



The Quantity of Agricultural Plastics Used in the Maritime Provinces

Final Report
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In partnership with:

Canadian Plastics Industry Association and RRFB Nova Scotia



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Appendix 1	Background Information on Calculations.
Appendix 2	List of Subject Matter Experts and Industry Contacts Interviewed

Key Acronyms used in report

EPR	Extended Producer Responsibility
HDPE	high density polyethylene
LDPE	low density polyethylene
PET	polyethylene terephthalate
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, the Canadian Plastics Industry Association (CPIA) and Resource Recovery Fund Board (RRFB) provided funds to undertake a study of The Quantity of Agricultural Plastics Used in the Maritime Provinces (Study). These and other agricultural experts made up a Steering Committee which guided this Study. 2cg Inc., in association with LP Consultants Limited, was retained to undertake this Study.

The Study involved considerable desktop research and some limited field research. It focused on developing a waste characterization by collecting and summarizing existing sources of information and interviewing various subject matter experts. All data collected was summarized and estimates of the annual generation of various plastic wastes were made. It should be noted that the results of this Study represent the development of baseline data and the start of an interactive process to refine and expand these estimates.

The intention is to use this information to assess the feasibility and opportunity for the expansion of existing agricultural recycling programs or the development of new recycling programs. Ultimately, it may assist in the development of Extended Producer Responsibility (EPR) programs for these wastes.

2.0 Summary of Results

Possible waste generation streams have 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. For this Study outputs were focussed on greenhouse products and fresh produce.

Table 1 Packaging waste types by type of production

Location	Inputs	Plastic Packaging Waste	Output	Plastic Packaging Waste
Farm Type				
Crops				
Field Crops and Seed Production	Seed	Woven plastic bags	Harvested crops	Bale wrap, silage wrap
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Fruit and Vegetable Production	Seed/Propagation	Plastic trays, film plastic bags, woven plastic bags,, mulch film, row covers	Harvested crops	Plastic packaging materials (e.g. LDPE, PET, PS).
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Greenhouse Production	Seed	Film plastic bags, Woven plastic bags	Harvested crops	Pots, trays, inserts and flats)
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
	Other	Plastic twine and plant clips		
Nursery Production	Seed/Propagation	Plastic trays, film plastic bags, woven plastic bags	Harvested crops	Pots
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Sod Production	Seed	Woven plastic bags	Harvested crops	
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Livestock and Livestock products (e.g. milk and eggs)	Feed	Film plastic bags, woven plastic bags	Livestock Livestock products	Plastic packaging materials (eggs)
	Supplements	Film plastic bags, woven plastic bags, plastic jugs, plastic pails		
	Sanitation products	Plastic jugs, pails and drums		

Table 2 presents a summary of packaging wastes generated on Maritime farms. An estimated 2,124 tonnes/year of plastic packaging wastes are generated on Maritime farms.

Table 2 Summary of Key Packaging Waste Generated on Maritime Farms (Inputs)

Plastic	Nova Scotia	New Brunswick	Prince Edward Island	Total	Comments
tonnes/year					
LDPE	392	527	560	1,479	Silage film, bale wrap, fertilizer bags, greenhouse film, grow bags bale wrap, mulch film, row covers and portion of fruit and vegetable packaging.
PP	260	131	107	498	Fertilizer, feed and seed bags (woven), twine, greenhouse twine, a portion of plant pots, inserts, flats, liners, plant tags and pot sleeves and a portion of mesh packaging bags
HDPE	46	47	41	135	Pesticide jugs, sanitation pails and drums, net wrap (hay and straw), and a portion of nursery plant pots
PS	4	6	1	11	A portion of plug trays, trays, inserts, flats, liners
PET	0.8	0.8	0.2	2	A portion of clamshell packaging
Sub-total	702	712	710	2,124	

Figure 1 provides an overview of the estimated waste composition of plastic packaging wastes generated on Maritime farms. About 70% of this waste is LDPE plastic film.

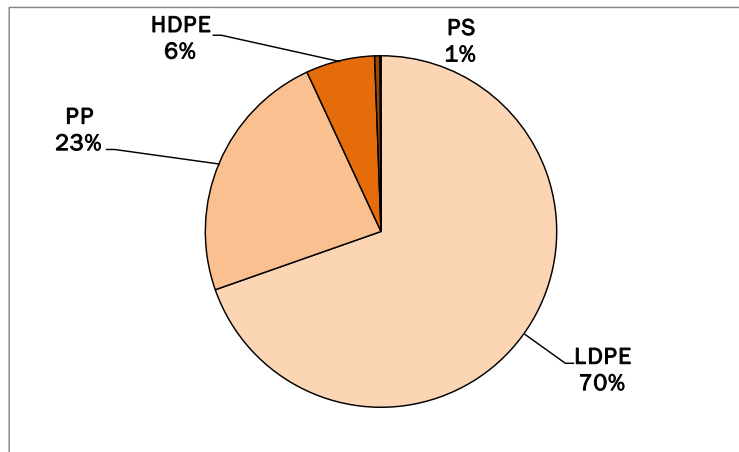


Figure 1. Estimated Waste Composition- Input

Table 3 presents a summary of the key waste producing packaging materials that are used to convey farm products to the marketplace (i.e. outputs). An estimated 1,277 tonnes/year of plastic packaging wastes leave Maritime farms.

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

Plastic	Nova Scotia	New Brunswick	Prince Edward Island	Total	Comments
tonnes/year					
LDPE	220	207	445	872	Fruit and vegetable packaging
PP	93	19	3	115	Plant pots, inserts, flats, liners, plant tags, pot sleeves, plastic mesh packaging
PS	74	115	22	210	Plant pots, inserts, flats, liners
PET	20	18	6	45	Clamshells
HDPE	15	17	4	35	Nursery pots
Sub-total	421	375	480	1,277	

Figure 2 provides an overview of the estimated waste composition of plastic packaging wastes that leave Maritime farms. About 70% of this waste is LDPE plastic film.

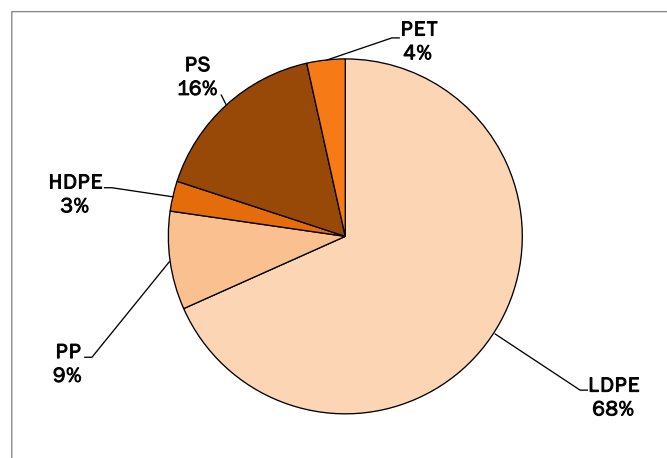


Figure 2. Estimated Waste Composition- Output

Key findings include:

- Each province generates about an equal amount of estimated plastic packaging waste inputs annually;
- The most common plastic packaging input streams are LDPE film (mostly bale film and silage wrap) and PP (mostly woven bags and twine);
- PEI generates the most plastic packaging outputs (i.e. from packaging of fresh produce) followed by New Brunswick and Nova Scotia;
- The most common plastic packaging output streams are LDPE film (plastic bags) and PP (mesh bags);
- There are some agricultural plastic diversion programs including chemical containers (i.e. pesticides), limited PP woven totes re-use (fertilizer only), limited HDPE drum re-use (some sanitation products) and a pilot program for diverting bale wrap and silage film (PEI); and
- It may be possible to increase diversion programs by setting up programs in areas of concentrated farm activity and by working together with local materials recovery facility operators to recycle plastic packaging and retailers to increase re-use of some plastic packaging.

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The intention is to use this information to assess the feasibility and opportunity for the expansion of existing agricultural recycling programs or the development of new recycling programs. Ultimately, it may assist in the development of Extended Producer Responsibility (EPR) programs for these wastes.

2.0 Methodology

2.1 Waste Characterization

Table 2.1 depicts the list of plastic packaging categories and sub-categories used for this waste characterization.

Table 2.1 Agricultural Plastic Packaging Categories

Plastic	Input	Output
LDPE	<ul style="list-style-type: none">• Silage film• Bale wrap• Greenhouse film• Mulch film• Row covers• Fertilizer packaging• Grow bags (greenhouse)	<ul style="list-style-type: none">• Packaging for fruit and vegetables
PP	<ul style="list-style-type: none">• Woven bags• Twine (hay and greenhouse use)	<ul style="list-style-type: none">• Greenhouse plant pots, trays, flats, liners and Nursery pots• Potted plant sleeves

Plastic	Input	Output
		<ul style="list-style-type: none"> • Plant tags
PET		<ul style="list-style-type: none"> • Clamshell packaging
HDPE	<ul style="list-style-type: none"> • Plastic jugs, Pails and Drums (pesticides, sanitation) • Net wrap 	<ul style="list-style-type: none"> • Nursery Pots
PS		<ul style="list-style-type: none"> • Greenhouse trays, flats, liners

The waste characterization was developed through a combination of the following methods:

1. Estimate of product and packaging sales to the agriculture sector from agricultural suppliers; and
2. Estimate of waste generated per unit of production on farms.

The flow of these wastes was estimated including:

1. Wastes generated on farm;
2. Wastes generated off-farm; and
3. Wastes generated per province.

Estimate of Product and Packaging Sales to the Agricultural Sector

This involved identifying the major materials sold to Maritime farms, interviewing key subject matter experts in each agricultural sector and obtaining 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 kilograms (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.

Estimates of Off Farm-based Plastic Packaging Usage

This was established through collecting data from sales of farm products and using estimates of plastic packaging types and the amounts used per product.

This resulted in estimates of wastes flowing to the IC&I sector and residential sectors. It was assumed that all agricultural plastic packaging delivered to the residential sector would flow to the residential waste stream.

Data Compilation

Waste characterization data, which came from different sources, was compiled into Excel spreadsheet tables. To the extent possible, estimates of waste generation were

developed from at least 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.

As this is the first Study of this type (i.e. for agricultural plastic packaging) undertaken by CleanFARMS in the Maritimes, it is important to understand that a baseline materials flow 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

Essentially all of this Study was undertaken as a desktop audit. This data collection exercise focused on developing: 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:

Literature Review

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

Internet Search

A detailed internet search was undertaken to help identify possible data sources of Maritime agriculture sector material flows. The internet search also attempted to uncover other relevant sources of information outside the Maritimes that could be used to help develop estimates.

Subject Matter Experts

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

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 and what proportion (if any) may go to the residential sector. 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 2.

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

2.3 Recycling Program Overview

Current agricultural plastics recycling programs were identified and summarized.

2.4 Enhancing Agricultural Plastics Recycling

Efficient ways and means of collecting, consolidating and shipping agricultural plastics after its use to a market were researched. This included identification of potential partners willing to be involved and options to leverage existing infrastructure.

3.0 Results

3.1 Description of Waste Types

Table 3.1 presents an overview of the different farm types and the plastic packaging wastes they produce. 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. For this Study outputs were focussed on greenhouse products and fresh produce. Outputs have been included when data required to make calculations has been readily available.

A description of the various input and output plastic packaging is described in the following sections:

3.1.1 Seed

Seed is sold in bulk and in packages. When sold in plastic packages, it is typically sold in smaller woven polypropylene (PP) (20-25 kg of product) or larger woven polypropylene (PP) bags (<1,000 kg of product).

Table 3.1: Plastic packaging waste by farm type

Location	Inputs	Plastic Packaging Waste	Output	Plastic Packaging Waste
Farm Type				
Crops				
Field Crops and Seed Production	Seed	Woven plastic bags	Harvested crops	Bale wrap, silage wrap
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Fruit and Vegetable Production	Seed/Propagation	Plastic trays, film plastic bags, woven plastic bags, mulch film, row covers	Harvested crops	Plastic packaging materials (e.g. LDPE, PET, PS).
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Greenhouse Production	Seed	Film plastic bags, Woven plastic bags	Harvested crops	Pots, trays, inserts and flats)
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
	Other	Plastic twine and plant clips		
Nursery Production	Seed/Propagation	Plastic trays, film plastic bags, woven plastic bags	Harvested crops	Pots
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Sod Production	Seed	Woven plastic bags	Harvested crops	
	Fertilizer	Film plastic bags		
	Pesticides	Film plastic bags, plastic jugs, plastic pails		
Livestock and Livestock products (e.g. milk and eggs)	Feed	Film plastic bags, woven plastic bags	Livestock Livestock products	Plastic packaging materials (eggs)
	Supplements	Film plastic bags, woven plastic bags, plastic jugs, plastic pails		
	Sanitation products	Plastic jugs, pails and drums		

3.1.2 Feed

Feed is sold in bulk and in packages. When it is sold in plastic packages it is typically sold in small (25-40 kg) or large (500 and 1,000 kg) woven polypropylene (PP) bags.

3.1.3 Fertilizer

Fertilizer is sold in bulk (solid and liquid) and in packages. When it is sold in plastic packages, it is typically sold in large woven PP bags with a low density polyethylene (LDPE) liner or in LDPE plastic bags (25 kg of product).

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.

3.1.5 Agricultural Film

Agricultural film includes greenhouse film, mulch film and row covers. These products are manufactured from LDPE.

3.1.6 Silage Film and Bale Wrap

Silage film and bale wrap are used to contain haylage, hay and corn silage and straw. These products are manufactured from LDPE.

3.1.7 Twine and Net Wrap

Twine (PP) and net wrap (HDPE) are used to contain hay and straw. Some twine is made from sisal (i.e. plant based material).

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 or 55 litre HDPE jugs, pails or drums. The sanitation products can come in liquid or solid forms.

3.1.9 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.

3.1.10 Plastic Packaging

A variety of farm outputs, including some fruit and vegetables, are shipped from the farm in plastic packaging such as clamshells (PET, PS) and plastic bags (LDPE). In some cases this is packaged and shipped from cooperatives. For this Study the amount of plastic packaging generated from the sale of fresh produce was estimated.

3.2 Estimate of Annual Tonnage of Various Plastic Packaging Materials

Each key agricultural plastic waste type is discussed in the following sections. Discussion is divided between waste inputs (i.e. generated and managed on-farm) and outputs (packaging materials used on-farm to prepare products for market). Figure 3.1 presents an overview of how the various calculations were made. Background information on calculations is provided in Appendix 1.

In some cases the tables presented in the body of the report do not fully add up due to rounding.

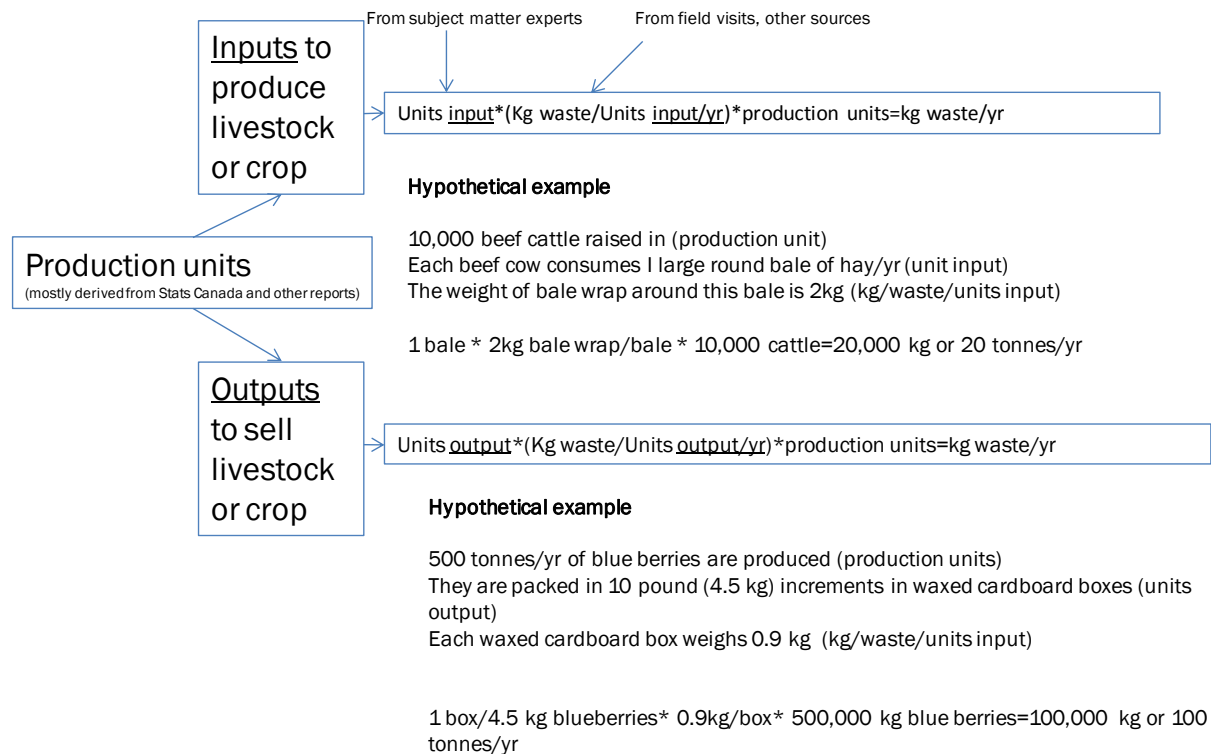


Figure 3.1. Overview of how Calculations were Developed

3.2.1. Film Plastic

LDPE film is used primarily for the following:

- silage film;
- bale wrap;
- mulch film;
- row covers
- fertilizer packaging;
- greenhouse film;
- grow bags used in the greenhouse vegetable growing industry; and

- packaging for fruit and vegetables.

It was estimated that approximately 1,252 tonnes/year of silage wrap and bale wrap is used in the Maritimes.

Mulch film is used predominantly for some field sweet corn, cucumber, pepper, tomato and strawberry production. Row covers are used (and retained for a number of years) for a variety of crops including beans, beets and peas. It was estimated that about 30 tonnes/year of mulch film plastic and 5 tonnes/year of row cover plastic are generated on Maritime farms.

A subject matter expert provided an estimate of the amount of fertilizers sold into the Maritimes agricultural market annually. It is estimated that about 22,000 tonnes/year of fertilizer is sold in bags and another 51,000 tonnes per year are sold in totes containing a plastic liner. This results in about 120 tonnes/year of film plastic being generated on Maritime farms.

Subject matter experts and industry contacts were contacted to help calculate estimates of greenhouse film plastic used annually. It was estimated that about 12 tonnes/year of this film plastic are generated on Maritime farms.

An estimate was developed of the annual amount of plastic film used in grow bags 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. It was estimated that about 4 tonnes/year of this film plastic are generated on Maritime farms.

It is estimated that close to 1,479 tonnes/year of film plastic waste are generated on Maritime farms. This film plastic waste is managed by the farmer.

Film plastic packaging (from field to wholesaler) is used for some fruit (apples, blueberries and strawberries) and some field and greenhouse vegetables (e.g. cucumbers, carrots and potatoes). Subject matter experts provided information on the amount of annual production that was packaged using film plastics and the weight of individual packages. It was estimated that about 871 tonnes/year of film plastic is shipped from Maritime farms.

It is estimated that about 5% or about 43 tonnes of this film plastic represents wastage that needs to be managed on the farm.

LDPE (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Silage Film and Bale Wrap	314	471	466	1,252
Mulch Film and Row Covers	30	3	4	37
Fertilizer	18	37	67	122
Grow Bags (greenhouse vegetable production)	13	0	0	13
Greenhouse film	5	6	1	12
Film plastic packaging	11	10	22	43
Total	391	527	560	1,479

LDPE (Output)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Fruit and Vegetable Packaging	169	207	445	821
Greenhouse Cucumbers and Peppers	50	0	0	50
Total	219	207	445	871

3.2.2 Woven Plastic Bags

In the Maritimes, woven PP plastic bags are typically used for packaging feed, seeds and fertilizers.

Data provided by subject matter experts were used to develop estimates of the annual tonnage of woven PP bulk bags used. It is estimated that about 320 tonnes/year are generated on Maritime farms.

PP (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Feed	56	36	18	110
Seed	6	8	20	34
Fertilizer	154	19	3	176
Total	71	54	35	320

3.2.3 Twine and Netwrap

Twine (PP) is used to hold together bales of hay and straw. It is estimated that about 173 tonnes/year of twine are generated on Maritime farms. It was estimated that another 30 tonnes/year of twine (not included in the above total) was made from sisal (i.e. non plastic).

Twine is also used in greenhouse vegetable production. It is estimated that about 3 tonnes/year of twine are used for this purpose.

PP (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Twine (Large Hay Bales)	15	33	34	82
Twine (Small Hay Bales)	3	14	5	22
Twine (Large Straw Bales)	18	19	26	63
Twine (Small Straw Bales)	1	1	1	3
Greenhouse Twine	3	0	0	3
Total	40	67	66	173

Netwrap (HDPE) is used to help hold together bales of hay and straw. It is estimated that about 55 tonnes/year (totals vary due to rounding) of net wrap are used for this purpose.

HDPE (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Netwrap (Large Hay Bales)	2	6	2	11
Netwrap (Large Straw Bales)	11	14	18	44
Total	13	20	20	55

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

Polypropylene and PS pots, trays, inserts and liners (trays) are used in the greenhouse industry (Photo 1). Polypropylene plant tags and plant sleeves are also used. High density polyethylene (HDPE) pots are used in the nursery industry (Photo 2).



Pot



Tray



Insert

Photo 1 Pots, Trays, Inserts and Flats



Photo 2 Nursery Pots

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

- Statistics Canada 2011 greenhouse and nursery production estimates;
- Weight based information gathered from manufacturer web sites; and
- Discussions with subject matter experts.

The following assumptions were made for calculation purposes:

- 100% of pots are made from PP

- 100% of plug trays, trays, inserts and liners (trays) used in the greenhouse industry are made from PS;
- 100% of nursery pots are made from HDPE.

Greenhouse Ornamental and Bedding Plant Production

It was assumed that both potted plants and bedding plants were initially propagated using PS plug trays. It was assumed that all of these become waste on an annual basis.

It is assumed that potted plants are grown in 1 litre, 2.4 litre, 11cm, 15cm, 30cm or hanging pots. Many potted plants are shipped in trays. For the purpose of these calculations it was assumed that all potted plants were grown in 15cm pots and that all required trays. 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 (estimated to be 5%).

It was assumed that bedding plants are grown in inserts (36 plants/insert) and that all of them were placed in a flat (also referred to as a tray) for transportation and marketing purposes. 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 (estimated to be 5%).

Nursery Production

It is assumed that containers are made from HDPE. For the purposes of calculations it was assumed that all are made from HDPE. A small percentage of pots used at a nursery become waste (estimated to be 5%).

It was estimated that about 33 tonnes/year of PP plant pots, tags and sleeves are used on Maritime farms.

It was estimated that about 209 tonnes/year of PS plug trays, trays, inserts and flats are used on Maritime farms.

It was estimated that about 35 tonnes/year of HDPE plant pots (nursery) are used on Maritime farms.

PP (Output)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Plant Pots	2.1	5.4	0.2	8
Plant Tags	6.7	6.9	2.7	16
Plant Sleeves	2.6	6.6	0.3	9
Total	11	19	3	33

PS (Output)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Plug Trays	11	11	4.4	27
Trays	32	82	3	114
Inserts	11	7.4	5.2	24
Flats	19	13	9	41
Total	73	114	22	209

HDPE (Output)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Nursery Pots	15	17	4	35
Total				35

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 15 tonnes/year of plug trays, pots, trays, inserts and flats are generated on Maritime farms. These wastes are either disposed in a garbage bin or recycled.

PP, PS and HDPE (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
PP	0.6	1	0.2	2
PS	4	6	1	11
HDPE	1	1	0.5	2
Total	6	8	1	15

3.2.5 Clamshell Packaging

Clamshell packaging is used to package some fresh fruit. In some cases this packaging takes place on farm. Clamshell packaging consists of PET and PS. For the purposes of calculation it was assumed that all clamshell packaging was made from PET.

The clamshell packaging for the production of blueberries and strawberries (packaged on farm or at cooperatives) was estimated. It is estimated that this results in 45 tonnes/year of packaging waste.

PET (output)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Clamshells	20	18	6	45
Total	20	18	6	45

It is estimated that approximately 5% of PET packaging becomes waste that needs to be managed at the greenhouse or farm. These wastes are typically disposed in a garbage bin. On the basis of these estimates about 2 tonnes/year of clamshells are generated on Maritime farms or cooperatives.

PET (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Clamshells	1	1	0.3	2
Total	1	1	0.3	2

3.2.6 Mesh Bag Packaging

Polypropylene mesh bags are used in the packaging of onions. In some cases this packaging takes place on farm.

The mesh bag packaging for the production of onions (packaged on farm or at cooperatives) was estimated. It is estimated that this results in **81 tonnes/year** of packaging waste.

PP (output)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Clamshells	81	0	0	81
Total	81	0	0	81

It is estimated that approximately 5% of PP packaging becomes waste that needs to be managed at the farm or cooperative. These wastes are typically disposed in a garbage bin. On the basis of these estimates about 11 tonnes/year of PP mesh bags are generated on Maritime farms (i.e. Nova Scotia) or cooperatives.

3.2.7 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- not calculated). Small amounts of fertilizers are also sold in plastic pails (not calculated).

CleanFARMS operates an “Empty Pesticide Recycling Program” across the country. In 2011, it was estimated that about 43 tonnes of plastic jugs and pails were generated in the Maritimes. There was no province by province data available so this value was divided by three to provide approximate provincial values.

Sanitation products are used in the dairy, poultry and hog industries. Estimates were developed from data collected from subject matter experts and then extrapolated for Maritime production. Based on available data, it was estimated that approximately 48 tonnes/year of jugs, pails and drums are generated on Maritime farms. There are some limited return programs for these wastes.

On this basis, it is estimated that about 93 tonnes/year of jugs, pails and drums are generated. While there are re-use programs available for some products, a considerable amount of these jugs, pails and drums are either recycled or require disposal.

HDPE (Input)

Sector	Nova Scotia	New Brunswick	Prince Edward Island	Estimated Weight
	tonnes/year			
Pesticides	14	14	14	43
Sanitation				
Sanitation products (Dairy)	20	16	11	48
Sanitation products (Poultry and Hog)	0.2	0.2	2	2
Total	34	30	27	93

3.3 Summary

Table 3.2 presents a summary of plastic packaging wastes generated on Maritime farms (i.e. inputs). An estimated 2,124 tonnes/year of packaging wastes are generated on Maritime farms.

Table 3.2 Summary of Plastic Packaging Wastes Generated on Maritime Farms

Plastic	Nova Scotia	New Brunswick	Prince Edward Island	Total	Comments
tonnes/year					
LDPE	392	527	560	1,479	Silage film, bale wrap, fertilizer bags, greenhouse film, grow bags bale wrap, mulch film, row covers and portion of fruit and vegetable packaging.
PP	260	131	107	498	Fertilizer, feed and seed bags (woven), twine, greenhouse twine, a portion of plant pots, inserts, flats, liners, plant tags and pot sleeves and a portion of mesh packaging bags
HDPE	46	47	41	135	Pesticide jugs, sanitation pails and drums, net wrap (hay and straw), and a portion of nursery plant pots
PS	4	6	1	11	A portion of plug trays, trays, inserts, flats, liners
PET	0.8	0.8	0.2	2	A portion of clamshell packaging
Sub-total	702	712	710	2,124	

Figure 3.2 provides an overview of the estimated waste composition of plastic packaging wastes generated on Maritime farms.

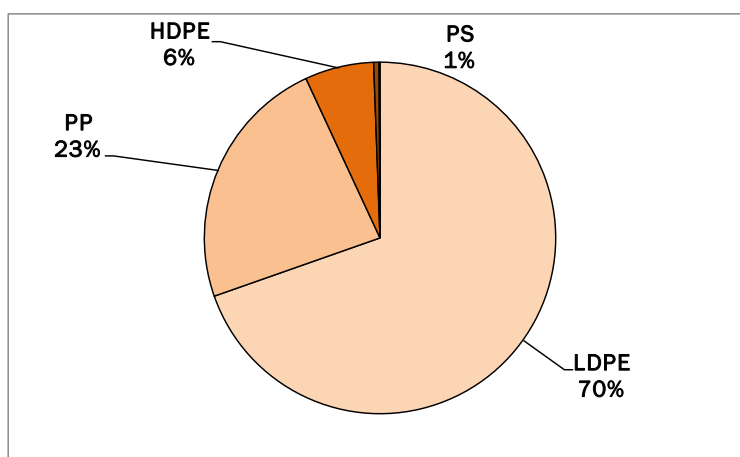


Figure 3.2 Estimated Waste Composition- Input

Table 3.3 presents a summary of the key waste producing packaging materials that are used to convey farm products to the marketplace (i.e. outputs). An estimated 1,277 tonnes/year of plastic packaging wastes leave Maritime farms.

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

Plastic	Nova Scotia	New Brunswick	Prince Edward Island	Total	Comments
tonnes/year					
LDPE	220	207	445	872	Fruit and vegetable packaging
PP	93	19	3	115	Plant pots, inserts, flats, liners, plant tags, pot sleeves, plastic mesh packaging
PS	74	115	22	210	Plant pots, inserts, flats, liners
PET	20	18	6	45	Clamshells
HDPE	15	17	4	35	Nursery pots
Sub-total	421	375	480	1,277	

Figure 3.3 provides an overview of the estimated waste composition of plastic packaging wastes that leave Maritime farms.

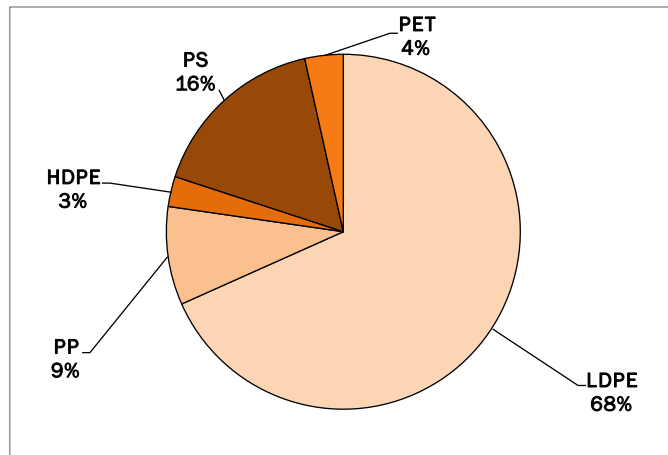


Figure 3.3 Estimated Waste Composition- Output

4.0 Agricultural Plastics Recycling and Re-Use Programs

There are few current recycling programs for agricultural plastic packaging in the Maritimes. Table 4.1 presents an overview of current programs.

Table 4.1 Agricultural Plastic Recycling Programs by Province

	Silage Wrap	Twine	Greenhouse Film	Net Wrap	Fertilizer bags	Chemical Containers
NS	None ¹	None	None	None	None	CleanFarms
PEI	Pilot Project ²	None	Pilot Project ²	Pilot Project ²	None	CleanFarms
NB	None	None	None	None	None	CleanFarms

¹ None – no program, all products go to the landfill.

² National Asset Recovery Specialists (NARS) and Island Waste Management Corp (IWMC) have implemented a Silage and Boat Wrap Pilot Recycling project from February 1 to July 31, 2012.

The Silage and Boat Wrap Pilot Recycling project, from an agricultural perspective, is mainly receiving silage wrap from farmers from six transfer facilities (i.e. Waste Watch Drop off Centers) across the island. They are accepting up to ½ tonne loads of these plastics. If a farm has more than a ½ tonne of plastics, they can contact IWMC and make special arrangements. There is no cost to the farmer unless the plastic is either contaminated or dirty. Twine, plastic containers of feed or fertilizer bags are not accepted.

This plastic is transferred to the East Prince Waste Management Facility and baled by IWMC forces for approximately \$25/tonne. IWMC is not certain how much silage wrap is being used by the agricultural industry therefore they cannot determine the percentage they have received. The Disposal Manager has indicated that there is still a high percentage that is not being recycled. Farmers have been doing a reasonable job of keeping the material clean and seem appreciative of having a place to take it free of charge.

As of July 2012, about 80-100 tonnes have been received. IWMC has just shipped out their first load to market. It is estimated that they will receive \$0.07/pound.

Incoming materials have a contamination rate of about 20%. As of July 2012 the project had been extended for another 6 months.

In Section 3.2.1 it is estimated that Prince Edward Island generates approximately 466 tonnes of bale wrap and silage film annually. Based on the amount of plastics received it can be roughly estimated that there is a capture rate of 20%. This estimate can be assessed at the end of the pilot project.

It is understood that the Westmorland St Albert Waste Management Commission, near Moncton, NB, is considering the recycling of silage and bale wrap although no program has commenced.

There do not appear to be any silage or bale wrap recycling programs in Nova Scotia.

In general, 55 litre HDPE drums used for soap and acid (i.e. sanitation products), are taken back by suppliers, refilled and brought back to the farm. They are re-used until they are no longer in good shape to refill.

Only fertilizer totes are re-used (nothing for feed and seed). Prince Edward Island is the largest re-user of tote bags followed by New Brunswick. The totes are returned by the farmers and reused (with new liners).

CleanFARMS helps coordinate successful pesticide container recovery programs across the country. This program results in the capture of about 66% of pesticide containers nationally. In the Maritimes, it is estimated that this capture rate is greater than 80%. Key to the success of this program is that virtually all manufacturers are part of the program and are committed to extended producer responsibility for all of the products they distribute into the market. In 2013, CleanFARMS is adding liquid fertilizer containers to the products that it will be capturing for recycling.

In general, voluntary waste diversion programs driven by manufacturers are relatively few in number. Most are the result of provincial regulation. But regardless of whether a program is driven voluntarily or through regulation, manufacturers that organize themselves across a province or nationally can provide much better access and recovery rates than small regional programs.

The three Maritime Provinces have some very successful waste diversion programs. Nova Scotia also consistently boasts the lowest solid waste disposal rates per capita for all of Canada. Their disposal rate isn't just low, it is almost half that of the rest of the country (New Brunswick and PEI also have low disposal rates, just not as low as Nova Scotia). It is assumed that this success is, in large part, due to its successful open burning and disposal bans. Additional success is also attributed to regulatory driven producer responsibility programs.

Unfortunately, except for the management of pesticide containers (and soon, fertilizer containers), few of the existing programs in the Maritimes address agricultural plastic wastes. Disposal bans do not apply to most farm plastics and

open burning bans are difficult to enforce in rural areas. Farmers therefore traditionally burn or landfill much of their plastic wastes.

If the Maritimes are interested in diverting the agricultural plastics from being burned or buried, they will need to consider options to move recycling programs forward on a voluntary or regulatory basis.

5.0 Development of Future Recycling/Diversion Programs

The key agricultural plastic packaging waste types that could be diverted are LDPE film (70%) and PP woven bags (23%).

There are currently few programs available to divert these materials as noted in Section 4.

Silage wrap and bale wrap are largely produced in association with dairy farming. Key dairy areas include Shubenacadie, Burwick and Antigonish in Nova Scotia; Sussex-Moncton and Fredericton in New Brunswick and Summerside in Prince Edward Island.

Prince Edward Island currently has a Silage and Boat Wrap Pilot Recycling project. The results of this project will have a great bearing on potential opportunities to divert these wastes in the rest of the Maritimes. It should be possible to set up similar programs in New Brunswick and Nova Scotia.

Depending on the success of the Prince Edward Island pilot project it may be possible to expand this program with their current contractor or another contractor.

Each province has waste management commissions. Nova Scotia has 6, New Brunswick has 12 and Prince Edward Island has 1. Each of these commissions manages waste and recycling in their region. Recyclables such as film plastic are directed/transferred to materials recovery facilities (MRFs). It may be possible for the agricultural community to work with these waste management commissions to help with collection and processing of these materials.

Most of the Maritime MRFs do not accept significant, if any, quantities of LDPE film or PP woven bags at this time. From discussions with some MRF operators it will be easier to adapt their MRFs for LDPE film than for PP woven bags.

It may be possible to expand the re-use of PP woven bags. While only some fertilizer PP woven bags are re-used it may be possible to re-use seed and feed PP woven bags. While they cannot re-enter these markets they could be re-used to package fertilizers. They would need to be clean, inside and out for this to be feasible.

Finally there has been some discussion by the private sector of developing a gasification facility in the Province. To date no official announcements have been made. Agricultural plastics could make up part of the feedstock for such a facility.

6.0 References and Bibliography

Clean FARMS 2012. Final Report British Columbia Agricultural Waste Study- Waste Characterization

Clean FARMS 2011. Final Report Ontario Agricultural Waste Study- Waste Characterization

Clean FARMS 2011. British Columbia Regional District Agricultural Plastics Collection

Statistics Canada, 2012. Cansim Table 011-100.

Statistics Canada, 2011. Service Bulletin-Fertilizers Shipment Survey. Catalogue no. 21-022-X

Statistics Canada ,2011. Cattle Statistics 2011. Catalogue no. 23-012-X

Statistics Canada, 2011. Hog Statistics. Catalogue no. 23-010-X

Statistics Canada 2011. Poultry and Egg Statistics- Catalogue no. 23-015-X

Statistics Canada 2011. Greenhouse, Sod and Nursery Industries- 2011. Catalogue no. 22-202-X

Statistics Canada 2011. Field Crop Reporting Series- 2011. Catalogue no. 22-002-X

Statistics Canada 2011. Fruit and Vegetable Production. Catalogue no. 22-003-X

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

Appendix 1

Background Information on Calculations

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Background information on calculations

Notes:

1. Numbers are rounded in the text of the report.
2. A five-percent factor of output packaging materials (i.e. for distribution of farm products) has been calculated as inputs (i.e. wastage from packaging process) and included in the text of the report.

Plastics

Low Density Polyethylene (LDPE) Plastic Film

Silage Film and Bale Wrap (input)

Silage wrap (Hay)						
Province	Estimated Area Harvested ¹	Usage ²	Silage/Bale Wrap Usage	Unit Weights ²	Weight	Annual Tonnage
	hectares	ft ² /ha harvested	ft ² /yr	kg/ft ²	kg	tonnes
Nova Scotia	33,240	200	6,648,000	0.0125	83,100	83
New Brunswick	29,986	200	5,997,200	0.0125	74,965	75
Prince Edward Island	17,586	200	3,517,200	0.0125	43,965	44
Total			16,162,400		202,030	202
Comments:						
1. Estimated production data calculated from Cansim Table 001-0010 (Statistics Canada).						
2. Data gathered from previous field work.						

Bale wrap (haylage)											
Province	Type of Wrap	Estimated Area Harvested ¹	Split Between Individual and Continuous Baling ²	Net Estimated Harvest Area	Bales ²	Total Bales	Bales/roll ²	Rolls	Total Rolls	Weight of Roll ²	Annual Tonnage
		hectares	%	hectares	bales/ha	#	bales/roll	#	#	kg/roll	tonnes
Nova Scotia	Individual	9,705	60%	5,823	20	116,458	23	5,063	7,651	27	207
	Continuous	9,705	40%	3,882	20	77,639	30	2,588			
New Brunswick	Individual	18,210	50%	9,105	20	182,101	23	7,917	13,987	27	378
	Continuous	18,210	50%	9,105	20	182,101	30	6,070			
Prince Edward Island	Individual	22,250	15%	3,338	20	66,751	23	2,902	14,769	27	399
	Continuous	22,250	80%	17,800	20	356,003	30	11,867			
Total				49,053		981,053					983

Comments:

1. Estimated production data calculated from Cansim Table 001-0010 (Statistics Canada).

2. Data gathered from subject matter experts.

Haylage (Ag Bag)					
Province	Estimated Area Harvested ¹	Ag Bag Usage ²	Ag Bag Usage	Weight of Ag Bag ³	Annual Tonnage
	hectares	ft/ha	ft/year	kg/ft	tonnes
Nova Scotia	291	12.4	3,610	0.58	2
New Brunswick	0	12.4	0	0.58	0
Prince Edward Island	1,113	12.4	13,795	0.58	8
Total					10

Comments:

1. Estimated production data calculated from Cansim Table 001-0010 (Statistics Canada).

2. Data gathered from subject matter experts.

3. Data gathered from previous field work.

Corn Fodder (Silage Wrap)						
Province	Estimated Area Harvested ¹	Usage ²	Silage/Bale Wrap Usage	Unit Weights ²	Weight	Annual Tonnage
	hectares	ft ² /ha harvested	ft ² /yr	kg/ft ²	kg	tonnes
Nova Scotia	2,240	600	1,344,000	0.0125	16,800	17
New Brunswick	2,400	600	1,440,000	0.0125	18,000	18
Prince Edward Island	2,100	600	1,260,000	0.0125	15,750	16
Total			4,044,000		50,550	51
Comments:						
1 Estimated production data calculated from Cansim Table 001-0010 (Statistics Canada).						
2. Data gathered from previous field work.						

Grain Corn (Silage Wrap)						
Province	Estimated Area Harvested	Usage ²	Silage Wrap Usage	Unit Weights ²	Weight	Annual Tonnage
	hectares	ft ² /ha harvested	ft ² /yr	kg/ft ²	kg	tonnes
Nova Scotia	1,005	125	125,625	0.0125	1,570	2
New Brunswick	0	125	0	0.0125	0	0
Prince Edward Island	0	125	0	0.0125	0	0
Total			125,625		1,570	2
Comments:						
1 Estimated production data calculated from Cansim Table 001-0010 (Statistics Canada).						
2. Data gathered from previous field work.						

Grain Corn (Ag Bag)					
Province	Estimated Area Harvested ¹	Ag Bag Usage ²	Ag Bag Usage	Weight of Ag Bag ³	Annual Tonnage
	hectares	ft/ha	ft/year	kg/ft	tonnes
Nova Scotia	1,002	7.4	7,415	0.58	4
New Brunswick	0	7.4	0	0.58	0
Prince Edward Island	0	7.4	0	0.58	0
Total					4
Comments:					
1. Estimated production data calculated from Cansim Table 001-0010 (Statistics Canada).					
2. Data gathered from subject matter experts.					
3. Data gathered from previous field work.					

Mulch Film

Mulch Film and LDPE- NS				
	Annual Production (Area) ¹	Annual Production (Covered area)	Unit Weight ²	Weight of Mulch Film
	ha	m ²	kg/m ²	tonnes/year
Sweet corn	95	950,000	0.02	3
Cucumbers	64	640,000	0.02	2
Peppers	101	1,010,000	0.02	3
Tomatoes	404	4,040,000	0.02	12
Strawberries	275	2,750,000	0.02	8
Total				28
1. Production data from Fruit and Vegetable Production Catalogue no. 22-003-X (Statistics Canada) and subject matter experts.				
2. Data gathered from previous field work.				

Mulch Film and LDPE- NB				
	Annual Production (Area)¹	Annual Production (Covered area)	Unit Weight²	Weight of Mulch Film
	ha	m ²	kg/m ²	tonnes/year
Sweet corn	47	470,000	0.02	1.4
Cucumbers	18	180,000	0.02	0.5
Peppers	4	40,000	0.02	0.1
Tomatoes	9	90,000	0.02	0.3
Squash and Zucchini	8	80,000	0.02	0.2
Total				3

1 Production data from Fruit and Vegetable Production Catalogue no. 22-003-X (Statistics Canada) and subject matter experts.

2. Data gathered from previous field work.

Mulch Film and LDPE- PEI				
	Annual Production (Area)¹	Annual Production (Covered area)	Unit Weight²	Weight of Mulch Film
	ha	m ²	kg/m ²	tonnes/year
Sweet corn	7	70,000	0.02	0.21
Cucumbers	2	20,000	0.02	0.06
Peppers	0.4	4,000	0.02	0.01
Tomatoes	0.8	8,000	0.02	0.02
Total				0.3

1 Production data from Fruit and Vegetable Production Catalogue no. 22-003-X (Statistics Canada) and subject matter experts.

2. Data gathered from previous field work.

Row Covers and LDPE- NS						
	Annual Production (Area) ¹	Annual Production (Covered area)	Unit Weight ²	Weight of Row Covers	Lifespan	Weight of Row Covers Waste
	ha	m ²	kg/m ²	tonnes/year	years	tonnes/year
Row Covers						
Beans	7	70,000	0.018	0.2	5	0.04
Beets	2	20,000	0.018	0.1	5	0.01
Carrots	123	1,230,000	0.018	3.3	5	0.66
Sweet Corn	38	380,000	0.018	1.0	5	0.21
Peas	3	30,000	0.018	0.1	5	0.02
Strawberries	27	270,000	0.018	0.7	5	0.15
Total				5		1

1 Production data from Fruit and Vegetable Production Catalogue no. 22-003-X (Statistics Canada) and subject matter experts.

2. Data gathered from on-line research.

Row Covers and LDPE- PEI

	Annual Production (Area) ¹	Annual Production (Covered area)	Unit Weight ²	Weight of Row Covers	Lifespan	Weight of Row Covers Waste
	ha	m ²	kg/m ²	tonnes/year	years	tonnes/year
Row Covers						
Beans	2	20,000	0.018	0.1	3	0.02
Beets	4	40,000	0.018	0.1	3	0.04
Broccoli	4	40,000	0.018	0.1	3	0.04
Cabbage	18	180,000	0.018	0.5	3	0.16
Carrots	5	50,000	0.018	0.1	3	0.05
Strawberries	2	20,000	0.018	0.1	3	0.02
Potatoes	352	3,520,000	0.018	9.5	3	3.17
Total				1		3

1 Production data from Fruit and Vegetable Production Catalogue no. 22-003-X (Statistics Canada) and subject matter experts.

2. Data gathered from on-line research.

Fertilizer (input)

Province	Estimated Use ¹	Bag/Liner Use	Unit Weights ³	Annual Tonnage
	tonnes	#/yr	kg	
	Tote liners²			
Nova Scotia	7,700	7,700	0.919	7
New Brunswick	15,750	15,750	0.919	14
Prince Edward Island	28,000	28,000	0.919	26
Subtotal				47
	Bags: 25 kg			
Nova Scotia	3,300	132,000	0.085	11
New Brunswick	6,750	270,000	0.085	23
Prince Edward Island	12,000	480,000	0.085	41
Subtotal				75
Total	73,500			122
Comments:				
1 Estimated use data from subject matter expert.				
2. LDPE liners included inside PP totes.				
3 Unit weights gathered from previous field work.				

Grow Bags (input)

Crop	Production ¹	Annual Production (Area)	Use of Grow Bags	Plants Per Grow Bag	Number of Grow Bags	Weight of Grow Bag ²	Weight of Grow Bags
	plants/ha	ha	%	#	#	kg	tonnes/year
Greenhouse Tomatoes (kg/m ²)	25,000	40	100	4	250,000	0.04	10
Greenhouse Cucumbers (units/m ²)	25,000	13	100	4	81,250	0.04	3
							13
Comments:							
1 Estimated production data from Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada) and subject matter experts. Full data only available for Nova Scotia.							
2 Weight of an empty grow bag.							

Greenhouse Film (input)

Provinces	Estimated Use ¹	Unit Weight ²	Weight of Greenhouse Film	Lifespan	Weight of Greenhouse Film Waste
	m ²	kg/m ²	tonnes/year	years	tonnes/year
Nova Scotia	137,846	0.14	20	4	5
New Brunswick	171,899	0.14	24	4	6
Prince Edward Island	20,562	0.14	3	4	1
Total			27		12
Comments:					
1 Estimated use data from Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada) and subject matter experts.					
2 Estimated from subject matter experts.					
3 Unit weight from supplier or calculated from available data.					

Plastic Packaging Materials Generated from Sale of Fresh Vegetables and Fruit (output)

	Marketed production	% Sold Fresh	% Sold in LDPE	Typical Weight of produce in package	Typical Weight of Plastic Packaging	Weight of packaging
	tonnes	%	%	g	g	tonnes/year
Nova Scotia						
Carrots	39,847	25	100	1,000	5	50
Potatoes	21,319	30	35	4,500	10	5
Apples	33,730	68	100	2,000	10	115
Subtotal						169
New Brunswick						
Carrots	1991	25	100	1,000	5	2
Potatoes	686,478	25	50	4,500	10	191
Apples	3,951	68	100	2,000	10	13
Subtotal						207
Prince Edward Island						
Carrots	18,420	25	100	1,000	5	23
Potatoes	1,156,680	30	35	2,300	8	422
Subtotal						445
Total						822

Polypropylene (PP)

Twine (Hay) (input)

Hay Twine PP			
Province	Production ¹	Unit Weight ²	Weight of Twine
	bales/year	kg/bale	tonnes/year
Large bales (600 pound)			
Nova Scotia	220,532	0.07	15
New Brunswick	477,377	0.07	33
Prince Edward Island	482,753	0.07	34
Subtotal			83
Small bales (40 pound)			
Nova Scotia	169,788	0.017	3
New Brunswick	809,622	0.017	14
Prince Edward Island	313,272	0.017	5
Subtotal			22
Total			105
Comments:			
1. Estimated usage data from subject matter experts.			
2. Data gathered from previous field work.			

Straw Twine PP			
Province	Production¹	Unit Weight²	Weight of Twine
	bales/year	kg/bale	tonnes/year
Large bales (600 pound)			
Nova Scotia	251,199	0.07	18
New Brunswick	276,640	0.07	19
Prince Edward Island	364,572	0.07	26
Subtotal			62
Small bales (40 pound)			
Nova Scotia	50,240	0.017	1
New Brunswick	55,328	0.017	1
Prince Edward Island	72,914	0.017	1
Total			3
Total			66
Comments:			
1. Estimated usage data from subject matter experts.			
2. Data gathered from previous field work.			

Woven Bags (input)

Fertilizer Woven PP			
Province	Estimated Use ¹	Unit Weight ²	Weight of Bags
	totes/year	kg/tote	tonnes/year
	Fertilizer- 1000kg tote		
Nova Scotia	77,009	2	154
New Brunswick	9,265	2	19
Prince Edward Island	1,647	2	3
Total			176
Comments:			
1 Estimated usage data from subject matter experts.			
2 Unit weight from supplier or calculated from available data.			

Seed Woven PP			
Province	Estimated Use¹	Unit Weight²	Weight of Bags
	totes/year	kg/tote or bag	tonnes/year
Seed- 500kg tote			
Nova Scotia	1,043	1.5	2
New Brunswick	1,685	1.5	3
Prince Edward Island	6,392	1.5	10
Subtotal			14
Seed- 40 kg bag			
Nova Scotia	17,091	0.08	1
New Brunswick	27,906	0.08	2
Prince Edward Island	101,585	0.08	8
Subtotal			12
Seed- 25 kg bag			
Nova Scotia	44,399	0.08	4
New Brunswick	44,399	0.08	4
Prince Edward Island	32,654	0.08	3
Subtotal			10
Total			35
Comments:			
1 Estimated usage data from subject matter experts.			
2. Data gathered from previous field work.			

Feed Woven PP			
Province	Estimated Use¹	Unit Weight²	Weight of Bags
	totes/year	kg/tote or bag	tonnes/year
	Feed- 1000 kg tote		
Nova Scotia	2,520	2	5
New Brunswick	1,620	2	3
Prince Edward Island	360	2	1
Subtotal			9
	Feed- 500 kg tote		
Nova Scotia	560	1.5	1
New Brunswick	360	1.5	1
Prince Edward Island	80	1.5	0
Subtotal			2
	Feed- 25-40 kg bags		
Nova Scotia	621,600	0.08	50
New Brunswick	399,600	0.08	32
Prince Edward Island	207,200	0.08	17
Subtotal			98
Total			109
Comments:			
1 Estimated usage data from subject matter experts.			
2. Data gathered from previous field work.			

Greenhouse Twine (input)

	Production	Annual Production (Area) ¹	Twine per plant	Total twine used	Weight of twine ²	Weight of Twine
	plants/ha	ha	feet	feet	g/foot	tonnes/year
Greenhouse Tomatoes (kg/m ²)	25,000	4	30	3,000,000	0.4	1
Greenhouse Cucumbers (units/m ²)	25,000	12	12	3,600,000	0.4	1
						3

Comments:

1. From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada).

2. Gathered from farm visits.

Polypropylene (PP), Polystyrene (PS) and High Density Polyethylene (HDPE) Plug Trays, Plant Pots, Trays, Inserts and Plant Tags (output)

Potted Flowers													
Province	Potted flowers ¹	Plug Tray	Weight ²	Total Weight	Pots	Weight ²	Total Weight	Tray	Weight ²	Total Weight	Sleeves ³	Weight ²	Total Weight
		PS			PP			PS			PP		
		#/tray	g	tonnes	#/pot	g	tonnes	pots/tray	g	tonnes	%	g	tonnes
Nova Scotia	1,285,505	102	168	2.1	1	18	23.1	6	150	32.1	50	4	2.6
New Brunswick	3,295,655	102	168	5.4	1	18	59.3	6	150	82.4	50	4	6.6
Prince Edward Island	127,105	102	168	0.2	1	18	2.3	6	150	3.2	50	4	0.3
Total	4,708,265			7.8			84.7			117.7			9.4

Comments:

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

2. Weighed and confirmed through on-line research

3. Estimated

Ornamental Bedding Plants										
Province	Ornamental Bedding Plants ¹	Plug Tray	Weight ²	Total Weight	Insert	Weight ²	Total Weight	Flat	Weight ²	Total Weight
		PS			PS			PS		
		#/tray	g	tonnes	#/insert	g	tonnes	#/flat	g	tonnes
Nova Scotia	4,143,825	102	168	6.8	36	73	8.4	36	127	14.6
New Brunswick	unknown	102	168		36	73		36	127	
Prince Edward Island	2,418,000	102	168	4.0	36	73	4.9	36	127	8.5
Total	6,561,825			10.8			13.3			8.5
Comments:										
1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada).										
2. Weighed and confirmed through on-line research										

Vegetable Bedding Plants										
Province	Vegetable Bedding Plants ¹	Plug Tray	Weight ²	Total Weight	Insert	Weight ²	Total Weight	Flat	Weight ²	Total Weight
		PS			PS			PS		
		#/tray	g	tonnes	#/insert	g	tonnes	#/flat	g	tonnes
Nova Scotia	1,280,695	102	168	2.1	36	73	2.6	36	127	4.5
New Brunswick	3,644,170	102	168	6.0	36	73	7.4	36	127	12.9
Prince Edward Island	127,655	102	168	0.2	36	73	0.3	36	127	0.5
Total	5,052,520			8			10			18
Comments:										
1 Production data from From Greenhouse, Sod and Nursery Industries Catalogue no. 22-202-X (Statistics Canada).										
2. Weighed and confirmed through on-line research										
3. Estimated										

Plant Tags				
Provinces	Plants ¹	Tags	Weight ²	Total Weight
		PP		
		#/plant	g	tonnes
Nova Scotia	6,710,025	1	1	6.7
New Brunswick	6,939,825	1	1	6.9
Prince Edward Island	2,672,760	1	1	2.7
Total	16,322,610			16

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

2. Weighed and confirmed through on-line research

3. Estimated

Nursery Container Production- 1 gallon								
Province	Nursery Container Production ¹	Years to Marketing	Plug Tray	Weight ²	Total Annual Weight	Pots	Weight ²	Total Annual Weight
			PS			HDPE		
		years	#/tray	g	tonnes	#/pot	g	tonnes
Nova Scotia	900,000	3	102	168	0.5	1	50	15
New Brunswick	1,000,000	3	102	168	0.5	1	50	17
Prince Edward Island	210,000	3	102	168	0.1	1	50	4
Total	1,900,000				1.0			35

Comments:

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

2. Weighed and/or confirmed through on-line research

High Density Polyethylene (HDPE) Net Wrap (Input)

Hay Net Wrap HDPE			
Province	Production ¹	Unit Weight ²	Weight of Twine
	bales/year	kg/bale	tonnes/year
Large bales (600 pound)			
Nova Scotia	19,176	0.09	1.7
New Brunswick	50,376	0.09	4.5
Prince Edward Island	18,467	0.09	1.7
Total			8
Comments:			
1. Estimated usage data from subject matter experts.			
2. Data gathered from previous field work.			

Straw Net Wrap HDPE			
Province	Production ¹	Unit Weight ²	Weight of Twine
	bales/year	kg/bale	tonnes/year
Large bales (600 pound)			
Nova Scotia	92,872	0.09	8.4
New Brunswick	117,473	0.09	10.6
Prince Edward Island	147,607	0.09	13.3
Total			32
Comments:			
1. Estimated usage data from subject matter experts.			
2. Data gathered from previous field work.			

**Plastic Jugs, Pails and Drums
Pesticides (Input)**

	Weight ¹	Weight of Pesticide Containers
	kg/year	tonnes/year
Pesticide Containers	42,900	43
Comments:		
1 Estimated usage data from subject matter experts.		

**Sanitation Products
Dairy (Input)**

Dairy Sanitation- Nova Scotia							
Sanitation Product	Usage	Dairy cows	Sanitation	20 litre pails ³	55 litre drums ³	205 litre drums ³	Total
	litres/year/cow ¹	000s ²	litres/year	tonnes/year			
Teat Dip	7.3	23	167,900	3	3	2	8
Chorine	3	23	69,000	1	1	1	3
Soap	6	23	138,000	2	3	1	6
Acid	2	23	46,000	1	1	0	2
Foot Bath ⁴	1	16	16,000	1	0	0	1
Total				8	8	4	20
Comments:							
1 From previous farm visits and subject matter experts.							
2 Data from Cattle Statistics 2011 Catalogue no. 23-012-X (Statistics Canada)							
3. Data gathered from previous field work or estimated							
Background information on calculations							
4. Only 70% of dairy cattle in Maritimes use footbaths							

Dairy Sanitation- New Brunswick							
Sanitation Product	Usage	Dairy cows	Sanitation	20 litre pails ³	55 litre drums ³	205 litre drums ³	Total
	litres/year/cow ¹	000s ²	litres/year	tonnes/year			
Teat Dip	7.3	19	138,700	2	3	1	6
Chorine	3	19	57,000	1	1	1	3
Soap	6	19	114,000	2	2	1	5
Acid	2	19	38,000	1	1	0	2
Foot Bath ⁴	1	13	13,000	1	0	0	1
Total				7	6	3	16
Comments:							
1 From previous farm visits and subject matter experts.							
2 Data from Cattle Statistics 2011 Catalogue no. 23-012-X (Statistics Canada)							
3. Data gathered from previous field work or estimated							
4. Only 70% of dairy cattle in Maritimes use footbaths							

Dairy Sanitation- Prince Edward Island							
Sanitation Product	Usage	Dairy cows	Sanitation	20 litre pails ³	55 litre drums ³	205 litre drums ³	Total
	litres/year/cow ¹	000s ²	litres/year	tonnes/year			
Teat Dip	7.3	13	94,900	2	2	1	4
Chorine	3	13	39,000	1	1	0	2
Soap	6	13	78,000	1	1	1	4
Acid	2	13	26,000	0	0	0	1
Foot Bath ⁴	1	9	9,000	0	0	0	1
Total				5	4	2	11
Comments:							
1 From previous farm visits and subject matter experts.							
2 Data from Cattle Statistics 2011 Catalogue no. 23-012-X (Statistics Canada)							
3. Data gathered from previous field work or estimated							
4. Only 70% of dairy cattle in Maritimes use footbaths							

Hog (Input)

Hog Sanitation- Total for Maritimes		
Using Industry Data ²	Value	Units
Hog production ¹	118,000	#/year
Space used	10	sq foot
Cycles	2.5	turnover/year
Total space used	1,180,000	sq feet/year
Ratio of Floor Space to total Barn Space	2.9	
Total barn space	3,422,000.0	sq feet/year
Undiluted Sanitation product used	0.75	ml/square foot
Undiluted Sanitation product used	2,567	litres/year
20 litre containers (HDPE)	128	#/year
Weight of containers	1.5	kg
Weight of all empty containers	0.19	tonnes/year
1 Production data gathered from Hog Statistics. Catalogue no. 23-010-X (Statistics Canada, 2011).		
2 Other data collected from subject matter experts.		

Poultry Sanitation- Layers- Total for Maritimes		
Using Industry Data	Value	Units
Poultry production	1,664,000	#/year
Space used	0.67	sq foot
Cycles	6.5	turnover/year
Total space used	1,114,880	sq feet/year
Ratio of Floor Space to total Barn Space	2.7	
Total barn space	3,010,176.0	sq feet/year
Undiluted Sanitation product used	0.75	ml/square foot
Undiluted Sanitation product used	2,258	litres/year
20 litre containers (HDPE)	113	#/year
Weight of containers	1.5	kg
Weight of all empty containers	0.2	tonnes/year
Comments:		
1 Production data gathered from Poultry and Egg Statistics Catalogue no. 23-015-X (Statistics Canada)		
2 Other data collected from subject matter experts.		

Poultry Sanitation- Broilers- Total for Maritimes		
Using Industry Data	Value	Units
Poultry production ¹	42,000,000	#/year
Space used ²	0.75	sq foot
Cycles	6.5	turnover/year
Total space used	31,500,000	sq feet/year
Ratio of Floor Space to total Barn Space	2.7	
Total barn space	85,050,000.0	sq feet/year
Undiluted Sanitation product used	0.31	ml/square foot
Undiluted Sanitation product used	26,366	litres/year
20 litre containers (HDPE)	1,318	#/year
Weight of containers	1.5	kg
Weight of all empty containers	2	tonnes/year
Comments:		
1 Production data gathered from Poultry and Egg Statistics Catalogue no. 23-015-X (Statistics Canada 2011)		
2 Other data collected from subject matter experts.		

Appendix 2
List of Subject Matter Experts and Industry Contacts
Interviewed

List of Subject Matter Experts and Industry Contacts Interviewed

Nova Scotia

Affiliation	Name	Title
Truro Agromart	Tim Fisher	Agrologist/Owner
	Donnie MacGregor	Agrologist
Cavendish AgriServices	Shelly MacInnis	Agrologist
AgraPoint (Perennia Food & Agriculture Inc.)	Bill Thomas	Manager of Extension/Field Crop Specialist
	Nancy Kent	Non-Ruminant Specialist
	Alex Oderkirk	Non-Ruminant Specialist
Greenhouse Nova Scotia	Yvonne Thyssen Post	Coordinator/Consultant
Horticulture Nova Scotia	Donna Crawford	
Clarence Farm Services Ltd	Frank VanGestal	Feed Specialist
Chicken Farmers of Nova Scotia	Tim Ansems	Chair
Nova Scotia Egg Producers	Paul Overmars	Chair
Pork Nova Scotia	Brad McCallum	Secretary
ScotianGold	Bill Kusack	
Doug Bragg Enterprises	Peter Swinkles	General Manager
Nova Agri	Darrell Sweet	
	Peter Sawlor	Producer/Owner
King Limousin Farm	Heather King	Producer/Owner
Eyking Brothers Farm	Chris Eyking	Producer/Owner

New Brunswick

Affiliation	Name	Title
Hartland Agromart	Robert Brennan	Agrologist/Owner
Grand Falls Agromart	Dan Blanchett	Agrologist/Owner
Cavendish AgriServices	Kent Curtis	Agrologist
Coop Atlantic	Rafael Gonzales	Atlantic Canada Seed & Crop Specialist
	Louis Snyder	Atlantic Feed Operation Manager
Quality Milk Management	Don Anderson	Maritime Udder Health Specialist
Porc NB Pork	Brenda MacLoon	Office Manager
Organic Vegetable Farmer	Tim Livingstone	Owner
New Brunswick Dept of Agriculture	Shirlyn Coleman	Manager of Crop Development
	Peter Scott	Field Crop Specialist
	Gerry Chevrier	Director Agri-Business Development
	Gerard Thebeau	Development Officer Agri-Business
	Pat Toner	
NB Soils and Crops Improvement	Susannah Banks	General Manager

Association		
Agriculture Alliance of New Brunswick	Nicole Arseneau	Office Manager
Vegetable Producer	Kevin Budd	Owner

Prince Edward Island

Affiliation	Name	Title
Cavendish AgriServices	Ryan Schofield	Agrologist
PEI Agromart	Andrew Robinson	Agrologist/Owner
PEI Department of Agriculture & Forestry	Chris Jordon	Berry Crop Development Officer
	Susan MacKinnon	
	Doon Pauly	Field Crop Development Officer
	Dr. Les Halliday	Beef Development Officer
	Fred VanderKloet	Dairy Development Officer
Co-op Atlantic	Ron Gamble	Feed Specialist
PEI Hog Commodity Marketing Board	Tim Seeber	Manager/Executive Director