (lined). On this farm about 80-100 bags are used annually. The bags are made from kraft paper and lined in plastic. This generates about 25-30 kg of waste per year. The bags are not recyclable and are burned on the property.

Depending on the variety and quantity ordered, some soybean and wheat seed comes in large bulk bags (Photo 40). The majority of seed is purchased in bulk. On this farm about 10 bulk bags are used per year. The bulk bags are made from woven PP plastic. This generates about 20 kg of waste per year. They are burned on the property.



Photo 40 PP Bulk Bags

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Pesticides

Pesticides used come in 3.78 litre – 10 litre containers. They are triple rinsed, labels removed and tops cut off and taken back to the retailer for recycling.

Oil

Hydraulic oil and engine oil comes in 20 litre HDPE pails (Photo 41). Due to the residue on the plastic they are considered a hazardous waste and are not accepted at the landfill. If purchased from a farm supplier, they are returned and reused.



Photo 41 HDPE Pails

Outputs

No wastes were generated from the sale of potatoes and grains.

Insights

A relatively small quantity of packaging waste is generated on the site annually. Some of this waste is burned (paper) and plastic packaging is returned to the retailer, re-used on site or burned. There are no recycling opportunities for HDPE “5 gallon pails” if not purchased from a farm supplier and woven PP bulk bags.

5. Farm Type - Vegetable (Sweet Corn and Potatoes) and Oilseed Eastern Ontario

Overview of Operations

A vegetable farming operation was visited that grows white, red and russet potatoes (12 acres), and hybrid sweet corn (60 acres). This operation also grows soybeans (50 acres) as a cash crop. The farming operation has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Vegetables

The sweet corn seeds come in 40kg paper (multi-layer) bags with plastic liners, generating 100 bags per year. This generates 30kg of waste per year. The bags are sent to landfill. The potatoes are delivered in bulk reusable plastic woven bags that are returned to the supplier. Potatoes yield approximately 18 tonnes per acre.

Cash Crop

Soybean seeds are purchased in large plastic woven bulk bags 4'x4'x4'. The bag is not returnable due to treated seeds (bags were returnable until 2001). One bag holds 1,000 pounds of seed and 10 bags are used annually. The bags are landfilled. This generates about 20 kg of waste per year.

Pesticides

The farmer uses 6 -10 litre jugs of blight control per year. A highly concentrated insecticide (1-4 litre jug per year) is used for sweet corn. The jugs are HDPE, and are triple rinsed and taken back to the local Co-op for recycling. Weed spray service is contracted.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Oil

Hydraulic oil and engine oil comes in bulk 45 gallon reusable metal drums that are returned to the supplier for refilling. Oil filters are sent to a local garage where the oil is drained and the filters are sent for recycling.

Outputs

No wastes are generated from the sale of vegetable and cash crops.

Insights

A small quantity of packaging waste is generated on the site annually. All of this waste is landfilled with no on-site burning.

4.5 Fruit and Tender Fruit

1. Farm Type - Apple, Tender Fruit Orchard and Field Vegetable, Southwestern Ontario

Overview of Operations

A fruit orchard and field vegetable farm was visited. The farm has 92 acres of apples, 11 acres of peaches, 7 acres of cherries and 3 acres of plums. They also grow 4 acres of sweet corn and 1 acre is planted with squash, tomatoes, peppers, cucumbers, cantaloupe, watermelons, pumpkins and gourds. The remainder of the 350 acre farm is used to grow soybeans. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seeds

The majority of vegetable seeds come in small OCC boxes. Seeds are planted in starter trays by a third party. Once the seedlings are planted in the field, starter trays are returned to the third party and reused.

Pesticides

Pesticides used come in 4 litre and 10 litre containers. They are triple rinsed and taken back to the retailer for recycling. Containers are shipped in OCC boxes. Most of this OCC is burned. The majority of herbicides are granular and come in 25kg multi-layer paper bags (i.e. paper, plastic and foil). This generates about 120kg of waste annually. This packaging is burned.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Oil

Hydraulic oil and engine oil comes in “5 gallon” pails. These are reused on the farm and eventually recycled. Used oil is being returned to the equipment dealer for recycling. The paper filaments in oil filters are burned and the metal is taken to the scrap yard.

Outputs

Apples are shipped in 20 bushel bins made of wood or plastic and stamped with the farm name (Photo 42). They are returned and reused.



Photo 42 20 Bushel Plastic and Wood Crates

Peaches are packaged in 3 litre punnet baskets (OCC with wood handle) which are shipped in masters (flat OCC boxes that hold 6 punnets).

The majority of cherries, plums, sweet corn and other fruits and vegetables are sold at a roadside stand on the farm. These are packaged in punnet baskets (OCC with plastic handle), plastic grocery bags or containers that customers bring with them.

Insights

A small quantity of packaging waste is generated on the site annually. Some of this waste is burned (paper) and plastic packaging is returned to the retailer. Shipping and storage containers are returned to the farm and reused.

2. Farm Type - Apple and Tender Fruit Orchard, Southwestern Ontario

Overview of Operations

A fruit orchard was visited. The farm has 50 acres of apples, 20 acres of cherries, 8 acres of peaches and 6 acres each of plums, apricots and pears. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Pesticides

Pesticides come in 10 litre containers. They are triple rinsed and taken back to the retailer for recycling. Containers are shipped in OCC boxes. Most of this OCC is recycled.

Fertilizers

Essentially all fertilizers come in bulk and no waste is generated.

Oil

Hydraulic oil and engine oil comes in 5 gallon pails. These are reused on the farm and eventually landfilled. Used oil is being returned to the equipment dealer for recycling. Oil filters are landfilled.

Outputs

Apples are shipped in 20 bushel bins made of wood or plastic and stamped with the farm name. They are returned and reused.

Peaches and pears are packaged in 3 litre punnet baskets (OCC with wood or plastic handle) (Photo 43) which are shipped in masters (flat OCC boxes that hold 6 punnets).



Photo 43 Punnet Baskets

Plums and apricots are packaged in 2 litre baskets which are shipped in masters (8 to a box).

The majority of cherries are “pick your own” for the general public. People bring their own containers or plastic bags are available at the farm.

Insights

Very little packaging waste is generated on the site annually. Most of this waste is recycled (OCC), landfilled (5 gallon pails) or returned to the retailer for recycling. Shipping and storage containers are returned to the farm and reused.

3. Farm Type - Apple Farm, Southwestern Ontario

Overview of Operations

A 50 acre apple farm was visited. The farm has an Environmental Farm Plan. The farm also participates in food production protocol (Global Gap). This helps it produce apples for the export market.

Apples are taken to a local cooperative for storage and final marketing. Approximately 40% of production is exported.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Plantings

Essentially all plantings come in bulk and no waste is created.

Fertilizers

Relatively little fertilizer is used at apple farms. About 50 bags are used and come in LDPE bags (25kg). This generates about 15kg of waste. This is disposed.

Pesticides

A variety of pesticides are used for apple production.

Approximately 1-1,000 litre tote of Dormant Oil Spray is used. The tote is returned to the retailer.

Fungicides are typically sold in paper bags. Approximately 45 bags are used annually. They are burned on-site.

Insecticides come in small bags (a number of small bags are contained in a single box). Bags are disposed in the garbage. Cardboard is burned on-site.

Some pesticides and growth regulators are sold in plastic jugs (range in size from 1-10 litres). The retailer (FS Partners) supplies large plastic bags (ca. 6' high; 5' wide) into which rinsed containers can be placed. These bags are then returned to the retailer.

Engine Oil/Hydraulic Oil

Oil is received in 45 gallon drums. Used oil is taken to a facility for recycling. Empty drums are collected by a waste contractor for recycling.

Oil Filters/Air Filters

The farms take used oil and oil filters to a local retailer for recycling (Jiffy Lube).

Waste Disposal

On average this farm takes one load of waste to the local landfill for disposal.

Outputs

Cardboard Boxes

The farm delivers approximately 800 tonnes of apples to the local cooperative. Of that about 600 are packaged in boxes and sent to various markets. Each box can hold 40 pounds of apples so approximately 44,000 boxes are used annually.

Each box weighs about 1.5 kg and therefore about 65 tonnes/year of OCC is used to package apples produced at this farm.

Insights

A moderate quantity of packaging waste is generated on the site annually. Most of these wastes are reused by others or recycled at local recycling facilities and/or returned to retailer.

To participate in the Global Gap food production protocol program this farm has had to develop a number of management policies/plans that focus on environmental performance. This includes policies to minimize environmental pollution and minimize waste disposal. The farm is audited annually to ensure compliance with these policies/plans. This is a condition of being able to export their apples into foreign (e.g. UK) markets.

4. Farm Type - Seasonal Strawberry Farm, Eastern Ontario

Overview of Operations

A strawberry farm was visited. The farm has a total of 250 acres with the majority of it rented out to area farmers for cash cropping. The farm uses 12 acres for strawberry growing with 6 acres producing saleable berries annually. The farm does not have an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities included:

Inputs

Strawberries

The plants are delivered to the farm site in OCC boxes (Simcoe Ontario). Each box contains 1,000 plants in 25 per bundle. The bundles are tied with rubber bands. The farm purchases 23,000 berries per annum (23 boxes).

Pesticides

Pesticides come in 1, 5 and 10 litre containers. They are triple rinsed and taken back to the local farm Co-op for recycling. Containers are purchased individually and are not shipped to the site in OCC boxes. Most of this OCC is burned.

Herbicides (Weed killer, fungicides)

In the spring, fungicides are applied to the crops (powder applications). Applications of 4.2kg per 2.5 acres (1 ha) are used. Bags are paper with waxed liners. Each bag contains 10kg of fungicide. Fungicide is applied to all 15 acres of strawberry crops (new plants and mature plants). Weed killer comes in 10 litre jugs (1.1 litres is applied to every 2.5 acres (1 ha) for all 15 acres. Paper bags are burned on site. Plastic jugs are triple rinsed and recycled at the local farm Co-op.

Fertilizers

Fertilizers are applied twice per season using 40 kg paper bags. The bags are not visibly coated and are recycled through the local Blue Box program. The site uses 40 bags in the summer and in the fall (80-40kg bags).

Packaging

Fibreboard berry boxes (1 quart capacity) and non-waxed OCC flats are purchased to package berry boxes. The berry boxes are delivered in OCC boxes carry 250 berry boxes per case. The farm orders 40 cases per year=10,000 berry boxes per year. A berry box (Photo 44) weighs 0.10kg for a total output of 1,000kg to customers (local groceries). Waste is minimized through reuse of berry boxes. Damaged berry boxes are recycled through the Blue Box program and the larger packaging boxes are also recycled.



Photo 44 Berry Box

Flats hold 8 boxes (8 quart capacity) per flat and are delivered (unfolded) in bundles of 25 to the site (Photo 45). The bundles are secured with low density plastic banding. The farm orders 400 bundles per year. The flats folded on site (Photo 46) and used for delivering the berry boxes to local grocery stores. An empty flat weighs 0.48kgs for a total output of 4,800 kg per year. Flats do not remain on sight. Damaged flats are recycled. The rubber bands are reused on the farm site. The plastic banding is burned.



Photo 45 Flats-Unassembled



Photo 46 Flats- Assembled

Oil

Hydraulic oil and engine oil comes in 1 litre, 4 litre and 5 gallon pails. The 1 and 4 litre jugs are recycled and the 5 gallon pails are triple rinsed and taken to local farm supply Co-op.

Outputs

All strawberries are packaged in the fibreboard berry boxes and OCC flats and are shipped to local stores. The boxes are not handled in crates.

Insights

Minimal packaging waste is generated on the site annually. The majority of paper waste is recycled and plastic packaging is returned to the local farm Co-op for recycling. Shipping and storage containers are not returned to the farm.

4.6 Field Nursery

1. Farm Type - Tree Nursery, Southwestern Ontario

Overview of Operations

A 100 acre tree nursery (coniferous) was visited. The nursery produces seedlings/transplants, larger trees as well as Christmas trees. They also have 100 acres in corn and rye production. Essentially all trees are marketed in Canada. The farm has an Environmental Farm Plan.

Key Waste Generating Activities and Waste Management

The key waste generating activities include:

Inputs

Seed bags

Trees are planted from seed.

Fertilizers

About 7 tonnes of fertilizer are used annually. Of that 2 tonnes come in LDPE bags (25kg) and the rest is received in bulk. On this basis about 80 bags are used. This generates about 25kg of waste. This is disposed with regular residential garbage and placed at the curb for pick-up.

Pesticides

A variety of pesticides are used in fairly low quantities at this nursery. This includes approximately 1-10L jug/year as well as some bagged product. Some pesticide is used over two years (i.e. entire package not used in one year). Any containers used are rinsed and returned to the retailer. Bags are disposed with regular residential garbage and placed at the curb for pick-up.

Engine Oil/Hydraulic Oil

This farm uses about 250 litres of oil per year. The oil itself is recycled at a local Petro Canada. The oil is received in containers that are 10 litres or smaller. There is no opportunity to recycle these pails and they are placed in the residential garbage and placed at the curb for pick-up.

Waste Disposal

On average this farm places one bag with residential garbage at the curb for pick-up per week.

Outputs

Fibre Pots

Larger trees are sold in fibre pots (Photo 47). These pots are planted directly into the ground with the tree and decompose over time. Each year 4000-5000 trees are sold. Each pot weighs 0.4kg on average. Approximately 2-3 tonnes of pots are generated annually.



Photo 47 Fibre Pots

Plastic Netting for Christmas Trees

Each year about 1,500 Christmas trees are sold. They are wrapped in about 7' of plastic netting (likely PP).

Burlap

Seedlings/transplants are shipped off farm using burlap (Photo 48). A 3' by 3' square is used for every 20 seedlings/transplants. About 300 of these pieces are used. Each burlap piece weighs 0.3 kg. Approximately 90 kg of burlap is generated annually.



Photo 48 Burlap root balls

Insights

A relatively small quantity of packaging waste is generated on the site annually. Most of this waste is disposed with residential garbage. There are no recycling opportunities for LDPE fertilizer bags and HDPE "5 gallon pails."

4.7 Summary

Table 4.2 presents an overview of how various non-organic waste streams are managed on different farm types.

A mixture of landfilling, recycling, re-use and on-site burning are used to manage wastes. There were a considerable number of examples of recycling programs (either through the Blue Box or retailers). It is clear that both farmers and retailers are making efforts to avoid the landfilling of wastes

Key findings include:

- Most key inputs (e.g. fertilizer, seed, feed) are sold in bulk and do not generate any non-organic waste at the farm;
- Most farms visited had an Environmental Farm Plan and all farms visited had a genuine interest in managing their non-organic wastes in an environmentally responsible manner;
- There were a number of examples of return to retail programs for some waste streams (e.g. jugs, pails, drums);
- Return to retail programs were inconsistent and not available across the Province;
- There were essentially no recycling programs and limited recycling opportunities for LDPE bags and unlined and lined paper bags; and
- There were a number of examples of farmers using the Blue Box program to divert wastes (e.g. paper bags, jugs, pails). It is unknown if steward fees have been paid for these waste materials (i.e. from the manufacturer).

Some of the data collected was used to help calculate total wastes generated in the Province.

It would be useful to undertake more farm visits to be able to gather more data and use this data to refine waste generation estimates.

Table 4.2 Management of various input waste streams by farm type

	Grain and Oilseed	Livestock	Greenhouse Vegetable, Potted Plants, Bedding Plants	Field Vegetable	Fruit and Tender Fruit	Nursery
Low density polyethylene (LDPE) bags and other film	Landfill	Landfill Some recycling of bale and silage wrap	Landfill	Landfill	Landfill	Landfill
Woven polypropylene (PP) bags	Landfill Limited take back programs	Landfill Limited take back programs	na	na	na	na
Twine (PP)	na	na	na	na	na	na
Pots, trays, inserts and flats (PP, PS, HDPE)	na	na	Landfill Recycling programs	na	na	na
High density polyethylene (HDPE) jugs, pails, drums	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Take back to retail programs (pesticides, some sanitation and oil products) Re-use (oil, sanitation) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging	Landfill (oil) Take back to retail programs (pesticides, some oil products) Re-use (oil) Blue Box Pails that contained oil most challenging
Unlined and lined paper bags	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box	Burned on site Blue Box
Cardboard	Recycled Blue Box	Recycled Blue Box	Recycled Baler	na	Recycled Blue Box	Na

	Grain and Oilseed	Livestock	Greenhouse Vegetable, Potted Plants, Bedding Plants	Field Vegetable	Fruit and Tender Fruit	Nursery
Animal Health Waste	na	Removed from the farm by vets Cardboard recycled Glass ampoules recycled or disposed	na	na	na	na
Animal Health Waste-sharps	na	Removed from the farm by vets Take back programs Landfill	na	na	na	na

5.0 References and Bibliography

DEFRA, 2003. Agricultural waste survey 2003. A study of the management of non-natural agricultural waste on farms. 68pp.

OMAFRA, 2010. Economics Information, Survey of Pesticide Use In Ontario, 2008. 22pp

OMAFRA, 2009. Summary of Agriculture Statistics for Ontario

Statistics Canada, 2010a. Service Bulletin-Fertilizers Shipment Survey. Catalogue no. 21-022-X

Statistics Canada ,2010b. Cattle Statistics 2010. Catalogue no. 23-012-X

Statistics Canada, 2010c . Hog Statistics Third Quarter 2010. Catalogue no. 23-010-X

Statistics Canada, 2010d . Sheep Statistics 2010. Catalogue no. 23-011-X

Statistics Canada 2010e. Poultry and Egg Statistics- July to September 2010. Catalogue no. 23-015-X

Statistics Canada 2010f. Aquaculture Statistics- 2009. Catalogue no. 23-222-X

Statistics Canada 2010g. Greenhouse, Sod and Nursery Industries- 2009. Catalogue no. 22-202-X

Statistics Canada 2010h. Field Crop Reporting Series- 2010. Catalogue no. 22-002-X

Statistics Canada 2010i. Canadian Potato Production. Catalogue no. 22-008-X

Statistics Canada 2010j. Fruit and Vegetable Production. Catalogue no. 22-003-X

Statistics Canada, 2002. Livestock Feed Requirements Study. 1999-2000. Catalogue no. 23-501-XIE

Page left intentionally blank

Appendix 1

Background Information on Calculations

Background information on calculations

Plastics

Low Density Polyethylene (LDPE) Plastic Film

Fertilizer

Item	Value	Units	Comments
Total weight of fertilizers in bags	39,000,000	kg/year	Data from Ontario Agribusiness Association (OABA)
Average weight per bag	25	kg	
Bag weight	0.2	kg/bag	
Estimated number of bags	1,560,000	bags/year	
Estimated weight of bags	312	tonnes/year	

Greenhouse Vegetable Production

Grow Bags

	Production	Annual Production (Area)	Plants Per Grow Bag	Number of Grow Bags	Weight of Grow Bag	Weight of Grow Bags	Comments
	plants/ha	ha	#	#	kg	tonnes/year	
Greenhouse Tomatoes (kg/m ²)	10,000	378	4.5	840,000	0.04	34	Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts
Greenhouse Cucumbers (units/m ²)	10,000	162	3	540,000	0.04	22	
Greenhouse Peppers (kg/m ²)	6,000	252	3	504,000	0.04	20	
						75	

Greenhouse film and silage/bale film see Blacksheep Strategy “Ontario Agricultural Film Plastic Waste Characterization Study- Revised

Woven Polypropylene(PP) Bags

Feed

Item	Value	Units	Comments
Value of market (2009)	\$1,300,000,000	\$/year	Estimate from OABA
Average feed, premix, supplement value	\$550	\$/tonne	Estimate from OABA
Average packaged feed, premix, supplement	5	%	Estimate from OABA
Total feed, premix, supplement	2,363,636	tonnes/year	Estimate from OABA
Total feed, premix, supplement bagged	118,182	tonnes/year	
Average weight of bagged products	25	kg	
Calculated number of bags	4,727,272	bags/year	
Weight of empty bag- Lined Paper Bags	0.2	kg	Direct weight
Weight of empty bag- Woven Plastic Bags	0.1	kg	Direct weight
Amount of Lined Paper Bags	50	%	Estimate
Amount of Woven Plastic Bags	50	%	Estimate
Weight of Lined Paper Bags	473	tonnes/year	
Weight of Woven Plastic Bags	236	tonnes/year	

Seed

Crop	Area in Production ¹	% Farm Saved	% Bulk (Seed totes)	% Bags	Seeding Rate ²	Units/se ed tote	Wt of one bag	Wt of all bags
	ha	%	%	%	units/ha	#	kg	tonnes
Soybeans	1,517,500	25	80	20	6.25	40	1.75	249

Comments

1. From Field Crop Reporting Series-November Estimates of Production of Principal Field Crops. Catalogue no. 22-002-X (Statistics Canada 2010 h)
2. Estimated from various OMAFRA Planting and Crop Development documents

Greenhouse Twine (PP)

	Production	Annual Production (Area)	Twine per plant	Total twine used	Weight of twine	Weight of Twine	Comments
	plants/ha	ha	feet	feet	g/foot	tonnes/year	
Greenhouse Tomatoes (kg/m ²)	10,000	378	30	113,400,000	0.4	45	Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts
Greenhouse Cucumbers (units/m ²)	10,000	162	12	19,440,000	0.4	8	
Greenhouse Peppers (kg/m ²)	6,000	252	0	0	0	0	Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts. Use jute (biodegradable twine)
						53	

Comments:

Twine used for forage crops see Blacksheep Strategy “Ontario Agricultural Film Plastic Waste Characterization Study-Revised

Plastic Jugs, Pails and Drums (HDPE)

Pesticides

Weight of Containers Collected in 2010	Average Container Weight	Estimated Capture Rate	Number of Containers Generated in Ontario	Total Weight of Containers Generated in 2010	Comments
tonnes	kg	%	#/year	tonnes	
221	0.36	80	761,019	276	Data obtained from Clean Farms

Sanitation Products

Dairy

From Farm Visits		Dairy cows	Sanitation		20 litre pails	110 litre drums	205 litre drums	
	litres/year/cow	000s	litres/year		tonnes/year			
Teat Dip	11	400	4,400,000	Teat Dip	99	96	107	302
Chorine	11	400	4,400,000	Chorine	99	96	107	302
Soap	11	400	4,400,000	Soap	99	96	107	302
Acid	6	400	2,400,000	Acid	54	52	59	165
Foot Bath	1	400	400,000	Foot Bath	9	9	10	27
				Total	360	349	390	1,099

Comments:

1. Data gathered from farm visits
2. The proportion of container sizes used for each product was estimated.

Hog

Using Industry Data	Value	Units	Comments
Hog production	4,500,000	#/year	Ontario Pork
Space used	10	sq foot	Industry Contact
Cycles	2.5	turnover/year	Industry Contact
Total space used	45,000,000	sq feet/year	Calculated
Ratio of Floor Space to total Barn Space	2.9		Calculated
Total barn space	130,500,000.0	sq feet/year	
Undiluted Sanitation product used	0.75	ml/square foot	Industry Contact
Undiluted Sanitation product used	97,875	litres/year	Calculated
20 litre containers (HDPE)	4,894	#/year	Calculated
Weight of containers	1.5	kg	Weighed
Weight of all empty containers	7	tonnes/year	

Poultry-Broilers

Using Industry Data	Value	Units	Comments
Poultry production	205,573,000	#/year	Poultry and Egg Statistics- July to September 2010. Catalogue no. 23-015-X (Statistics Canada 2010e)
Space used	0.75	sq foot	Industry Contact
Cycles	6.5	turnover/year	Industry Contact
Total space used	154,179,750	sq feet/year	Calculated
Ratio of Floor Space to total Barn Space	2.7		Calculated
Total barn space	416,285,325.0	sq feet/year	
Undiluted Sanitation product used	0.31	ml/square foot	Industry Contact
Undiluted Sanitation product used	129,048	litres/year	Calculated
20 litre containers (HDPE)	6,452	#/year	Calculated
Weight of containers	1.5	kg	Weighed
Weight of all empty containers	10	tonnes/year	

Poultry-Layers

Using Industry Data	Value	Units	Source of Information
Poultry production	9,493,000	#/year	Poultry and Egg Statistics- July to September 2010. Catalogue no. 23-015-X (Statistics Canada 2010e)
Space used	0.75	sq foot	Industry Contact
Cycles	6.5	turnover/year	Industry Contact
Total space used	7,119,750	sq feet/year	Calculated
Ratio of Floor Space to total Barn Space	2.7		Calculated
Total barn space	19,223,325.0	sq feet/year	
Undiluted Sanitation product used	0.75	ml/square foot	Industry Contact
Undiluted Sanitation product used	14,417	litres/year	Calculated
20 litre containers (HDPE)	721	#/year	Calculated
Weight of containers	1.5	kg	Weighed
Weight of all empty containers	1	tonnes/year	

Oil and Hydraulic Oil

Small and Medium Farms ¹	Estimated Average Pails Used on Each Farm	Wt. of Pail	Wt of all pails
#	#/farm	kg	tonnes/year
48,000	5	1.5	360

Comments:

1. Summary of Agriculture Statistics for Ontario (OMAFRA, 2009)

Greenhouse Plant Pots, Inserts, Flats, Liners (PS, PP,HDPE) and Nursery Pots (PS, PP,HDPE)

Greenhouse Pots (PS and PP)

Pot Type	Potted Plants ¹	Weight of a Pot ²	Weight of Pots	Per-Cent Polystyrene ³	Weight of Pots (Polystyrene)	Per-Cent Polypropylene ³	Weight of Pots (Polypropylene)
	#	g/pot	tonnes/year	%	tonnes/year	%	tonnes/year
11cm	28,000,000	9	252	50	126	50	126
1 litre	750,000	22	17	0	0	100	17
15 cm	65,000,000	30	1,950	50	975	50	975
2 litre	750,000	78	59	0	0	100	59
25-30 cm	6,500,000	250	1,625	0	0	100	1,625
25-30 cm Hanging Baskets	19,000,000	250	4,750	0	0	100	4,750
Trays	1,000,000	30	30	50	15	50	15
	121,000,000		8,682		1,101		7,551

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Weighed

3. Estimate developed with help of subject matter experts.

Greenhouse Bedding Plants (PS and PP)

Container Type	Bedding Plants ¹	Weight of a Tray ²	Plants/Insert and Tray	Weight of Containers	Per-Cent Polystyrene	Weight of Pots (Polystyrene)	Per-Cent Polypropylene	Weight of Pots (Polypropylene)
	#	g/tray	#	tonnes/year	%	tonnes/year	%	tonnes/year
Inserts	336,000,000	140	40	1,176	50	588	50	588
Trays	160,000,000	30	40	120	50	60	50	60
				1,296		648		648

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Weighed

3. Estimate developed with help of subject matter experts.

Nursery Pots Based (PS and PP)

Pot Type	Potted Nursery Plants ¹	Weight of a Pot ²	Weight of Pots	Per-Cent Polystyrene ³	Weight of Pots (Polystyrene)	Per-Cent Polypropylene ³	Weight of Pots (Polypropylene)
	#	g/pot	tonnes/year	%		%	
1 gallon	1,125,000	50	56	0	0	100	56
2 gallon	1,125,000	83	93	0	0	100	93
							150

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Weighed

3. Estimate developed with help of subject matter experts.

Greenhouse Sleeves (outbound)

Pot Type	Potted Plants ¹	Proportion Shipped with Sleeve ²	Weight of a Sleeve ³	Weight of Sleeves	Weight of Shipping Box	Plants/shipping Box	Weight of Shipping Boxes
	#	%	g	tonnes/year	kg/box	#	tonnes/year
11cm	28,000,000	100	8	224	1	8	3,500
1 litre	750,000						
15 cm	65,000,000	100	10	650	1	8	8,125
2 litre	750,000						
25-30 cm	6,500,000						
25-30 cm Hanging Baskets	19,000,000	100	10	190	1	8	2,375
Trays	1,000,000						
	121,000,000			1,064			14,000

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Estimated

3. Weighed

Paper

Paper bags –unlined

Seed

Crop	Area in Production ¹	Seeding Rate ²	Weight/bag	Weight of bags
	Acres	Acres/bag	kg	tonnes/year
Corn	3,213,535	2.5	0.32	411

1. From Field Crop Reporting Series-November Estimates of Production of Principal Field Crops. Catalogue no. 22-002-X (Statistics Canada 2010 h)

2. Estimated from various OMAFRA Planting and Crop Development documents

Paper bags-lined

Feed

Item	Value	Units	Comments
Value of market (2009)	\$1,300,000,000	\$/year	Estimate from OABA
Average feed, premix, supplement value	\$550	\$/tonne	Estimate from OABA
Average packaged feed, premix, supplement	5	%	Estimate from OABA
Total feed, premix, supplement	2,363,636	tonnes/year	Estimate from OABA
Total feed, premix, supplement bagged	118,182	tonnes/year	
Average weight of bagged products	25	kg	
Calculated number of bags	4,727,272	bags/year	
Weight of empty bag- Lined Paper Bags	0.2	kg	Direct weight
Weight of empty bag- Woven Plastic Bags	0.1	kg	Direct weight
Amount of Lined Paper Bags	50	%	Estimate
Amount of Woven Plastic Bags	50	%	Estimate
Weight of Lined Paper Bags	473	tonnes/year	
Weight of Woven Plastic Bags	236	tonnes/year	

Cardboard (unwaxed)

Potted Plants (i.e. delivered to farms)

Pot Type	Potted Plants ¹	Weight of Box ²	Number of Pots/Box	Weight of Boxes
	#	kg	#	tonnes/year
11cm	28,000,000	1.2	1,200	28
1 litre	750,000	1.2	430	2
15 cm	65,000,000	1.2	540	144
2 litre	750,000	1.2	295	3
25-30 cm	6,500,000	1.2	50	156
25-30 cm Hanging Baskets	19,000,000	1.2	50	456
Trays	1,000,000	0.5	50	10
	121,000,000			800

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Calculated

Bedding Plants

Container Type	Bedding Plants ¹	Weight of Box ²	Number of Pots/Box	Weight of Boxes
	#	kg	#	tonnes/year
Inserts	336,000,000	0.5	1,200	140
Trays	160,000,000	0.5	540	148
				288

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Weighed

Nursery Plants

Pot Type	Potted Nursery Plants ¹	Weight of Box ²	Number of Pots/Box	Weight of Boxes
	#	kg	#	tonnes/year
1 gallon	1,125,000	0.4	75	6
2 gallon	1,125,000	0.4	50	9
				15

Comments:

1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada g) and OMAFRA subject matter experts

2. Weighed

Pesticides

Number of Containers Generated in Ontario	Containers per Box	Estimated Number of Boxes	Weight of One Box	Total Weight of Cardboard Boxes Generated in 2010	Comments
#/year	#	%	kg	tonnes	
761,019	2	380,510	1	381	Data obtained from Clean Farms

Fruit and Vegetable Packing

	ha	1000s tonnes/year	Packaging Type ²	Packaging Weight	% Packaged	Average Weight ³	Tonnes/Year
CARDBOARD				pounds		kg	
Fruit Production¹							
Apples	7,451	169,742	Cardboard Tray Packs	40	75	1.2	8,406
Apricots	20	157	Cardboard Multi Master (20 pound)	20	100	1	17
Cherries, sour	1,161	6,364	Cardboard Multi Master (20 pound)	20	100	1	700
Cherries, sweet	223	799	Cardboard Multi Master (20 pound)	20	20	1	18
Grapes	7,946	49,427	Cardboard Multi Master (20 pound)	20	5	1	272
Nectarines			Cardboard Multi Master (20 pound)	20	85	1	0
Peaches	2,325	19,321	Cardboard Multi Master (20 pound)	20	85	1	1,807
Pears	560	3,517	Cardboard Multi Master (20 pound)	20	100	1	387
Plums and Prunes	326	1,661	Cardboard Multi Master (20 pound)	20	100	1	183
Vegetable Production¹	ha	tonnes/year					
Carrots	3,339	170,800	Bulk bin (plastic, reusable), plastic bags	0	0	1	0
Corn	10,131	119,988	Bulk bin (plastic, reusable), mesh plastic bags	0	0	1	0
Dry Onions	2,701	114,413	Bulk bin (plastic, reusable), mesh plastic bags	0	0	1	0
Pumpkin	1,639	29,865	Bulk bin (plastic, reusable)	0	0	1	0
Rutabegas and turnips	1880	21,551	Bulk bin (plastic, reusable)	0	0	1	0
Tomatoes	6052	494,263	Cardboard Multi Master (20 pound)	20	100	1	54,394
Watermelon	714	13,558	Bulk bin (plastic, reusable)	0	0	1	0
Subtotal							66,184

Comments:

1. From Fruit and Vegetable Production. Catalogue no. 22-003-X (Statistics Canada 2010 j)
2. Obtained box data from the Ontario Fruit and Vegetable Growers Association (OFVGA)
3. Estimated Box weights

Waxed Cardboard

Fruit and Vegetable Packing

	ha	1000s tonnes/year	Packaging Type ²	Packaging Weight	% Packaged	Average Weight ³	Tonnes/Year
WAXED CARDBOARD				pounds		kg	
Fruit Production¹							
Blueberries	233	896	Waxed Cardboard 6* 1 litre Master	10	100	0.9	177
Raspberries	328	633	Waxed Cardboard 6* 1 litre Master	10	100	0.9	125
Strawberries	1,333	6,210	Waxed Cardboard 6* 1 litre Master	10	100	0.9	1,230
Vegetable Production¹							
Asparagus	11,465	6,343	Waxed Cardboard 9 Pound Carton	9	100	0.9	1,396
Beans	3,557	21,430	Waxed Cardboard 13 Pound Carton	13	100	0.9	3,265
Beets	407	9,652	Waxed Cardboard Multi Master (50 pound)	50	100	1	425
Cabbage	2,064	57,926	Waxed Cardboard Multi Master (50 pound)	50	10	1	255
Cauliflower	615	10,923	Waxed Cardboard Multi Master (50 pound)	50	100	1	481
Celery	192	12,436	Waxed Cardboard Multi Master (50 pound)	50	100	1	547
Cucumbers	1,467	30,809	Waxed Cardboard Multi Master (20 pound)	20	100	1	3,391
Lettuce	445	5,179	Waxed Cardboard 20 Pound Carton	20	100	1	570
Peas	6,475	32,001	Waxed Cardboard 13 Pound Carton	13	100	0.9	4,876
Peppers	1,165	28,664	Waxed Cardboard Multi Master (20 pound)	20	100	1	3,154
Squashes and zucchinis	1281	14,494	Waxed Cardboard Multi Master (30 pound)	30		1	0
Subtotal							19,894

Comments:

1. From Fruit and Vegetable Production. Catalogue no. 22-003-X (Statistics Canada 2010 j)
2. Obtained box data from the Ontario Fruit and Vegetable Growers Association (OFVGA)
3. Estimated Box weights

Page left intentionally blank

Appendix 2
Ontario Agricultural Film Plastic Waste Characterization Study
Blacksheep Strategy Inc., December 2010.

Page left intentionally blank

Barry Friesen
General Manager
CleanFARMS Inc.

12.15.10

Re: Ontario Agricultural Film Plastic Waste Characterization Study - Revised

Barry,

We have completed our assessment of the volumes, manufacturers or first importers and possible future trends for the five agricultural products outlined in the research proposal.

Attached is a final report with respect to the specific plastic products used in agriculture in the province of Ontario. In this document, we provide a summary of the key findings, a detailed list of suppliers documented during our research and the thoughts of interview subjects and the research team with respect to considerations for the future volumes of plastics from the five product groups researched.

We appreciate the opportunity to work on this project and are available to respond to any questions you may have regarding this study.

Regards,

Sharon Barker
Director, Research Strategy
Blacksheep Strategy Inc.
403.239.3458

Ron Kroeker
Project leader
Blacksheep Strategy Inc.
250.935.0268

CleanFARMS Inc.
Ontario Agricultural Film Plastic Waste Characterization Study

11.18.10

Prepared by
Blacksheep Strategy Inc.

Table of Contents

1. PROJECT OVERVIEW	2
2. METHODOLOGY	2
3. GREENHOUSE FILM	3
4. SILAGE FILM AND BALE WRAP	4
5. GRAIN BAGS.....	7
6. PLASTIC BALE TWINE AND PLASTIC NET WRAP FOR BALES	7
7. MULCH FILM	9
8. VOLUME SUMMARY	12
APPENDIX A: DETAILED CALCULATIONS	13

1. Project Overview

CleanFARMS is a non-profit industry stewardship organization committed to environmental responsibility through the proper management and disposal of agricultural waste. They contracted Blacksheep Strategy to conduct a preliminary assessment of the volumes of certain plastic products used in agriculture in the province of Ontario. The intention is to use this information to assess the feasibility and opportunity for the development of recycling programs for these products.

The primary purpose of this study was to quantify certain types of film plastics used in agriculture in Ontario and identify the manufacturers or importers of these plastics.

- The uses investigated include low density polyethylene (LPDE) #4 plastics used in greenhouse film, silage film and grain bags. Twine and mulch film used in commercial fruit and vegetable production were also assessed.
- Information on who is producing or importing these materials was also collected wherever possible.
- The study also looks at whether the existing uses for these specific types of plastic products are likely to increase, decrease or stay at existing levels, and whether there are new developments or trends that would impact the use of LDPE in the future.

During the course of the project, numerous companies and individuals were contacted and asked to supply information or data for use in the research. Each request was preceded by a brief explanation of the project and its purpose. Almost all interview subjects were positive about the potential for improved stewardship options for these products. Farmers in particular voiced the need for responsible and cost effective options to manage these products at the end of the usable life of the product.

2. Methodology

The study used various methods to estimate the quantity of the specified plastic products used in the province of Ontario.

Literature Review – A review of existing studies with similar objectives but conducted in different geographies provided some metrics which can be applied to this analysis.

Internet Searches – General internet searches provided contact information for domain experts, information on manufacturers and suppliers and some data used to calculate volume estimates.

Domain Expert Contacts – Where possible, we attempted to utilize the expert advice of specialists in the specific application or use of each type of plastic. For example, various specialists for the province of Ontario (OMAFRA) were contacted and asked to estimate the amounts of plastic used in various agricultural production practices.

Industry Contacts – Major suppliers and manufacturers were contacted to obtain their estimates of market size.

Manufacturers and First Importers - Major suppliers, retailers and manufacturers were contacted to obtain their estimates of market size. In some cases, they also provided information on trends and future developments.

Wherever possible, various methods and or sources were used in an effort to validate or increase the reliability of the estimate. For example, calculated values for various products were presented to major suppliers of these products. Suppliers were asked if they believed the calculated values to be accurate based on their knowledge of the marketplace.

The lists of manufacturers, first importers and retailers included in this report was compiled through internet searches, discussions with those contacted to supply data for this research and from existing documentation.

3. Greenhouse Film

A Greenhouse Specialist for Ontario provided an estimate of 7.5 million square meters of plastic used to cover greenhouses in the province. The estimate is based on data from Statistics Canada and takes into account the fact that growers use a double layer of poly. When converted to weight using a factor provided by a major manufacturer of greenhouse film, this represents 1063 tonnes of total use. Unless it is damaged by extraordinarily severe weather, this plastic film is usually replaced every three to four years. Using the maximum lifespan of four years, the minimum total of this type of film plastic available for recycling annually is estimated to be 265.5 tonnes.

While a major manufacturer of this product declined to specify their assessment of the size of the Ontario greenhouse film market, when asked to comment on the estimated volume, a senior executive with the firm confirmed the figure provided was close to his firm's estimate of the total market.

It should be noted that this estimate does not include agricultural research greenhouses or those used in the silviculture industry. It is safe to assume that given the value of the contents and the importance of consistent environmental conditions in agricultural research greenhouses, the vast majority would be glass rather than plastic. The use of plastic film for silviculture greenhouses was outside of the scope of this project.

Several individuals surveyed for this product indicated there is significant end consumer demand for recycling of other plastic items used by greenhouse operators such as plastic trays and pots. These products were outside the scope of this study, but may merit further research.

Future developments affecting this product could include the introduction of new technology which displaces or replaces this form of use. The study did not uncover any significant future trends related to use of greenhouse film.

Key volume drivers for this product include total greenhouse production of crops grown under plastic greenhouses and extraordinary weather or other conditions which increase the current rate of replacement.

Suppliers of greenhouse film documented during the research are listed below.

AT Films Inc.
4605-101 Avenue
Edmonton, AB T6B 3R4
780-450-7760

Westland Greenhouse Equipment & Supplies Inc.
4029 11th Street
St. Catharines, ON L2R 6P9
905-685-0578

Trillium Greenhouse Equipment
R.R. #1,
Dundas, ON L9H 5E1

Plant Products Co. Ltd.
314 Orenda Road
Brampton, ON L6T 1G1
905-793-7000

Excalibur Plastics
P.O. Box 459
Ruthven, ON N0P 2G0
519-326-6000

4. Silage Film and Bale Wrap

Inquiries regarding the amount of plastic silage cover and bale wrap used in the province led to a previous comprehensive study of these products conducted by OMAFRA staff in the year 2000. The study estimated the volume for that year at 2000 tonnes based on a survey of manufacturers, wholesalers and retailers.

Many of the retailers contacted for this study regarding twine volumes also sell silage film and bale wrap. They were asked to estimate growth in the use of silage film and bale wrap since the year 2000. All indicated that there has been an increase since 2000. There was a wide range of responses, from a tripling in use to an increase of 25%.

These estimates were then reviewed with a major manufacturer of silage film for the Ontario market. The manufacturer declined provide a specific estimate of the size of this market, but indicated that his company's estimate of the total silage film use in Ontario fell much closer to the lower end of this range and that 25% would be a reasonable growth factor to use for eastern Canada including Ontario during this time period.

Future developments affecting this product could include any introduction of new technology which displaces or replaces this form of use. No emerging technologies were noted during this research. Any increase or decrease in the use of upright silos to store forage crops or corn silage would impact this product category.

Key volume drivers for this product include the number of cattle in the province and the portion of cattle fed silage versus bales. The value of forage crops and long term weather patterns may also play a role in the use patterns for bale wrap. If forage has a higher dollar value, farmers are likely to continue to protect the quality of this crop by covering it in plastic. Wetter weather patterns may lead to more farmers storing higher moisture forages in plastic bags to ensile it.

Another factor influencing volumes of silage cover and bale wrap is total provincial cattle numbers. Any significant change in the total number of cattle will likely lead to a change in volumes of these products.

Suppliers of silage film documented during the research are listed below.

AT Films Inc.
4605-101 Avenue
Edmonton, AB T6B 3R4
780-450-7760

Dubois Agrinovation
478 Notre-Dame
Saint-Remi, Québec J0L 2L0
or
710 Old Highway 24, R.R. # 3,
Waterford, ON N0E 1Y0
450-454-3961

Farmer's Sealed Storage
#3, Unit 5 Industrial Park Rd.
South Gower Business Park
Kemptville, ON K0G 1J0
613-258-9818

AEP Industries
125 Phillips Ave.
South Hackensack, N.J. USA 07606
201-807-2482

Ag Bag International
2320 SE Ag-Bag Lane
Warrenton, OR 97146 USA
800-334-7432

Atlantic Packaging Products Ltd.
Roger Keeley
111 Progress Ave.
Scarborough, ON M1P 2Y9
416-298-5422

AT Plastics Inc.
142 Kennedy Rd. S.,
Brampton, ON L6W 3G4
905-451-1630 www.atplas.com

Balcan Plastics Ltd.
9340 Meaux St.
St-Leonard, PQ H1R 3H2
514-326-9130

Pactiv Corp.
1900 West Field Court
Lake Forest, IL 60045
888-828-2850

Presto Products Company
P.O. Box 2399,
Appleton, WI, USA 54912-2399
717-392-0848

Sacomatic Inc.
790, Rang 4
Saints-Anges, PQ G0S 3E0
418-253-5745

Tenneco Packaging
Suite 300
Dearfield, IL 60015 USA
847-914-1909

Tube-o-lator Inc.
RR#1 Thorsby, AB T0C 2P0
403-789-2411

Uniplast Industries Inc.
Box 2000, 301 Forest Ave.
Orillia, ON L3B 6R9
705-326-1777

W. Ralston (Canada) Inc.
135 East Drive
Brampton, ON L6T 1B5
905-791-3980

BP Chemicals
150 W. Warrenville Rd.
Mail Code C-1
Naperville, IL. 60566
630-420-4402

5. Grain Bags

This use of film plastic in agriculture is the newest or most recent compared to the other products included in this report. Grain bags began to be commonly used for grain storage in the western Canadian market approximately five years ago. Since their introduction into the western Canadian market, the growth in use has been exponential.

This study did not find any evidence of the use or sale of grain bags into the Ontario market at this time. An OMAFRA source indicated that the department did not recommend the use of this product by farmers at this time. One of the largest retailers in western Canada was contacted and this retailer had not sold any product into the Ontario market and was not aware of any retailing of grain bags in Ontario.

Several of the functional limitations of grain bags are being addressed by new technology. For example early users disliked the clumsy nature of unloading the bags when they wanted to remove the grain. Several companies have now introduced grain bag unloaders which solve this logistics problem. This type of innovation suggests that the product is here to stay and the existing market will likely continue to grow.

Given these facts, it is somewhat likely that this product may be tried in Ontario at some point in the future. If initial trial use is successful, some level of market acceptance should be expected; including this product in plans for recycling programs would ensure that a responsible end of life management option exists, should their use become widespread.

6. Plastic Bale Twine and Plastic Net Wrap for Bales

An estimated volume of plastic bale twine and net wrap has been calculated based on average forage production. This volume was calculated using the average forage acres over the last ten years supplied by Statistics Canada and multiplying this area by the ten year average forage yield for the same ten year period from the same source. By using ten year averages, relatively small fluctuations of acres and yield are taken into account.

From this total production volume, the total volume of forage chopped for silage is subtracted, i.e. no twine or net wrap is used in this harvesting process. While no hard data for this volume was found, a survey of twine and net wrap retailers provided estimates ranging from zero to thirty-five percent of the total forage volume may be chopped for silage on any given year. To ensure a conservative estimate of twine and net wrap for the purposes of this study, a factor of twenty-five percent was used for forage production chopped for silage.

A range of values for twine per tonne of forage baled has been determined during previous similar research done for another province in Canada. Discussion with retailers, custom balers and farmers has confirmed that the same amount of net wrap or twine is used whether the farmer is baling forage or straw.

Several large multi outlet retailers in various parts of Ontario were contacted to estimate the percentage of twine use vs. net wrap use. Estimates ranged from a low of 50 percent to a high of 80 percent net wrap use.

The estimated total volume of plastic twine used in Ontario ranges from 391 to 542 tonnes per year. The estimated volume of plastic net wrap is 697 tonnes annually.

As with other products included in the research, the development of new or improved technology such as an effective and efficient biodegradable plastic twine or net wrap would have an impact on this segment.

Introduced to the market approximately 20 years ago with broad adoption beginning 10 years ago, net wrap has gained a significant share of the baling market. The shift from twine to net wrap will increase total volumes of plastic from this source, as net wrap typically uses more weight per tonne of baled forage or straw.

A second important factor influencing volumes of twine and net wrap is total provincial cattle numbers. Any significant change in the total provincial cattle number needs to be considered in long term planning and projections for sourcing plastic twine for recycling purposes.

Suppliers of plastic twine and net wrap documented during the research are listed below.

Canadian Hay and Silage Limited
R.R.1, Bowden, AB T0M 0K0
403-224-2072

Donaghy's
Nobleford, AB
403-795-7062

Bridon Cordage Ltd.
Saskatoon, SK
306-652-4133

Amjay Ropes & Twines Ltd.
Newmarket, ON
905-830-6755

Syfilco Ltd.
320 Thames Rd. E.
Exeter, ON N0M 1S3
519-235-1244

Tama Canada Ltd.
50 Dundas Street East-Ste 200,
Dundas, ON L9H 7K6
905-690-4442

Guelph Twines Ltd.
50 Crimea St.,
Guelph, ON N1H 6J6
519-821-9140

7. Mulch Film

Provincial Specialists for both fruit and vegetable crops were contacted to determine use by crop. Mulch retailers and large fruit and vegetable producers were interviewed to establish use patterns and practices in the field. The majority of the product is used on two fruit crops, day neutral strawberries and melons. Vegetable crops types with the highest percentage of use include tomatoes not destined for processing, peppers and certain vine crops.

When volumes for fruit crops are added to volumes used in vegetable crops, the total annual volume of plastic mulch for these two sectors is estimated at 456 tonnes.

Future developments impacting the volume of this type of film available for recycling include improvement of biodegradable mulch products available today. The current biodegradable mulch products are reported to decay prematurely. As a result, use is limited. If this problem is solved, it is conceivable that biodegradable mulch could take over the market meaning this source of plastic film is no longer available.

A second factor might be any other improvements to the product which would enhance the agronomic value and therefore increase the use rate by expanding use to crop types where plastic mulch is not currently used. Similarly, new research indicating an agronomic benefit when mulch is used in nontraditional crops is also affecting use rates.

Several trends were noted for this product during the research project. Use in strawberries is predominantly on day neutral varieties and the acreage of this type of strawberries is increasing over time. One source indicated that there has been a slight increase in use on blueberries and raspberries in recent years. Sweet corn growers have recently begun using plastic mulch on early seeded crop to hasten maturity. This new use could become significant as there are nearly 25,000 acres of this crop grown in Ontario. Further adoption of this cultural practice could therefore produce a considerable volume of used mulch.

The key volume drivers for this product are the total production of fruit and vegetable crops grown under plastic mulch and the adoption of agronomic or cultural practices utilizing this growing system.

One provincial berry specialist noted that 15 to 20 percent of the nearly 4500 acre strawberry crop is covered with a spunbonded floating row cover. While outside the scope of

this research study, it was noted that there are currently few good disposal options for this product. It was also noted that the lack of disposal options for plastic mulch may also be a barrier to use. If growers had a cost effective and user friendly disposal option, more might begin to use plastic mulch.

Suppliers of mulch film documented during the research are listed below.

Dubois Agrinovation
478 Notre-Dame
Saint-Remi, Québec J0L 2L0
or
710 Old Highway 24, R.R. # 3,
Waterford, ON N0E 1Y0
450-454-3961

Robert Marvel Plastic Mulch
2425 Horseshoe Pike (Rt. 322)
Annville, PA 17003

Westgro Horticultural Supply Inc.
1557 Hastings Crescent S.E.
Calgary, AB T2G 4C8
800-661-2991

Mechanical Transplanter Co.
1150 Central Ave.
Holland, MI 49423
616-396-8738

Plastitech Inc.
478 Notre-Dame, C.P. 750
St-Remi, Quebec J0L 2L0
800-667-6279

Pliant Corp.
1515 Woodfield Rd. Suite 600
Schaumburg, IL 60173
866-878-6188

Rochelle Plastic Film
P.O. Box 606
Rochelle, IL 61068

Climagro Mulch Film
LECO Industries
3235 Sartelon
St-Laurent, Quebec H4R 1E9
800-561-8029

Ken-Bar Inc.
25 Walkers Brook Drive
Reading, MA 01867-0704
781-944-0003

Agricultural Supply, Inc.
P.O. Box 3397
Escondido, CA 92033
619-741-0066

Armin Plastics Corporation
18901 E. Railroad Street
City of Industry, CA 91748

Bio-Way, Inc. R.R.2
Leduc, AB T9E 2X2
403-986-1067

G & M Agricultural Supply Co.
5301 N. 82nd Street, Scottsdale, AZ 85250
602-947-0096

Johnny's Selected Seeds
Foss Hill Road
Albion, ME 04910
207-437-4395

McConkey Co.
P.O. Box 1690
Sumner, WA 98390-0369
206-863-8111

Polywest
1106 2nd Street, Suite 112
Encinitas, CA 92025
619-943-7795

Professional Gardener Co.
915 23rd Avenue S.E.
Calgary, AB T2G 1P1
403-263-4200

Stokes Seeds, Ltd.
39 James Street, Box 10
St. Catharine's, ON L2R 6R6
416-688-4300

Baskpac Products
Box 187, 296 Lyndhurst Road
Lyndhurst, ON K0E 1N0
613-928-2432

8. Volume Summary

Product	Estimated Volume
Greenhouse Film	265 tonnes
Silage Film	2400 tonnes
Grain Bags	0 tonnes
Plastic Twine	391 to 542 tonnes
Net Wrap	697 tonnes
Mulch Film	456 tonnes

While the values above are estimates, every reasonable effort has been made to ensure that they are as close to the actual amount that may be available for recycling as possible. Where assumptions were required, the authors of this study have attempted to err on the side of caution and use the most conservative values available. The estimated range of error for most of the products should be in the range of 10 - 20%.

Appendix A: Detailed Calculations

(from spreadsheet, provided under separate cover)

Ontario Agricultural Film Plastic Recycling Study Product Greenhouse Film

Notes

Data Sources

Estimate is in square metres. 7,500,000.00

Converted to sq ft 80,729,362.88

Conversion factor from
manufacturer 1000sq.ft. = 29lb 2,341,151.52

Converted to tonnes; total use 1,061.99 tonnes

Estimate provided by
Provincial Specialist based
on Stats Can data.

Estimate provided by
Provincial Specialist
based on Stats Can
data.

**Converted to tonnes; annual
use 265.50 tonnes**

Greenhouse film is
replaced every three to four
years on average. Total
use divided by 4 provides
the minimum estimated
annual use.

Silage cover and bale wrap

Results of 2000 research by
OMAFRA 2,000.00 tonnes

Estimates by retailers
ranged from 25 to 300%.
Consultation with a major
manufacturer determined
that 25% is the most
reasonable estimate.

AGRICULTURAL
PLASTICS RECYCLING
HANDBOOK By Steve
Clarke and Carl
Fletcher, June 2002

Increase in use since 2000 25.00 %
Estimated current use 2,400.00 tonnes

Twine and Net Wrap

Total forage tonnes produced
annually 6,180,000.00 tonnes

Less estimated volume of hay
chopped for silage (25%). 4,635,000.00 tonnes

This value is calculated
using ten year average
values for acres and yield.
This estimate is based on
information from twine and
net wrap retailers. Range
was 0-35%.

Source: Statistics
Canada CANSIM
custom tables

Plus total straw baled, estimated at 30% of hay volume.	6,025,500.00	tonnes	This estimate is based on information from twine and net wrap retailers' estimates of hay to straw ratio. Range was 25-33%. Most said 30%. Retailer estimates for net wrap vs. twine ranged from 40% to 80% of all baled forage and straw. For this calculation, 50% was used.	
Adjusted for net wrap use	3,012,750.00	tonnes		This value was determined by interviewing custom balers, farmers and twine and net wrap retailers in Saskatchewan.
Twine (tonnes) using retailer estimate	391.66	tonnes	Value is from previous research: 0.13 kg twine per tonne of baled material.	This value was determined by interviewing custom balers, farmers and twine and net wrap retailers in Saskatchewan.
Twine (tonnes) using custom baler estimate	542.30	tonnes	Value is from previous research: 0.18 kg twine per tonne of baled material.	
Net Wrap (tonnes)	696.98	tonnes	Net wrap used at a rate of 0.51lb per tonne on 50% of baled forage and straw.	
Mulch			Notes	Sources
Fruit crops, acres adjusted for % use and % cover	972.7	acres	Use and cover rates are average values obtained from various sources.	Area, Production and Farm Value of Specified Commercial Fruit Crops, Ontario, 2008- 2009, OMAFRA
Adjusted acres for fruit crops x 43560 sq ft per acre	42,370,812.0	sq. ft.		
Weight for 1.1mil; 4000 ft roll = 84.5lb or .00528 lb/sq ft	223,717.9	lb.		
Total – fruit crops	101.5	tonnes		

Vegetable crops, acres adjusted for % use and % cover	3,399.0	acres	Use and cover rates are average values obtained from various sources.	Area, Production and Farm Value of Specified Commercial Vegetable Crops, Ontario, 2008-2009, OMAFRA
Adjusted acres for vegetable crops x 43560 sq ft per acre	148,060,440.0	sq. ft.		
Weight for 1.1mil; 4000 ft roll = 84.5lb or .00528 lb/sq ft	781,759.1	lb.		
Total – vegetable crops	354.6	tonnes		

Estimated Total Tonnes of Plastic Mulch **456.10** tonnes

Detailed calculations for acres using mulch:

Crop	Acres	Use rate	Cover	Adjusted acres	
Pumpkin and squash	7200	20%	75%	1080	
Cucumber	3625	15%	50%	272	
Tomato, less processing	1750	90%	50%	788	Processing acres are subtracted; no mulch use.
Pepper	2800	90%	50%	1260	
Sweet Corn	24460	10%	50%	1223	2005 acres data from OPVG website
Total				3399	

Crop	Base acres	% coverage	% use rate	Annual adjusted acres	
Strawberries once in 2 years	4,243	50	25	265.2	Estimates ranged from 40-90% cover. Only used in establishment year.
Raspberries once in 10 years	1,153	50	15	8.6	Only used in establishment year.
Blueberries once in 10 years	732	50	10	3.7	Only used in establishment year.
Melons Annual	1,545	50	90	695.3	Estimates ranged from 50-100% cover.
Total				972.7	

Data Sources:

Use and cover rates are average values obtained from various sources including growers, mulch retailers and OMAFRA specialists.

Area, Production and Farm Value of Specified Commercial Vegetable Crops, Ontario, 2008-2009 (OMAFRA)

Appendix 3
List of Subject Matter Experts and Industry Contacts
Interviewed

List of Subject Matter Experts and Industry Contacts Interviewed

Name and Affiliation	Expertise Provided
Livestock Production	
Mr. Brian Lang, P.Ag. Dairy Cattle Production Systems Specialist Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)	Dairy production
Mr. Doug Richards Swine Grower and Finishing Specialist OMAFRA	Swine production
Mr. George Jeffery; Mr Daniel Darragh Vétoquinol Canada	Livestock sanitation products
Crop Production	
Mr. Wayne Brown OMAFRA	Greenhouse and flower production
Mr. Hugh Fraser Agricultural Engineer OMAFRA	Greenhouse and flower production
Mr. Shalin Khosla OMAFRA	Greenhouse vegetable production
Ms Leanne Wilson Ontario Greenhouse Vegetable Growers (OGVGA)	Greenhouse vegetable production
Mr. Dean Shoemaker/Mr. Irwin Smith Executive Director/Former Executive Director Flowers Canada Growers	Flower production
Mr. Scott Banks Emerging Crop Specialist OMAFRA	Field crops
Ms. Allison Robertson Consultant/School Project Co-ordinator Ontario Fruit and Vegetable Growers Association	Field Fruit and vegetable production
Ms. Jennifer Llewellyn Nursery Crops Specialist OMAFRA	Nursery crop production
General	
Mr. Ron Campbell Operations & Member Services Manager Ontario Agribusiness Association (OABA)	Fertilizers, Feed, Supplements, Pre-mix, Sharps

Name and Affiliation	Expertise Provided
OABA Operations Committee Ms. Vicky Hammell, Wallenstein Feed & Supply Ltd. Mr. Ryan Kreager, New-Life Mills Ltd. Mr. Matt Gardner, Parrish & Heimbecker Mr. Steve Rongits, Growmark Mr. Larry Hale, FS Partners Mr. Fred Ryckman, Shur-Gain, Nutreco Canada Inc.	Feed, Supplements, Pre-mix, Sharps
Mr. Clyde Graham Vice President, Strategy & Alliance Canadian Fertilizer Institute	Fertilizers
Dr. Bill Leask Executive Vice President Canadian Seed Trade Association	Seed production
Mr. Barry Friesen General Manager CleanFARMS™ Inc.	Pesticides
Ms. Tracey Firth Programs Director Canadian Animal Health Institute	Animal health products, Sharps
Mr. Paul Sims Divisional Program Specialist, Ministry of the Environment	Environmental Farm Plans