

**Cleanfarms Inc.
Final Report
Manitoba Agricultural Waste Characterization**

April 2019

Submitted by:



Page left intentionally blank

Table of Contents

1.0	Introduction	2
1.1	Project funding	2
2.0	Methodology	3
2.1	Waste Characterization.....	3
2.1.1	Desktop Audit.....	4
3.0	Results.....	5
3.1	Description of Waste Types	5
3.1.1	Seed.....	5
3.1.2	Feed	5
3.1.3	Fertilizer	6
3.1.4	Pesticides	6
3.1.6	Silage/Bale Wrap/Grain Bags.....	6
3.1.7	Twine and Net Wrap.....	6
3.1.8	Cardboard and Boxboard	6
3.2	Summary of Results	7
4.0	Conclusions	10
5.0	References and Bibliography	11

Appendix 1 Background Information on Calculations.

Key Acronyms used in report

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

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 primarily operates industry-funded programs across Canada and is one of Manitoba's 12 Producer Responsibility Organizations (PROs) that operate industry-funded programs that manage items like pesticide and fertilizer containers, beverage containers, electronics, paint, used oil, tires and batteries.

Manitoba Sustainable Development asked Cleanfarms to help the province evaluate transitioning its government-funded ag plastics pilot projects into a permanent, industry-funded stewardship program. This document is part of this work.

A waste characterization study, like this one, estimates the annual tonnage and type of waste generated. This report updates a similar study, conducted in 2011.

Similar to the 2011 study (see Section 5), this report uses desktop research and existing sources of information. All data collected was summarized and estimates of the annual generation of various wastes were made.

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

1.1 Project funding

Funding for this work was provided by Manitoba Sustainable Development.

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. A scoped waste characterization of agricultural packaging wastes was undertaken. The following waste categories and sub-categories were considered:

Category	Examples of Sub Categories
Plastic	Greenhouse film (LDPE) Plastic mulch (LDPE) Silage film (LDPE) Bale wrap (LLDPE) Twine (PP) Netwrap (HDPE or PP) Grain bags (LDPE) Feed bags (PP) Seed bags (PP) Sand bags (LDPE)
Paper packaging	Cardboard Boxboard Laminates Feed bags Seed bags

This waste characterization was developed by combining the following two factors:

1. Estimate of Units of Production

Data on agricultural units of production (e.g. head of cattle, acres per crop) on Manitoba farms are regularly estimated by Statistics Canada and other organizations. Available data was collected from a variety of sources.

2. Estimate of Waste Generated Per Unit of Production

This was accomplished by reviewing 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.

(Note: This was left relatively unchanged from 2011 report)

Data Compilation

Waste characterization data, which come from different sources, was compiled into an Excel spreadsheet. The compiled data was analyzed and the results were summarized in a variety of tables and figures.

2.1.1 Desktop Audit

This above noted data was gathered as part of a desktop audit. The desktop audit consisted of research, data collection and data analysis.

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 waste generation and composition. This included a number of existing Cleanfarms reports.

Internet Search

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

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

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.

Farm Type	Inputs	Waste Types
Crops		
Field Crops and Seed Production	Seed	Woven plastic bags, paper bags
	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
	Fertilizer	Film plastic bags
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails
Greenhouse Production	Seed	Film plastic bags, Woven plastic bags
	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
	Fertilizer	Film plastic bags
	Pesticides	Film plastic bags, paper bags, plastic jugs, plastic pails
Sod Production	Seed	Film plastic bags, Woven plastic bags
	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
	Supplements	Film plastic bags, woven plastic bags, paper bags, plastic jugs, plastic pails
	Sanitation products	Plastic jugs, pails and drums

Table 3.1 Packaging waste types by type of production

Possible packaging waste generation has been broken into the various inputs required for farm production. Inputs will create wastes that need to be managed at the farms. 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.

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 in 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

Fertilizer (solid and liquid) is sold in bulk 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.

3.1.5 Agricultural Film

Agricultural film includes greenhouse film and mulch film. These products are typically manufactured from LDPE.

3.1.6 Silage/Bale Wrap/Grain Bags

Silage/bale wrap are used to store hay, silage and straw. Grain bags are used to store grain. 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 and also in the greenhouse vegetable growing industry. These products are typically manufactured from PP, but also HDPE.

3.1.8 Cardboard and Boxboard

Cardboard and boxboard are used as packaging for some inbound materials delivered to farms.

3.2 Summary of Results

Table 3.2 presents a summary of scoped packaging wastes generated. An estimated 5,604 tonnes/year of non-organic wastes are generated on Manitoba farms.

Category	Sub category	Tonnes/year
Plastic		
	Grain bags	272.2
	Silage film	144.6
	Bale wrap	129.6
	Greenhouse film	15.3
	Sand bags	7.6
	Plastic mulch	0.4
Subtotal - LDPE		569.7
PP	Feed bags	383.6
	Twine	293.4
	Seed bags	43.0
Subtotal - PP		720
HDPE or PP	Netwrap	103.9
Subtotal - PP or HDPE		103.9
Subtotal - plastic		1,393.6
Paper		
Cardboard		2,586.7
Boxboard		966.4
Laminates		338
Seed bags (paper)		139.1
Feed bags (paper)		179.8
Subtotal - paper		4,210
Total		5,603.6

Table 3.2 Summary of scoped packaging waste generated on Manitoba farms by category (annual)

The data from Table 3.2 is shown in Figure 3.1.

It is estimated that almost 75% of this consists of cardboard and boxboard, with most of the balance consisting of plastic.

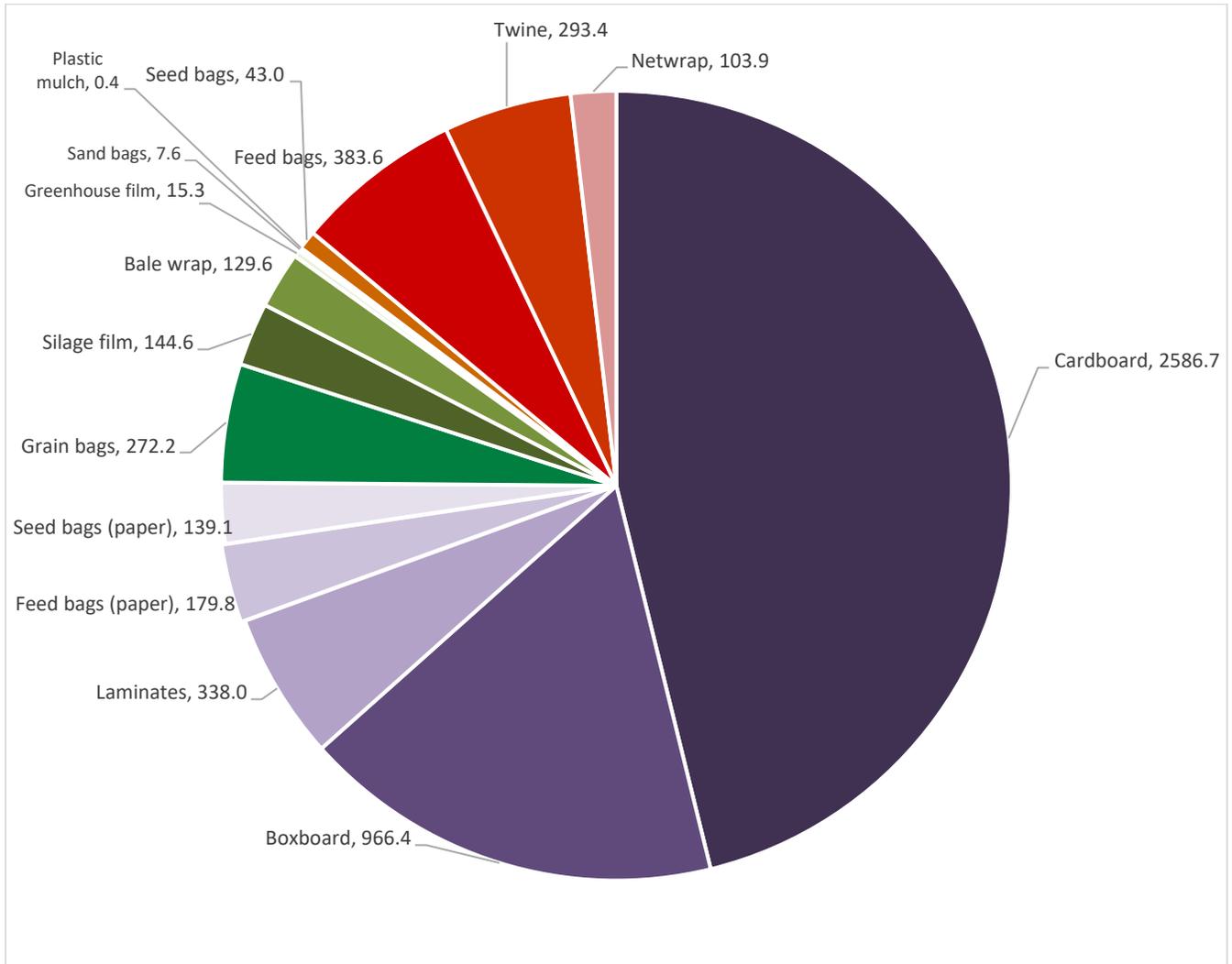


Figure 3.1 Estimated Annual Waste Composition – paper and plastic (tonnes)

Figure 3.2 shows/summarizes plastic packaging only. It is estimated that more than 70% of this consists of grain bags (LDPE), twine (PP), feed (PP) and seed bags (PP).

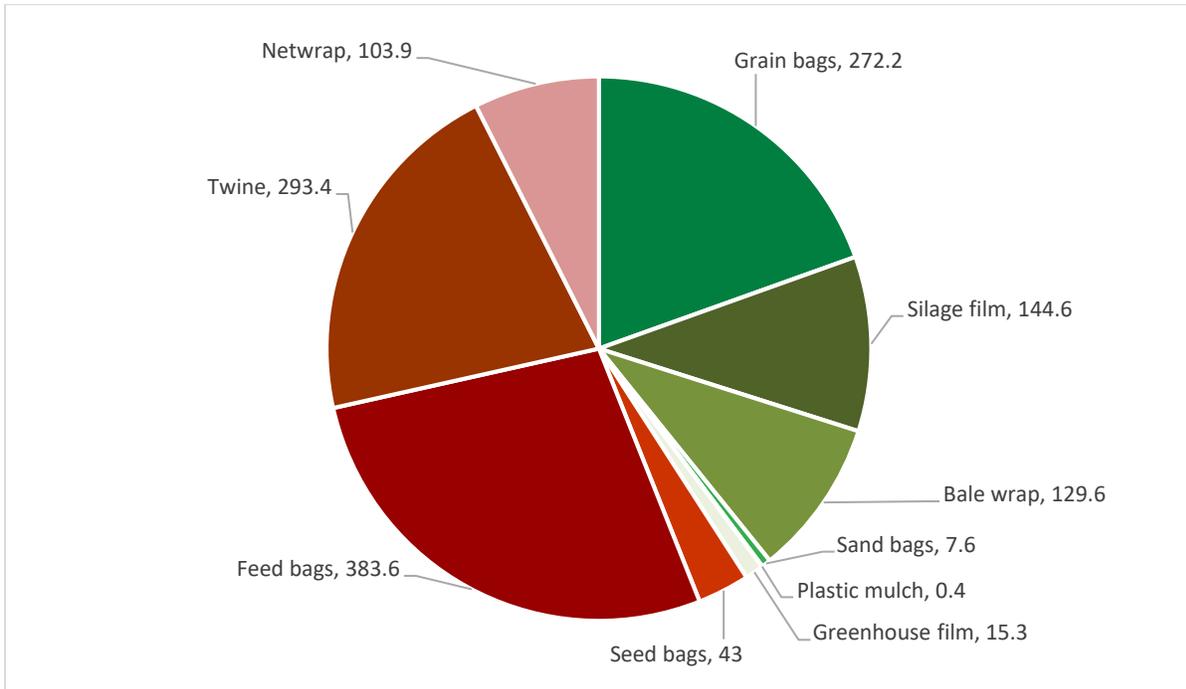


Figure 3.2 Estimated Annual Plastic Packaging Waste Generation and Compensation (tonnes)

Figure 3.3 shows/summarizes paper packaging only. It is estimated that more than 80% of this consists of cardboard and boxboard.

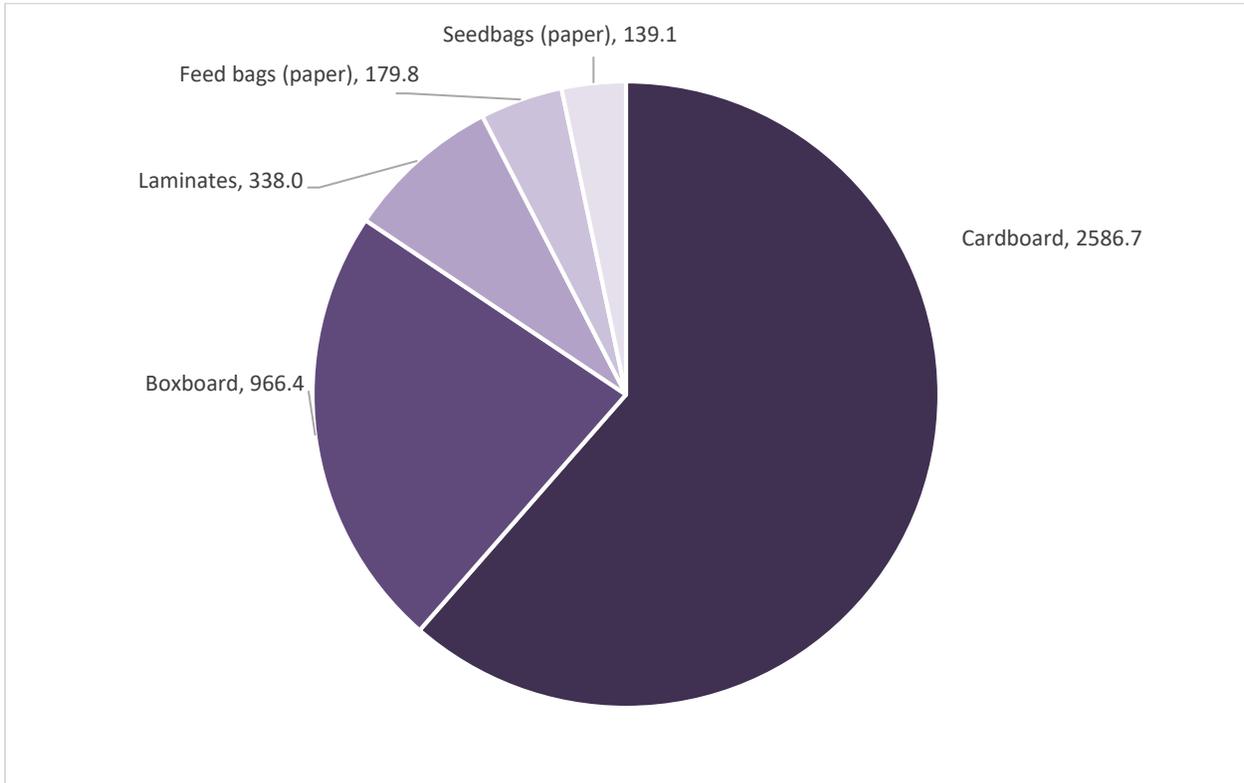


Figure 3.3 Estimated Annual Paper Packaging Generation and Composition (tonnes)

4.0 Conclusions

The amount of scoped plastic and paper packaging waste generated on Manitoba farms was estimated at 5,604 tonnes/year, consisting of 4,210 tonnes/year paper packaging and 1,394 plastic packaging is generated.

5.0 References and Bibliography

CleanFarms 2011. Manitoba Agricultural Waste Study

https://cleanfarms.ca/wp-content/uploads/2017/07/MBAgWasteStudy_20110324_FINAL3.pdf

Statistics Canada 2018. Number of cattle, by class and farm type (x 1,000)

<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210013001&pickMembers%5B0%5D=1.8&pickMembers%5B1%5D=2.4>

Statistics Canada 2017. Farm and Farm Operator Data

<https://www150.statcan.gc.ca/n1/pub/95-640-x/95-640-x2016001-eng.htm>

Statistics Canada 2017. Estimates of greenhouse total area and months of operation.

<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210001801&pickMembers%5B0%5D=1.8>

Manitoba Agriculture 2017. Manitoba Crop Highlights- 2016 Census of Agriculture.

<https://www.gov.mb.ca/agriculture/markets-and-statistics/crop-statistics/pubs/crop-highlights-census.pdf>

Manitoba Agriculture 2018. November estimates of production of principal field crops 2017.

<https://www.gov.mb.ca/agriculture/markets-and-statistics/crop-statistics/pubs/november-estimates-of-production.pdf>

Appendix 1 - Background Information on Calculations

Manitoba Agricultural Waste Study (2018)

Greenhouse Film

Total area of poly covered greenhouse (sq feet)	3,358,710	The most recent Stats Canada data for poly greenhouse area; 2017
Conversion to film area based on 24' average greenhouse width. (sq feet)	3,963,278	This factor used to convert greenhouse area to area of film used was obtained from two large retailers of greenhouse film.
6 mil, 60% of the market, estimated at 30 lb per 1,000 sq ft (lb)	71,339	These market segments were supplied by a major retailer.
8 mil, 40% of the market, estimated at 40 lb per 1,000 sq ft (lb)	63,412	These market segments were supplied by a major retailer.
Total lb	134,751	This value represents the total film used in the province.
Total Tonnes	61	This value represents the total film used in the province.
Annual film replaced and available for recycling	15	Calls with several of the largest greenhouse operators in MB indicated average replacement is every four years.

Plastic Mulch

Adjusted area for saskatoons (sq feet)	95,832	Ten acres with 4 ft row cover and 14 ft row spacing w/o mulch between rows. Coverage equals 22%.
Area for strawberries (sq feet)	87,120	
Total area (sq feet)	182,952	Estimates from provincial fruit specialist.
Total annual weight applied lb	966	Density of .00528 lb/sq ft, supplied by a mulch manufacturer.
Total Tonnes	0.44	

Silage Film

	Total	Value for Calculation
Number of cattle, by class and farm type, July 2018	433,380	43,338 An estimated 10% of beef cattle are fed silage. This estimate from two extension staff.
Number of cattle, by class and farm type, July 2018	40,200	36,180 An estimated 90% of dairy cattle are fed silage. This estimate from two dairy extension staff.
Total number of cattle, adjusted for upright silos.		32,562 Silage stored in upright silos does not require cover. 10% of dairy cattle are fed from an upright silo. This estimate from two dairy extension staff.
Using Levitar's 4.2 lb per cow factor		145 (tonnes)
Using Levitar's 7.5 lb per cow factor		258 (tonnes)

Bale Wrap

Forage wrapped (tonnes)	336,825	Forage and livestock specialists estimate 20 to 30% of all baled forages are wrapped. 20 % is the value used.
Plastic per tonne (lb)	0.8485	This estimate is calculated from values obtained from a custom bale bagger. 350 lb roll = 412.5 tonne
Volume of plastic wrap (tonne)	130	

Twine Calculation based on feeding assumptions

	Total	Value for Calculation
Number of cattle, by class and farm type, July 2018	433,380	390,042 An estimated 10% of beef cattle are fed silage. This estimate from two extension staff.
Number of cattle, by class and farm type, July 2018	40,200	4,020 An estimated 10% of dairy cattle are fed bales. This estimate from two dairy extension staff.
Average annual hay and straw volume (tonnes)		3.63 This estimate provided by bovine specialist, U of M. 2.98 tonnes is forage, remainder is straw.
Total hay and straw (tonnes)	1,430,352	
Adjusted for net wrap use	1,144,282	Retailers estimates ranged from 10% to 30% of the market is net wrap. A value of 20% is used.
Twine per tonne of forage and straw (kg) retailer estimate		0.13 This estimate obtained from a large twine retailer during previous research.
Twine per tonne of forage and straw (kg) custom baler estimate		0.16 This estimate obtained from a large custom baler during previous research.
Twine (tonnes) using retailer estimate	151	
Twine (tonnes) using custom baler estimate	187	
Twine estimate based on forage production		
Total forage tonnes	2,994,000	2017 is the most recent forage production data available from Stats Can.
Less quantity cut as silage	2,245,500	Twine retailer estimates vary widely from less than 10% to as high as 40% in some areas. An average of 25% was used.
Twine (tonnes) using retailer estimate	236	Note that this estimate would not account for hay exports from the province.
Twine (tonnes) using custom baler estimate	293	Note that this estimate would not account for hay exports from the province.

Net Wrap based on feeding assumptions

Volume of forage baled with net wrap. (tonnes)
Net Wrap (tonnes)

286,070 Calculated from above.
 66 Net wrap used at a rate of .51lb per tonne baled. This estimate obtained from a large custom baler during previous research.

Net Wrap estimate based on forage production

Tonnes baled with net wrap
Net Wrap (tonnes)

449,100 20% of forage volume baled with net wrap
 104 Net wrap used at a rate of .51lb per tonne baled. This estimate obtained from a large custom baler during previous research.

Grain bags

Tonnes

2,000 Estimated provincial volume from survey of retailers and confirmed with manufacturer.
 272 Average 300 lb per bag

Corrugated Cardboard

Average survey result
 Average survey result (cubic metres)
 Total Manitoba Farm Operators
 Provincial Total (cubic metres)
 Average density (kg/sq metre)
Provincial Total (tonnes)

91.94 Valid responses = 155
 2.34 Conversion rate is 0.0254 m³/inch
 20,140 Source: 2017 Statistics Canada, Farm and Farm Operator Data
 47,030
 55.00 Source: Stewardship Ontario
2,587

Boxboard

Average survey result
 Average survey result (cubic metres)
 Total Manitoba Farm Operators
 Provincial Total (cubic metres)
 Average density (kg/sq metre)
Provincial Total (tonnes)

31.48 Valid responses = 159
 0.80 Conversion rate is 0.0254 m³/inch
 20,140 Source: 2017 Statistics Canada, Farm and Farm Operator Data
 16,106
 60.00 Source: Stewardship Ontario
966

Laminates

Average survey result
 Average survey result (cubic metres)
 Total Manitoba Farm Operators
 Provincial Total (cubic metres)
 Average density (kg/sq metre)
Provincial Total (tonnes)

18.88 Valid responses = 143
 0.48 Conversion rate is 0.0254 m³/inch
 20,140 Source: 2017 Statistics Canada, Farm and Farm Operator Data
 9658.18
 35.00 Source: Stewardship Ontario
338

Feed Bags (Paper)

Packaging supplier estimate

500,000 One major supplier provided this estimate of the entire market. Several mills thought this estimate was reasonable.

Weight of estimate @ 300 grams per bag (tonnes)

150 Bag weight supplied by mill.

Feed Bags (Poly)

Packaging supplier estimate

1,000,000 A major supplier estimated the entire market at 500,000 to 1,000,000. A smaller supplier provided an estimate of 300,000.

Weight of estimate @ 320 grams per bag (tonnes)

320 Bag weight supplied by mill.

Feed Bags all types calculated

Weight of paper @ 300 grams per bag, 1/3 of volume (tonnes)
Weight of plastic @ 320 grams per bag, 2/3 of volume (tonnes)

1,800,000 Assumes six mills bag @ 30 tonne/day each, 250 days/year.
 180 Assumes 1/3 of the total calculated market is paper.
 384 Assumes 2/3 of the total calculated market is plastic.

Seed Bags

Crop	Acres	Bags	Paper or Poly
Wheat	2,765,352	53,180	Poly
Oats	519,909	13,186	Poly
Barley	264,897	4,066	Poly
Rye	69,931	885	Poly
Flax	55,104	5,250	Poly
Canola	3,159,979	270,205	Paper
Corn	409,947	185,496	Paper
Peas	64,742	7,847	Poly
Soybeans	2,292,393	Returnable	Poly
Dry Beans	135,661	Returnable	Poly
Sunflower	64,989	8,124	Paper
Forages are perennial, estimate based on trade information.	-	50,000	Poly
	Bags	Tonnes	
Total paper seed bags @ 300 grams per bag	463,825	139	
Total plastic seed bags @ 320 grams per bag	134,415	43	

Sandbags

Average survey result	9.3 Valid responses = 175
Total Manitoba Farm Operators	20140 Source: 2017 Statistics Canada, Farm and Farm Operator Data
Provincial Total (bags)	187302
Average weight (kg)	0.04 90lb/1000 bags; supplied by a major supplier for Manitoba.
Provincial Total (tonnes)	7.64671354
Use rate	3.45% This portion of our survey sample reported using sandbags on their farm during an average year.