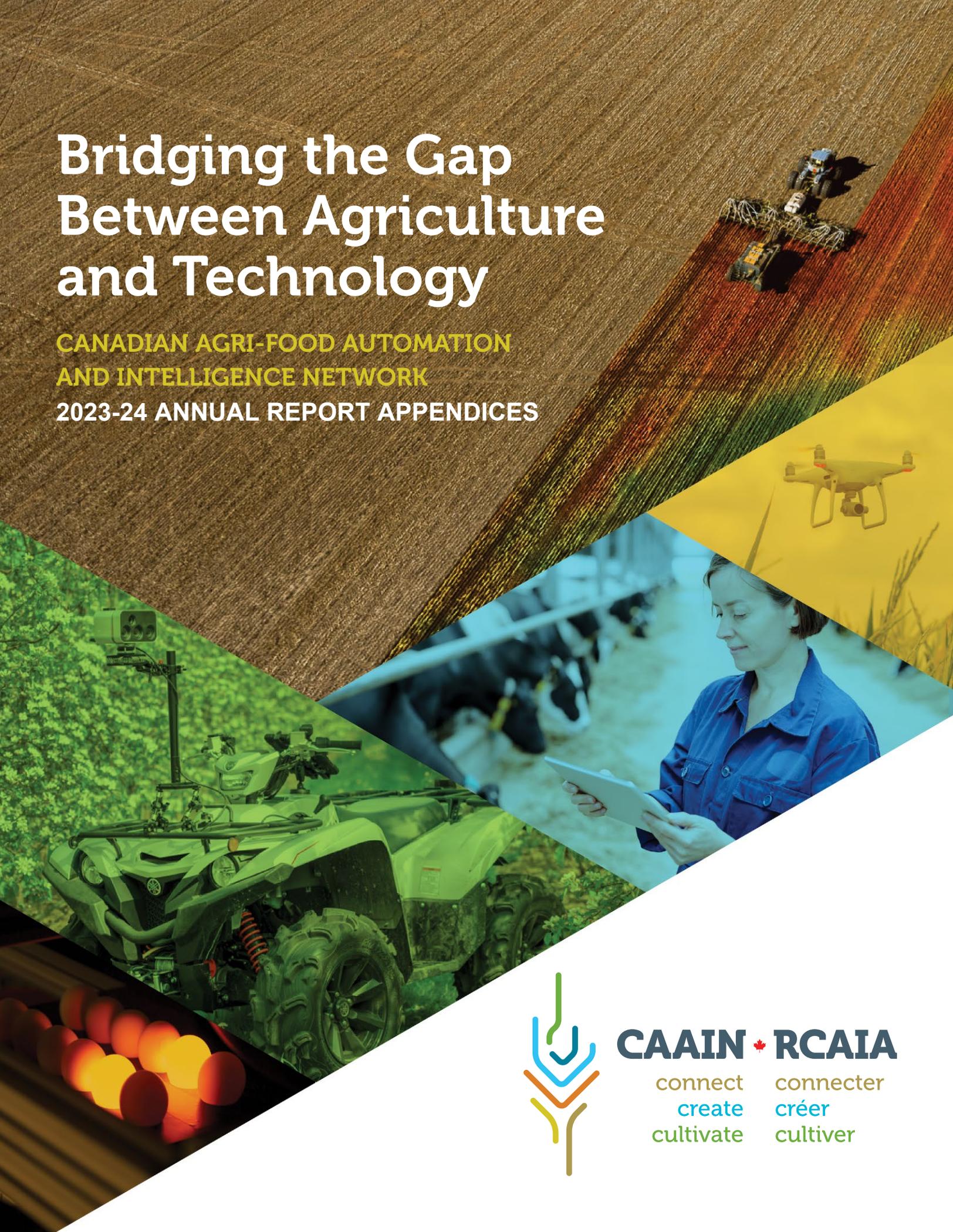# Bridging the Gap Between Agriculture and Technology

CANADIAN AGRI-FOOD AUTOMATION AND INTELLIGENCE NETWORK

2023-24 ANNUAL REPORT APPENDICES

CAAIN • RCAIA

connect   connecter
create   créer
cultivate   cultiver

Appendices

Automation & Robotics

Feasibility of an Autonomous Solution for Optimized Application of Livestock Manure

Led by **Haggerty AgRobotics Co.**, this project will design, test, and document the Raven OmniPower autonomous farming system to apply liquid livestock manure in bare/standing fields to enhance efficiency and demonstrate a marketable made-in-Canada solution for handling high volumes of livestock waste.

Project ANT: An Innovative Approach to a Fully Autonomous Greenhouse Mobility Platform

This project aims to validate the design of the ANT logistics mobile platform to solve the complex technical challenges in using multiple classes of robots that cooperate to efficiently delegate tasks and efficiently relocating tools around a greenhouse.

Autonomous Tractor Kit for Enabling Autonomous Farm Implement Operation

Mojow is developing the Eye-Box™ Autonomous Tractor Kit for Enabling Autonomous Farm Implement Operation, allows for the conversion of conventional tractors to autonomous tractors or can be integrated into ready-to-market farm machinery, such as Barnstorm's swarm capable autonomous tractor, to enhance their functionality.

> *Mojow is thankful for timely support from CAAIN to develop intellectual property and thoroughly test our technology on customer farms to ensure robust and repeatable field applications. We also appreciate CAAIN's providing access to its network and for facilitating cross-promotional opportunities.*

Owen Kinch, Project Lead, Autonomous Tractor Kit for Enabling Autonomous Farm Implement Operation

Using Automation, Data and Insights to Improve Meat Quality and Safety

Led by Ontario-based **P & P Optica**, this project seeks to connect the practices of pork producers and processors to the quality of meat produced. This will be done by integrating a wide variety of variables from the plant, the farm, and publicly available sources using artificial intelligence (AI) and machine learning algorithms and analytics to identify predictive and prescriptive trends that will optimize production and improve the quality and safety of meat products in Canada.

Development of an Automatic Pork Quality Grading (APoG) System for Sustainable Pork Production

This project seeks to develop an automatic pork quality grading (APoG) system using hyperspectral imaging, machine learning, and deep learning for online multidimensional pork quality trait assessment of entire pork loins.

Integration, Optimization, Field Validations of BHF Agrobot, and Development and Validation of its Electric Weeding and Precision Agrochemical Application Technologies

This project seeks to develop, validate, and demonstrate an autonomous agricultural robot that can eradicate weeds with high voltage electricity and data-driven precision agrochemical application.

Smart In-Ovo Sexing: Enhancing Performance of the Hyper-Eye System

The project will advance the Hyper-Eye system towards commercialisation by enhancing its performance. The project partners will identify and remove egg samples that are incorrectly positioned or that are of low quality. The detection protocols will be integrated into the Hyper-Eye technology to achieve consistent, high-performance operation, making it increasingly compatible for hatchery use.

> *CAAIN has played a crucial role in MatrixSpec's mission to advance AI applications in the agri-food sector. Their commitment to funding and supporting innovative projects has allowed us to develop cutting-edge solutions like Hyper-Eye and Marbling Meter, which significantly enhance productivity and sustainability in the poultry and meat industries. The support from CAAIN has been essential in helping us bring these advanced technologies to the field. We deeply appreciate our partnership with CAAIN and the opportunities it has created for us to make a positive impact on the industry.*

Dr. Michael Ngadi, Project Lead, Smart In-Ovo Sexing: Enhancing Performance of the Hyper-Eye System

Data-Driven Decision-Making

Advancing Agronomy Through Hyperlayer Data Collection and Analytics

Led by **Olds College**, this project's overarching goal is to collect data and develop a robust repository of different, validated, high-resolution, geospatial agronomic datasets. These will then support the ensuing development of field- and site-specific decision-making tools to reduce risks, ensure cost savings, and optimize production for farmers.

Precision Ranching for Improved Reproductive and Grazing Efficiencies

Led by **Lakeland College**, this project will use sensing technology to identify and evaluate location, activity, temperature, and behaviours that determine cattle fertility.

Harvesting Automation: Reducing the Requirement for Highly Skilled Labour During the Harvest of Broad-Acre Cash Crops

This project aims to automate much of the functionality of **MacDon Industries'** combine headers, freeing farmers for more important tasks, and increasing their overall productivity and profitability.

Without the support of the CAAIN funding and resources, I would not have collaborated with all the companies currently engaged in our research project. Their network has allowed our institution to obtain cross-provincial support and explore novel technologies for livestock management with promising results for future improvement of production efficiencies. CAAIN presents a unique model for research collaboration that I was surprised to see works very well to attract other research partners.

Susan Markus, Project Lead, Precision Ranching for Improved Reproductive and Grazing Efficiencies

Automation and Scalability of SWAT MAPS to Advance Canadian Agriculture

Led by **Croptimistic**, this project will see academic and on-farm researchers, industry players, and smart farm staff collaborate to expand SWAT MAPS's capacity and develop scalable analytics and agronomic validation solutions supporting the widespread adoption of precision agriculture.
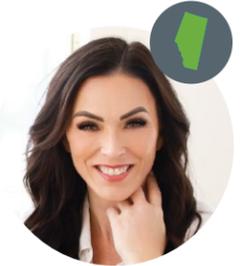

Commercialization of IOT and AI for Carcass Cooling to Improve Meat Profitability, Quality and Food Safety

Led by **mode40**, this project will make use of a Meat Quality Management (MQM) System using Artificial Intelligence, mobile technology, and smart sensors for real-time adjustment of the carcass-cooling process.

Through CAAIN's program, our key research project received critical funding, enabling us to secure vital resources and accelerate progress towards achieving its groundbreaking goals. This invaluable support significantly enhanced our ability to bring this project to fruition.

Cameron Bergen, Project Lead, Commercialization of IoT and AI for Carcass Cooling to Improve Meat Profitability, Quality and Food Safety

F3: Farm to Factory to Farm - Pea Protein Quality and Traceability

Led by **PIP International**, this project will build a detailed vendor management and data connecting exchange mechanism between farm, flour mill, and a pea fractionation facility to create an ag-tech circular ecosystem that connects farms to the factory and back to the farms.

CAAIN's support has unlocked the opportunity for PIP to delve into the unknowns of traceability and supply chain monitoring from our farms to our facility. When our project is finished the data and analysis collected will springboard PIP and our partners into incorporating a broader reach traceability program and allow us to scale up the technology developed.

Christine Lewington, Project Lead, F3: Farm to Factory to Farm: Pea Protein Quality and Traceability

Integrated Real-Time Nitrogen Guidance System for Optimizing Canadian Prairie Agriculture: The Automated Nitrogen Recommendation Algorithm

This project will combine knowledge from agricultural science, data science, and AI to develop a nitrogen recommendation algorithm to help Canadian growers improve nitrogen management.

ONGOING PROJECTS AT A GLANCE
Data-Driven Decision-Making

GeoAI Platform for Automatically Digitizing and Modernizing Wheat Grain Grading (Phase 2)

This project aims to leverage deep learning, machine vision, geospatial, and high-performance computing technologies to digitize grain grading and automate the laborious manual observation required for wheat production.

> *CAAIN's funding and ongoing invaluable support have been vital to SGA's success. Without this backing, SGA's remarkable achievements might have remained untold. CAAIN's endorsement, funding, and the meticulous evaluations and invaluable guidance from CAAIN's reviewers and committee served as a lifeline for SGA at a critical time in 2021 when its future was uncertain. The AI algorithms developed through the CAAIN project are central not only to the Grain Grading initiative but also to SGA's broader research and development efforts in developing AI-powered tools to automate a wide spectrum of labor-intensive tasks in agriculture. CAAIN's network and sustained support have been pivotal in bringing our AI-powered AgTech products to market.*

Weiping Zeng, PhD, Project Lead, GeoAI Platform for Automating Manual Observation Associated with Wheat Production

Prescriptive Beekeeping: Leveraging Artificial Intelligence to Automate the Management of a Beekeeping Operation to Maximize Honeybee Colony Survival Rates and Business Profitability

The objective of this project is to develop, deploy, and test a data-driven tool leveraging artificial intelligence that will automate the management of commercial beekeeping operations in a field setting.

On-Farm Direct Measurements to Validate Traceability and Develop GHG Monitoring Tools for Canadian Dairy Producers

This project will enable the **EcoFarm** to further differentiate itself in the market as a supplier of sustainable dairy products. By building this integrated data-capture system, the company will be able to advertise its reductions in greenhouse gas emissions directly to consumers. Additionally, the funding provided by CAAIN will allow the EcoFarm to conduct feed, product, and animal analysis beyond what is currently routine for the farm. This data will provide insights into performance and efficiency of the operation from sustainability and GHG perspectives.

Creation of a Dairy Management, Modelling, and Collaborative Framework System to Facilitate Predictive and Data-Driven Decision-Making in Canada

CATTLEytics is developing a groundbreaking strategy to place Canada as a leader in dairy data systems. They are providing a much more powerful and intuitive replacement for existing dairy management software solutions, and have a vision and a plan to create a collaborative, intelligent dairy framework.

> *The deep commitment of CAAIN to advancing the dairy industry and their support of CATTLEytics has been foundational to what we can accomplish in the near future. Not only are we assisting dairy farmers in assembling their best 'team' of cows, solving difficult staff communication and scheduling issues, and creating forward-thinking economic models, but we are also fostering an ecosystem of innovation by engaging the next generation of Canadians who are familiar with both farm life and technology. Together, we aim to develop remarkable solutions to challenging agricultural issues in Canada. We are grateful for their support and eagerly anticipate contributing to the broader team that propels Canadian dairy technology onto the world stage.*

Shari Van de Pol, DVM, Project Lead, Creation of a Dairy Management, Modelling, and Collaborative Framework System to Facilitate Predictive and Data-Driven Decision Making in Canada

Data-Driven Dormant Apple Tree Pruning and Tree Vigour Models to Improve Farm Outcomes

Vivid Machines' system combines modern deep learning and computer vision approaches with state-of-the-art edge processing technology, providing accurate, plant-level, large-scale assessment of specialty crops in real time, in the field.

> *Working with CAAIN has enabled Vivid Machines to fund the use of top machine learning and engineering talent to solve critical problems in agriculture. One of the challenges we're focused on solving with the help of CAAIN is enabling more precise pruning of apple trees in dormancy through better instructions using bud data, which results in higher-quality fruit less prone to disease. The other is providing an understanding of tree volume, which enables a much better understanding of the target crop load per tree, reducing labour requirements by focusing efforts where they're needed. Having the ability to address these two issues will significantly help grower profitability, reduce food loss by increasing quality, and enable Vivid Machines to become a leading provider of precision agriculture products globally.*

Jenny Lemieux, Project Lead, Data-Driven Dormant Apple Tree Pruning and Tree Vigour Models to Improve Farm Outcomes

Smart Farms/Validation & Demonstration of Emerging Agtech

Pan-Canadian Smart Farm Network Development

Led by Alberta's **Olds College**, this project will use a growing network of smart farms across Canada to provide geographically-diverse, real-world validation of the latest agricultural technology.

Application of Artificial Intelligence (AI) Technologies for Improved Welfare and Productivity in Commercial Sow Barns

The objective of the proposed project is to apply AI to improve resilience and sustainability of the Canadian sow barns.

Smart Barn Technology for Swine Disease Prevention, Enhanced Biosecurity & Rapid Response

This project will develop "smart barn" technologies, where swine producers and their veterinarians can effectively prevent diseases, strengthen bio-security, and enhance disease response capabilities.

Smart Barn for Sustainable Swine Husbandry

This project will focus on automation of barn control system adjustments, based on real-time IoT data and trend analysis of data records, to optimize the barn environment for animal welfare and productivity while reducing personnel-hours required to maintain optimal rearing environments.
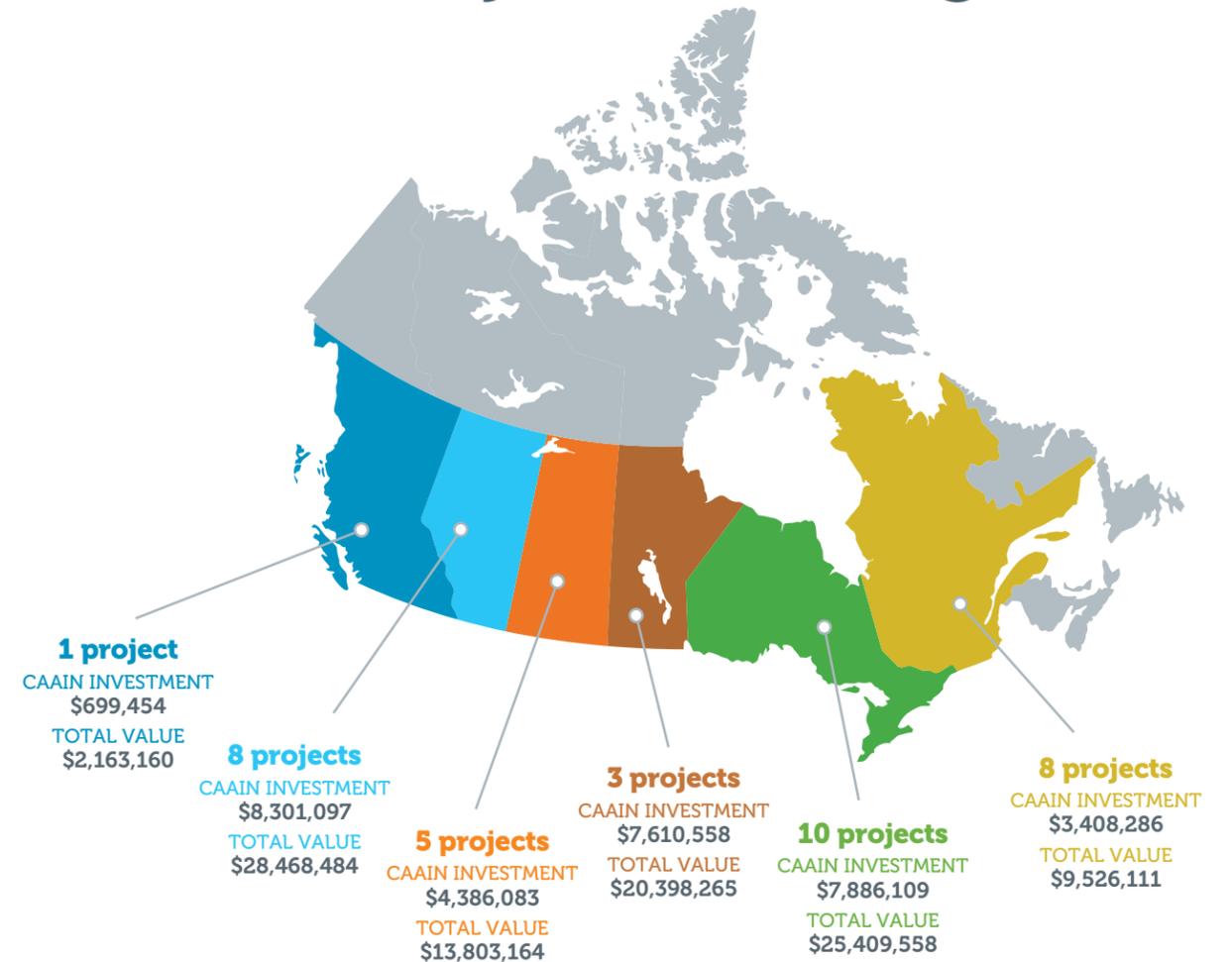
CAAIN Program Funding Summary

Program Status	Program Name	Projects	CAAIN $	Industry $	In-Kind	Project Management (4%)	Eligible Not Supported & Ineligible Costs	Total Project Value
In progress	2020 CLOSED	9	$14.3M	$13.4M	$5.3M	$0.5M	$4.2M	$39.9M*
In progress	2021 OPEN	7	$3.0M	$4.6M	$2.8M	$0.3M	$1.2M	$11.9M
In progress	2022 OPEN	6	$5.6M	$8.4M	$0.5M	$0.6M	$3.0M	$18.1M
In progress	Beef & Pork Primary Processing	2	$3.5M	$5.2M	$0.6M	$0.4M	$1.3M	$11.0M
In progress	Livestock Innovation	5	$2.1M	$3.1M	$0.6M	$0.2M	$0.6M	$6.6M
In progress	2023 OPEN	6	$3.8M	$5.7M	$1.1M	$0.4M	$1.3M	$12.3M
TOTALS		**35**	**$32.3M**	**$40.4M**	**$10.9M**	**$2.4M**	**$11.6M**	**$99.8M**

* Includes $2.2M contribution of funds from public programs

Geographic Distribution of Project Funding

1 project
CAAIN INVESTMENT
$699,454
TOTAL VALUE
$2,163,160

8 projects
CAAIN INVESTMENT
$8,301,097
TOTAL VALUE
$28,468,484

5 projects
CAAIN INVESTMENT
$4,386,083
TOTAL VALUE
$13,803,164

3 projects
CAAIN INVESTMENT
$7,610,558
TOTAL VALUE
$20,398,265

10 projects
CAAIN INVESTMENT
$7,886,109
TOTAL VALUE
$25,409,558

8 projects
CAAIN INVESTMENT
$3,408,286
TOTAL VALUE
$9,526,111

Aggregated Project Investment by Province ($)

Quebec **10%**
British Columbia **2%**
Ontario **24%**
Alberta **26%**
Manitoba **24%**
Saskatchewan **14%**