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NORTH AMERICAN AGRICULTURAL PLASTIC RECYCLING END MARKET ASSESSMENT

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List of Acronyms

HDPE (High-Density Polyethylene): A resin often used to produce rigid plastics.

PP (Polypropylene): A resin typically used in production of twine and supersacks.

LDPE (Low-density Polyethylene): A resin often used to produce film plastics like grain bags and silage plastic.

LLDPE (Linear Low-Density Polyethylene): A resin with an additive to promote stretch.

PCR (Post-Consumer Recycled): This describes resin made from post-consumer plastic.

Ag Plastics: Agricultural plastics

1 Executive Summary

Wide-spread attention focused on how plastics are used and managed, combined with sustainability commitments made by various stakeholder groups, are just two issues that have sparked interest in agricultural plastic (ag plastic) recycling.

The long-term viability of ag plastics recycling programs offers a unique set of challenges, one of which is the availability of end markets.

This assessment, conducted during 2020, examined the demand for various types of ag plastics used in Canada, which varies depending on the item (or ag plastic) in question as summarized below.

Table 1 – End Market Assessment Summary

Ag Plastic	End Market Assessment & Analysis - as of December 2020
Pesticide & Fertilizer containers (HDPE)	This is a highly recyclable resin. Recycling markets are stable, in part due to the positive characteristics of this item (relatively clean and consistent) at its end-of-life.
Grain Bags (LDPE)	Recycling markets, which have shown promise in recent years, are stable but limited.
Twine (PP)	Recycling markets are limited and showing some promise. Experts are mildly optimistic that markets will improve because demand is strong.
Bale Wrap (LLDPE)	Bale wrap recycling markets are unreliable with preliminary signs of development.
Silage Bags and Bunker Covers (LDPE)	Recycling markets for silage bags and bunker covers are limited, primarily due to higher (when compared to grain bags) contamination of this material at end-of-life.
Net Wrap (HDPE, mixed plastics)	Recycling markets currently do not exist and are unlikely to develop due to technical barriers. Waste-to-energy incineration (currently in use in one region) will likely remain the only viable option to manage net wrap.
Supersacks (PP with nylon and LDPE)	Recycling markets are currently unavailable with some testing underway.

The key to improving end markets for ag plastics is ensuring downstream demand for recycled content. A number of private-sector and government-led initiatives are underway that, if fully executed, will likely improve demand for recycled content and have a cascading, positive impact.

2 Introduction

As Canada works towards improving the management of single-use plastics and developing a more circular economy for plastics, a vital first step is to identify existing end markets and gaps.

This report provides a North American assessment of recycling markets for the major types of agricultural plastics that are used on Canadian farms. It also highlights key market pressures that are likely to impact the development and success of end markets, as well as key challenges operators and recyclers must manage when recycling ag plastics.

Researchers combined a sector-wide industry scan, interviews with ag plastics recycling experts and facility visits to develop this report. The recycling sector is changing rapidly as the world adapts to consumer expectations, corporate commitments and government regulation and therefore this report is a snapshot of existing ag plastics end market facilities captured between November 2019 and December 2020.

Findings can be used to help program operators design collection programs to best ensure that ag plastics are collected in a way that maximizes their marketability, while balancing convenience and cost-effectiveness.

This report is one of two research initiatives undertaken in 2019 and 2020 to provide baseline data aimed at improving end-of-life management of agricultural plastics and increasing the quantities of agricultural plastics that are ultimately recycled and brought back into the economy. A second report that quantifies the types and volumes of ag-plastics used in Canada was undertaken during the same timeframe and is available at www.cleanfarms.ca.

2.1 Project Funding

This project was undertaken with the financial support of the Government of Canada through Environment and Climate Change Canada.

2.2 About Cleanfarms

Cleanfarms is a national not-for-profit organization that delivers industry-funded, end-of-life stewardship programs to the agricultural sector across Canada. It works collaboratively with more than 70 members in the pesticide, fertilizer, seed, ag plastic and animal health medication sectors, as well as partner agencies, and governments to ensure that Canadian farmers can actively contribute to a healthy environment and a sustainable future.

Cleanfarms has over ten years' experience identifying and helping to develop North American markets for agricultural plastics through the ongoing development and management of farmer-focused recycling programs. In 2020, Cleanfarms arranged for the recycling or safe disposal of approximately 6,000 tonnes of ag plastics.

3 Methodology

3.1 Market Status of Ag Plastics

The following tactics were undertaken to identify and classify current end markets:

- An industry scan, using desktop research, was undertaken to identify and classify potential firms according to their function (e.g., processor, recycler/end market, or waste to energy facility) in the ag plastics recycling value chain.

- Individuals that have direct experience developing ag plastics recycling programs and/or marketing ag plastics to recyclers were interviewed to refine the list of potential firms that currently accept or process ag plastics.

- Researchers visited Canadian facilities that are currently accepting agricultural plastics, testing ag plastics in their recycling lines, or have expressed an interest in accepting agricultural plastics to confirm and assess a firm's potential to accept ag plastics, both at present and in the future.

Data gathering took place between November 2019 and December 2020 with report writing in January 2021. The current volatility of plastics recycling markets means that the findings provide a snapshot for this time period. Where applicable, projections have been noted.

3.2 Analysis - Market Pressures & Key Ag Plastic Challenges

Individuals with direct experience managing ag plastics were asked to identify current market pressures that are impacting the development of end markets for ag plastics and challenges that are unique to recycling ag plastics.

3.3 Scope

A variety of ag plastics are used in Canadian agriculture. This report focuses on the following commonly used types of ag plastics, which are primarily used in beef, dairy, grain and oilseeds production:

- Pesticide and fertilizer containers
- Grain bags
- Twine
- Bale wrap
- Silage bags and bunker covers
- Net wrap
- Supersacks

This report focuses only on North American recycling markets.

4 Findings

4.1 Market Status of Ag Plastics

There are a wide variety of firms that can play a role in the ag plastics recycling value chain. One of the challenges many program operators face is determining a firm's current capabilities. This is one of the reasons this type of analysis is vital and should be repeated regularly.

An industry scan generated a total of approximately 70 firms that appear to have some interest or capability in ag plastics recycling. Expert interviews and site visits narrowed this list down to 33 facilities (Appendices A and B), that, as of the writing of this report, are accepting (either as test feedstock or in commercial applications) or have evaluated the acceptability of the scoped ag plastics.

This section identifies the number of facilities currently accepting an ag plastic, where applicable, how recyclers receive the material and an analysis (based on expert interviews) of the market.

4.1.1 Pesticide and Fertilizer Containers (HDPE)

Pesticide and fertilizer containers are most often made from HDPE and used on crop and livestock farms across Canada.

13 recycling facilities accept these containers for recycling. Seven processors are also active in recycling these types of containers. A predominant end use for this recycled material is in drainage tile, which can then be used on farms.
The way this program operates, program operators can offer recyclers a relatively clean, homogeneous (single stream) feedstock.

Experts describe pesticide and fertilizer container recycling markets as stable, in part due to the highly recyclable nature of this item. The long-standing recycling program that has been in place for this item since 1989, also delivers a relatively clean, single stream of feedstock.

4.1.2 Grain Bags (LDPE)

Grain bags, single-use plastic bags used to temporarily store commodities, are made from LDPE plastic and are primarily used by grains & oilseed farmers in the prairies.

There are four facilities accepting grain bags for recycling, and one additional facility in the testing phase. Grain bags are frequently delivered directly to recycling firms in a rolled format. Bags are shredded, washed and pelletized to produce materials such as plastic bags, lumber, fence posts and highway guard rails.

Experts describe grain bag recycling markets as stable but regionally limited.

4.1.3 Twine (PP)

Twine, made from PP, is primarily used by livestock farmers across Canada to temporarily store hay and straw.

Two facilities in North America are accepting twine for recycling. Twine is generally accepted in a baled or loose format. Twine is pelletized and pellets are used for a variety of end uses (e.g., car parts, plastic dimensional lumber and roofing materials).

Experts describe twine recycling markets as relatively stable because recycling facilities are searching out feedstock. Of note, there are limited recycling facilities currently accepting this material.

4.1.4 Bale Wrap (LLDPE)

Bale wrap is primarily used by livestock farmers to temporarily store hay, straw or silage that is eventually fed to livestock.

One facility in Quebec is accepting bale wrap for recycling and typically accepts it in baled format. Two waste to energy facilities are accepting limited amounts for waste to energy recovery.

Experts classify bale wrap recycling markets as unstable with preliminary signs of development.

4.1.5 Silage Bags and Bunker Covers (LDPE)

Silage bags, similar in appearance to grain bags, are manufactured from LDPE, and used to contain hay, silage, and straw. Silage or bunker covers are a LDPE sheeting product used to cover bunkers or pits, as well as ground piles of animal feed. Compared to grain bags, silage bags and bunker covers are often more contaminated at end of life.

Recycling markets for silage bags and bunker covers are limited, primarily due to higher (when compared to grain bag) contamination of this material at end of life.

4.1.6 Net Wrap - HDPE or Mixed Plastic

Net wrap, also known as netting, is a mixed plastic item that is often used to wrap hay and straw bales.

Recycling facilities for net wrap have not been identified. Because net wrap is often manufactured using a mixed plastic resin and often highly contaminated at end of life, there are technical barriers to recycling it and experts do not expect any recycling markets to develop for net wrap in the near future. Two waste to energy facilities are currently accepting this material.

4.1.7 Supersacks – PP, low levels of LDPE, Nylon

Supersacks are used to hold different materials and help deliver seed, pesticide, fertilizer and feed packaging on-farm. They are a multi-material product that is comprised of a PP exterior and an LDPE liner. Many of these bags also have a nylon strap.

North American end markets do not currently exist, in part due to the multi-material nature of these bags and contamination (associated with the contents and the nylon strap). Two recycling facilities are currently testing supersacks for their viability. Results were not available at the time this report was written.

4.2 Ag Plastic Market Challenges

4.2.1 Contamination

The potential for high contamination at end-of-life is one of the key challenges to establishing reliable end markets. Organic materials including mud, manure, hay, and grain are often mixed with the plastics upon collection, which can sometimes render the plastic unrecyclable.

Recyclers also require uniform material streams (feedstock). There are certain materials that are commonly used together on farm, such as twine and net wrap, or bale wrap with net wrap. Combined uses lead to further contamination (e.g. a twine collection program classifies any net wrap that is co-collected as a contaminant). While best practices and tools (like grain bag rollers and on-farm presses) are in development to minimize contamination, it remains an on-the-ground challenge.

Processing generally improves the cleanliness of the material stream and the value of materials at the end market. Baling, shredding, washing and pelletizing are all different types of processing. While a number of processors exist for residential recyclable materials, few processors have experience with the particularities of ag plastics.

4.2.2 Transportation and Consolidation

Agricultural plastics account for one to one and a half percent of the plastic used in Canada and are used over a vast geographical area and mostly in rural areas. End markets are also currently

sparsely located across North America. These factors increase the cost of transportation and consolidation, which can hinder program development.

4.2.3 Waste to Energy

Some stakeholders recommend energy recovery as a viable alternative to recycling. Currently, Cleanfarms sends a limited amount of material to incinerators. Energy is recovered through either the generation of steam or the creation of an alternative fuel source, to be used for power. While the environmental benefits of energy recovery (compared to recycling) are reduced, this is a viable alternative for hard-to-recycle materials.

Energy recovery facilities have specific requirements for the feedstock that can be used, and testing is required before facilities will accept ag plastics materials. Waste to energy is not a catch-all solution for agricultural plastics disposal, and, similar to recycling markets, access to these facilities is regional, and it benefits from ongoing relationships.

4.3 Market Pressures

A number of international and domestic trends are impacting the availability and development of end markets for plastics.

4.3.1 China's National Sword Policy

On January 1, 2018, the National Sword Policy was implemented in China. This policy banned the importation of most plastics, eliminating the end markets for many plastics. This policy also set in place strict rules for imports which remain today.

One of the more immediate consequences of the introduction of this policy was a flood of material being sent to other Southeast Asian countries, overwhelming their capacity to manage the materials. This led to further an oversupply in these countries and the virtual elimination of these previously viable end markets.

The rapid closure of these international markets has left a significant capacity and infrastructure gap in the end markets for plastic materials around the world. It has also led to an oversupply of plastic for limited North American markets. New players in North American markets are slowly starting to emerge. Further assessments are required to determine their capabilities and capacity to accept ag plastics.

4.3.2 Basel Convention Amendment

The Basel Convention is an international agreement to control transboundary movements of hazardous wastes and their disposal under the UN Environment Programme. The Norwegian Environmental Agency put forward a proposal in 2018 to amend the Basel Convention to include low-quality plastic waste subject to the informed consent (Amber control) procedure required for the movement of hazardous wastes. The amendment was adopted in May 2019, with changes taking effect January 1, 2021. This amendment will further restrict the global trade of plastic scraps and will have a significant impact on the ability to freely trade plastics, including agricultural plastics, with international markets.

Canada is party to the treaty, though the United States is not. Consequently, much discussion has taken place over the past year about the impact the amendment could have on scrap plastic trade relations between the U.S. and Canada. To date, the U.S. and Canada have developed an

arrangement[1] that will allow the trade of non-hazardous plastic materials to remain at the status quo, though the decision remains controversial[2]. The recyclability of certain ag plastics materials currently relies on access to end markets in the US. To further strengthen the capacity of recycling and resource recovery infrastructure in Canada, and by extension, in North America as a whole, the maintenance of this trade relationship is vital.

The Basel Convention Amendment is particularly important for Canadian ag plastics recycling because Canadian program operators rely heavily on U.S. markets. Assuring recyclers in the U.S. that they will have access to Canadian ag plastics may encourage the development of U.S. recycling firms.

4.3.3 Municipal Interest in Preserving Landfill Capacity

Landfill capacity is top of mind for many municipalities across Canada. The approval process for landfill development is complex and uncertain, and current landfills are experiencing capacity sustainability challenges[3]. To preserve landfill capacity, the diversion of materials that have recyclability potential is necessary.

While ag plastics only comprise a small proportion of overall national plastics use[4], in ag intensive regions they pose a particular burden to small rural landfills and there is strong interest in diverting agricultural plastics from landfills; especially when viable end markets exist.

Maximizing landfill capacity is one of the tangible results of ag plastics recycling programs and can lead to calls from provincial and municipal governments to put regulatory mechanisms in place to encourage the development of recycling programs, which is one way to reassure recyclers that they will have access to feedstock.

4.3.4 Higher Demand for Post Consumer Recycled (PCR) Resin

Driving demand for PCR content is crucial for infrastructure investment and securing end markets for plastic materials. Currently PCR resin prices are not competitive with virgin resin prices coming in significantly lower than PCR resin. Various industry commitments, government legislation and policy targets are signals that this could change in the future.

For example, the Ellen MacArthur Foundation's Global Commitment[5] has mobilized over 500 signatories including the world's leading retailers, packaging producers, and resource management specialists to build a shared vision and targets for tackling plastic waste at its source. The Alliance to End Plastic Waste[6] creates partnership and investment opportunities for projects and programs dealing with plastic waste. These commitments provide investment dollars for infrastructure development while also helping to complete supply chains for recycled materials.

In some European countries, ambitious targets are also being set that mandate a certain percentage of PCR resin be included in packaging materials. The full impact of these targets on the North American recycled plastics market is unknown at this time. However, it is reasonable to expect some increase in demand for North American materials to help meet the targets.

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[1] https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/international-commitments/canada-us-arrangement/arrangement-non-hazardous-waste-and-scrap.html
[2] https://resource-recycling.com/plastics/2020/12/09/groups-question-us-canada-basel-arrangement/
[3] See for example https://www.owma.org/cpages/landfills
[4] https://www.canada.ca/content/dam/eccc/documents/pdf/pded/plastic-pollution/Science-assessment-plastic-pollution.pdf
[5] https://www.newplasticseconomy.org/projects/global-commitment
[6] https://endplasticwaste.org/

Increasing demand for PCR resin, and decoupling its pricing with virgin resin pricing, will promote end markets for recycled plastics.

4.3.5 Chemical Recycling to Complement Mechanical Recycling

Chemical recycling can serve to complement the traditional mechanical recycling industry by providing solutions for hard to recycle material. Chemical recycling includes the processes of depolymerization and pyrolysis. Pyrolysis is best suited for polyethylene and polypropylene, two common base materials for ag plastics.

Historically chemical recycling facilities have followed a boom-and-bust cycle, leaving an air of skepticism in whether the industry and the technology can rise to the materials recovery challenges of the current day. With the increased demand for circular solutions for plastics materials a variety of chemical recycling plants are being invested in in North America.

However, it is worth noting that not all facilities will accept ag plastics materials (several specialize in polyethylene terephthalate or polystyrene materials).

A Nova Scotia-based firm, currently in the start-up phase, uses pyrolysis. While opportunity exists for ag plastics to be processed via chemical recycling at this facility, its capacity is small. It warrants further monitoring as an option for hard-to-recycle materials.

The long-term impact of chemical recycling as an end market for ag plastics depends on the industry's ability to increase capacity and diversify feedstocks.

4.3.6 New Program Development

One way to stimulate the development of end markets and ensure their longevity is to ensure that recycling facilities have access to adequate feedstock.

In Canada, there are a number of initiatives underway, primarily in the form of pilots, to develop recycling programs for various ag plastics. Pilots can help create reliable feedstock (to stimulate end markets) and gather data and best practices to inform the development of permanent programs.

The table below identifies where pilots (typically government-funded and with Cleanfarms' involvement) are in place or expected to be in place by the end of 2021 for the items scoped in this study. Relevant permanent programs are also identified.

Table 2 - Overview of Ag Plastics Recycling Programs

Region	Pesticide & Fertilizer Containers	Grain Bags	Twine	Bale Wrap	Net Wrap	Seed & Pesticide supersacks
BC	Permanent program available since 1989	Pilot starting: 2021 (tbd)	Pilot starting: 2021 (tbd)	Pilot starting: 2021 (tbd)		
AB		Pilot started: 2019	Pilot started: 2019	Pilot starting: 2021 (tbd)		Pilot started: 2019
SK		Permanent program available since 2018	Pilot started: 2020			Pilot started: 2018

MB		Permanent program expected in 2021	Permanent program expected in 2021	Pilot started: 2013		Pilot started: 2019
ON		Item not used in these regions.	Pilot starting: 2021 (tbd)	Pilot starting: 2021 (tbd)		Permanent program available since 2016
QC			Pilot started: 2019	Pilot started: 2019	Pilot started: 2019	
Atlantic Canada			Pilot starting: 2021 (tbd)	Pilot started: 2019		

There is often a correlation between the maturity of a program (e.g. Cleanfarms' pesticide & fertilizer container recycling program which has been in place since 1989) and demand for ag plastics in part due to ongoing relationships that develop between end markets and the program operator. These relationships benefit both parties – the recycler has access to reliable, consistent feedstock and the program operator has the ability to ensure that feedstock is delivered in an acceptable manner.

5 Conclusions

Markets are developing for agricultural plastics, though significant gaps remain. They are also influenced by broader plastics/recycling industry trends, which will likely lead to both volatility and development in the near future.

Ag plastics market development is further complicated by unique challenges like contamination that limit already limited end markets and potentially high transportation/consolidation costs.

There is some optimism that ag plastics recycling markets will improve in conjunction with the execution of government-led and industry-led initiatives aimed at increasing the recycled content of products and packaging and increased availability of feedstock through new program development.

Appendix A: End Markets and Processors for Pesticide and Fertilizer Containers

Table 3 - End Markets and Processors for Pesticide and Fertilizer Containers

Location	Status	End-use Application	Role
Kensington, PE	Mature	Shred	Processor (collections & processing)
Ste. Françoise, QC	Mature	Drainage tile	End market
Yamachiche, QC	Mature	Drainage tile	End market
Blainville, QC	Mature	shred (to drain tile producers)	Processor & end market
Ajax, ON	Mature	Shred and pellets	End market
Etobicoke, ON	Mature	Pellets	End market
Brampton, ON	Mature	Energy recovery	End market
Brantford, ON	Mature	Pellets (wax)	End market
Dorchester, ON	Mature	Shred	Processor (collections & processing)
St. Jean Baptiste, MB	Mature	Shred	Processor (collections & processing)
Naicam, SK	Mature	Shred and bales	Processor (collections & processing)
Saskatoon, SK	Mature	Shred	Processor (collections & processing)
Portage la Prairie, MB Regina, SK Saskatoon, SK Calgary, AB Vermillion, AB	Mature	Shred	Processor (collections & processing)
Delta, BC	Mature	Pellets	End market
Reidsville, NC	Mature	Shred and Pellets	End market
Jefferson, WI, USA	Mature	Drain tile	End market
Stanwood, IA	Mature	Plastic pallets	End market
Paris, ON	Developing	Garbage bin liners, ATV parts, greywater tanks for RVs	End market
Englefeld, SK	Developing	Ag and non-ag products (wheelbarrow tires, auto parts)	End market
Lethbridge, AB	Developing	Plastic lumber	End market

Legend:
Mature – Sufficient capacity; actively accepting materials on an on-going basis
Developing – Limited capacity; accepting materials infrequently on an as-needed basis
Pilot – Minimal capacity; testing materials for viability

Appendix B: End Markets for Agricultural Plastics (excluding Pesticide and Fertilizer Containers)

Table 4 - End Markets for Ag Plastics (excluding Pesticide and Fertilizer Containers)

Location	Status	End-use application	Role
Grain Bags (LDPE)			
Stuttgart, AR, USA*	Mature	LDPE bags	Processor and End market
Bassano, AB	Developing	Pellets	Processor and End market
Lethbridge, AB*	Developing	Plastic lumber, ag fence posts, highway guard rails	End market
Bashaw, AB*	Developing	Pellets	Processor and End market
Montreal, QC	Pilot	Packaging manufacturer	End market
Twine (PP)			
Joliette, QC	Mature	Energy recovery, energy for cement kiln	End market
Albert Lea, MN, USA	Mature	Pellets to car parts manufacturers, flower pots and lumber	Processor and End market
Brooks, OR, USA	Developing	Roofing materials	Processor and End market
Bale Wrap (LLDPE)			
Joliette, QC	Mature	Energy recovery, energy for cement kiln	End market
Lachute, QC	Developing	Pellets	Processor and End market
Elie, MB	Developing	Energy recovery, district heating	End market
Silage Bags and Bunker Covers (LDPE)			
Stuttgart, AR, USA*	Developing	LDPE bags	Processor and End market
Net Wrap (Mixed plastics - HDPE, LDPE, PP)			
Joliette, QC	Mature	Energy recovery, energy for cement kiln	End market
Elie, MB*	Developing	Energy recovery, district heating	End market
Supersacks (PP)			
Charlottetown, PE	Mature	Energy recovery, district heating	End market
Saint-Joseph-de-Beauce, QC*	Developing	PCR content in bags	Processor and End market
Elie, MB*	Developing	Energy recovery, district heating	End market
Crossfield, AB	Developing	Shred, potential for composite decking	Processor

*Researchers visited the facilities identified with an asterisk during the study period.

Legend:
Mature – Sufficient capacity; actively accepting materials on an on-going basis
Developing – Limited capacity; accepting materials infrequently on an as-needed basis
Pilot – Minimal capacity; testing materials for viability