Measuring the Environmental Footprint of Alberta Peas

Sustainability of agri-food systems has never been more important than it is today. To gain a comprehensive understanding of sustainability performance and identify opportunities for improvement, the Alberta Pulse Growers (APG) collaborated with Alberta Agriculture and Forestry (AF) to conduct an Alberta pea environmental footprint assessment using a method called life cycle assessment (LCA).

LCA is a holistic yardstick of the environmental performance of products and services. It measures how much environmental impact the production of a product contributes throughout its life. It looks at all significant environmental impacts including carbon footprint, water footprint, eutrophication, acidification, photochemical smog, etc.

"Having a published LCA number is not the overall objective of the process," explained Nevin Rosaasen, APG's Policy and Program Specialist. "Conducting an LCA sets a benchmark, identifies certain 'hotspots' where best management practices, employing targeted fertility programs, and other extension opportunities to growers on how they can save money and produce food more efficiently are other motivators."

Recently, LCA has become a mainstream method for environmental sustainability assessment being used by many agriculture commodities to measure and communicate their environmental footprint. LCA is also being endorsed by international organizations (e.g. the United Nations Environment Programme (UNEP), the UN Food and Agriculture (FAO) and the European Union (EU)) and a leading global non-profit organization such as The Sustainability Consortium (TSC).

"Using an internationally accepted method such as LCA, it provides this work with credibility, transparency and reliability," said Aung Moe, AF's Environmental Footprint Agrologist and a certified LCA professional. "It is clear, consistent and flexible enough to run the model repeatedly. Which means we can go back to the model again and again as new technologies, new varieties and new management practices are available."

At farm gate, Alberta Peas Carbon Footprint is 0.183 kg CO_2/kg!

An LCA provides a baseline for the environmental footprint and identifies environmental hotspots (activities or operations which contribute to the greatest environmental footprint) which identify opportunities for improvement of the environmental performance. This information can also support business decision making for cost saving.

Farm data from Alberta pea growers was collected for the 2015 crop year on crop yield, farm inputs (seed, inoculant, fertilizers, herbicide, fungicide and desiccant), field operations (seeding, chemical application and harvesting) and transportation distances for farm activities and deliveries. Additional information and data from regional sources (emission factors) as well as international life cycle inventory database (Ecoinvent) was used for modelling. Environmental footprints of Alberta pea from "cradle" (all inputs starting at extraction and production) to farm gate were calculated based on ISO 14040 and 14044 standards from International Organization for Standardization (ISO).

Key Findings of the LCA

Crop inputs and field operations were major contributors to the carbon footprint and other environmental footprints of Alberta pea production. Synthetic fertilizers, particularly phosphorus fertilizer and field emissions accounted for a majority of the environmental footprints from crop inputs. Fuel consumption and emissions associated with fuel combustion from field operations contributed to a large proportion of the environmental footprints from field operations. Grain drying and storage contributed to a lesser degree of environmental footprints compared to crop inputs and field operations. Environmental footprints associated with transportation were quite negligible, accounting for less than one per cent of total environmental footprints.

Alberta pea's carbon footprint was 0.183 kg CO_2-e/kg of pea at farm gate. The unit is carbon dioxide equivalent, meaning all greenhouse gases in a common unit. Alberta pea production contributed to a lower carbon footprint than other crops because of less nitrogen (N) fertilizer required and the adoption of a no-till system. Less N fertilizer requirement for pea production reduces the nitrous oxide emissions (which is more potent than carbon dioxide and has a great global warming impact), resulting in a lower carbon footprint. Additionally, a no-till system

Continued from page 21

requires fewer passes for field operations, resulting in less fuel consumption and a lower carbon footprint.

“Compared to other regional, national and international LCA studies of pea production, Alberta pea’s carbon footprint is lower than any other study due to Alberta’s higher crop yield and lower fertilizer application rate,” Moe said.

However, phosphorus (P) (applied as P_2O_5) fertilizer application rate for pea production varies widely from farm to farm. Therefore, improving fertilizer use efficiency is one of the opportunities for improvement areas for reducing the environmental footprints and increasing resource use efficiency.

“We now have a starting point to build from,” Rosaasen noted, adding that this LCA is preliminary, and APG will continue to revisit the process with more robust numbers. “The industry knows Canada has the most sustainable cropping practices, where we can do more with less. This preliminary exercise exemplifies why Alberta and Canada is the number one sought after supplier for sustainably grown and healthy protein sources.”

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> – Aung Moe

Lessons learned from the LCA

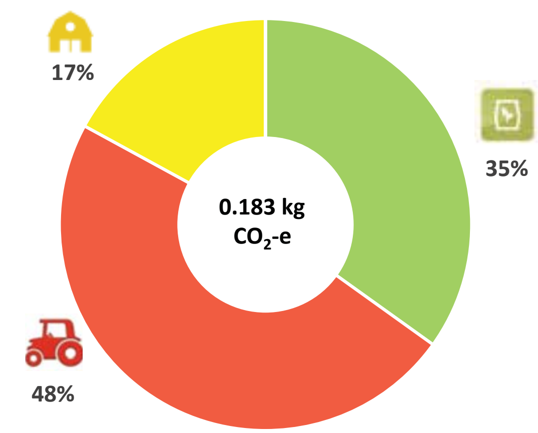
LCA results provide a better understanding of which farm inputs or operations contribute to the greatest environmental footprints. The results highlight that tillage management and efficient fertilizer management play a major role in reduction of the overall environmental footprints of Alberta pea production. Crop yield is a major factor that determines resource use efficiency, productivity and profitability of crop production. Improving crop yield enhances resource use efficiency and reduces overall environmental footprints.

Next steps

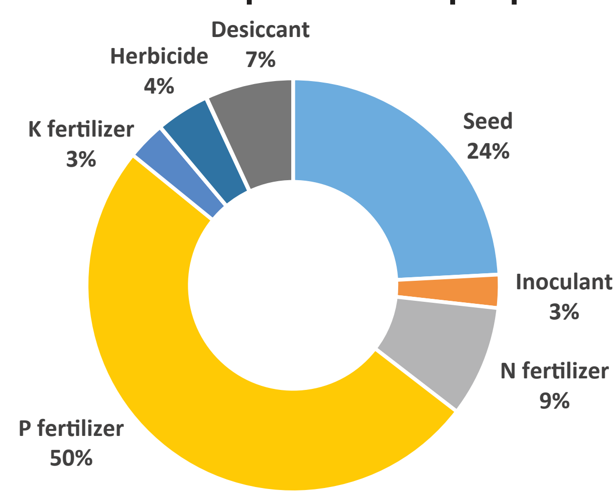
The results of this work are useful for benchmarking environmental footprints and provides credible information to communicate

	Crop inputs (seed, inoculant, fertilizer, herbicide, fungicide, desiccant, etc.)
	Field operations (seeding, harrowing, rolling, chemical application, etc.)
	Grain drying and storage (grain bin, shed, electricity, natural gas, etc.)

Carbon Footprint at farm gate (1 kg of Alberta peas)

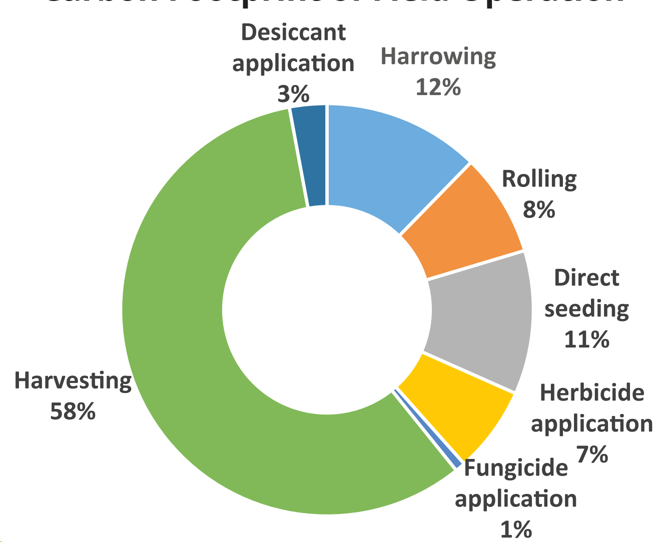


Carbon Footprints of Crop Inputs



Fungicide and S fertilizer are not shown in the chart due to less than 1% impact.

Carbon Footprint of Field Operation



progress on environmental performance of Alberta pea production over time. The results will also be used to develop on-farm footprint calculator. The on-farm footprint calculator will provide an interactive framework to explore potential improvement opportunities for environmental performance and resource use efficiency.

"Using on-farm footprint calculator, growers will have the ability to play around with key parameters of their production system such as crop yield, fertilizer application rate, number of passes for field operations, etcetera, to better understand the relationship between crop inputs, crop yield and environmental footprint," Moe explained. "The calculator will provide a comparison of results between the grower's own farm and the average provincial grower."

The LCA is an effective way to communicate information on the product's environmental footprints to stakeholders across supply chains. This LCA work will support the Alberta pulse industry in demonstrating sustainability leadership and environmental stewardship locally and globally. Additional potential and use for the LCA results provide a platform to develop an Environmental Product Declaration (EPD) which is a business-to-business (B2B) environmental communication for transparency and consistency. EPD's are becoming increasingly used as a tool for product differentiation and brand promotion.

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Eutrophication is the process of nutrient enrichment in aquatic and terrestrial ecosystems. Nitrogen (N) and phosphorus (P) are the main causes of eutrophication. Eutrophication is expressed as *PO_4^{3-} (phosphate) – equivalents.*

Acidification is a process of increasing acidity of water and soil by hydrogen ion concentration. It is caused by the emissions of air-borne chemicals like nitrogen oxides *(NO_x)*, sulphur dioxide *(SO_2)* and ammonia *(NH_3)*. Acidification is expressed as *SO_2 (sulphur dioxide) – equivalents.*

Photochemical smog is a type of secondary pollutant formed in the lower atmosphere from *SO_2* and hydrocarbons in the presence of sunlight. Photochemical smog is expressed as *C_2H4 (ethylene) – equivalents.*

Watch for Part 2 of the two-part series on LCAs in the next Pulse Crop News.