Horizon Series:

Livestock and plastic use

White paper highlights with Dr. Erica Pensini

As part of its Horizon Series, the Livestock Research Innovation Corporation (LRIC) has written a series of white papers on the issues that will have a direct impact on the future of Ontario's livestock industry.

Dr. Erica Pensini tackles the problem of plastic use in agriculture and shares her team's work in finding bio-based alternatives to products like bale wrap, silage bags, plant pots and more—all items currently made from conventional, fossil fuel-based plastics. Pensini is an associate professor in the Department of Engineering at the University of Guelph.

"We need to look at the environmental costs of plastics. It's not just about improper disposal but also the process of making plastics."

Making plastics starts with petroleum extraction, then fractionation into components to make polymers. According to Pensini, extraction takes about 6.5 barrels of water per barrel of oil. It can also disrupt the aquifer in some instances if it is close to the oil being extracted. In fracking, where rock is fractured to extract the oil, underground water becomes salty as it runs through the rock and needs to be disposed of, presenting another impact.

"Overall recycling of plastics isn't as effective as it could be."

Agricultural plastics in general contain contaminants that make them harder to recycle, but even if they didn't, only nine percent of Canada's annual plastic waste production is recycled. The rest goes into landfill, waste-to-energy facilities or into the environment. In the United States, the situation is similar with less than nine percent of the United States' annual plastic waste being recycled. As well, China, a traditional market for plastic wastes, is no longer accepting shipments.

"Alternatives become viable when there is an increased cost in oil or due to political reasons."

Currently, alternative products are more expensive than conventional plastic as the cost for conventional plastics doesn't take into account the true cost of water. In some situations like California or the southwestern United States, water scarcity is also a significant and growing

problem that will impact future plastics production. The opportunity exists to transition from regular plastics to other materials.

"We've been looking at different options...a mix of epoxidized soybean oil, oleic acid and citric acid cured in the oven has been the best so far in terms for performance and they are flexible and stretchy."

Pensini and her team have been exploring different options, starting with a corn protein called Zein that is very versatile and simple to work with, but very appealing to rodents. Adding linseed or tung oil created a rigid plastic bioplastic that can be mixed with natural fibres to make plant pots.

Mixing Zein with cutin, a component found in tomato and grape peels—normally a waste by-product of processing—resulted in a water-repellent coating that was hard to make and although flexible, didn't meet the level of stretchiness plastics needed for applications like bale wrap.

Ultimately, a pre-fabricated film made of epoxidized soybean oil, citric acid as a hardener, and oleic acid to make it stretchier was found to be the most promising alternative plastic product.

"We want to upscale waste products to help valorize the ag stream."

As a next step, the team will be introducing fibres to upcycle agricultural waste products and make them into useful solutions for agricultural applications. They'll also be experimenting with other fatty acids to see if they can be used in place of citric or oleic acids to further enhance the new materials' properties.

"We need to start to see the cost of plastics go up before these materials become large scale."

According to Pensini, the need to find commercial partners is also important, but conventional plastics will either need to start being phased out or become more expensive before bio-based alternatives will come into large scale production and use.

Watch the full webinar or review the white paper at **livestockresearch.ca/white_papers**.

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