Research brief — Value Chain Discovery of Canadian Participatory Plant Breeders

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THE BAUTA FAMILY INITIATIVE ON CANADIAN SEED SECURITY

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Value Chain Discovery of Canadian Participatory Plant Breeders

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Background

Participatory Plant Breeding (PPB) is an approach to plant breeding that allows farmers to incorporate regional climates, local markets, and farmers' expertise into the variety development process. Farmers who are part of the PPB program run by the University of Manitoba in partnership with The Bauta Family Initiative on Canadian Seed Security have developed PPB crop varieties to the point that they are starting to be commercialised, but questions remain about the socio-economic landscape that these PPB crops can enter. Who will buy them? Why? What barriers will PPB varieties encounter in entering the market? To address this gap in understanding, we conducted an exploratory review and open interviews with ten farmers to understand and outline the structure and qualitative characteristics of Canadian PPB grain value chains, as well as barriers to PPB commercialization.

Results highlights and major takeaways

- The major determinants of grain value chains that impact the commercialization of PPB grains are the following structural factors: quantity of grain produced, regional market access, and on-site processing.
- These structural factors have downstream implications for the fungibility (and thus, identity preservation), value, and marketing of organic grain.
- Factors that influence the success and speed of PPB commercialization are: quality, variability, grain testing relationship building, cooperation, competition, on-farm processing, marketing, and communication of the distinct nature of PPB.
- Economic risk is the biggest barrier to PPB commercialization. Risk mitigation strategies to lower the risk threshold and maximise chances of successful commercialization are currently needed.
- Farmers, PPB program facilitators, and others with a vested interest in PPB need to build awareness and popular understanding of PPB and plant breeding issues amongst the public. This would help farmers use the social, environmental, and political benefits of PPB as a marketing tool in a way that is successful with consumers.
- Farmers need more transparency and programming around navigating through the quality testing process and value chain outreach and development.

- Farmers have already taken steps towards demonstrating PPB's commercial viability, and now look towards PPB program facilitators and institutions to support them in more practical steps towards commercialization.

Read the full report here: Value Chain Discovery of Canadian Participatory Plant Breeders

Introduction

Participatory Plant Breeding (PPB) is a farmer-led crop breeding approach where farmers collaborate with researchers to develop crop varieties. Farmers can use PPB to breed field crop varieties that are selected to meet their individual needs and that are also adapted to local climatic and socio-economic environments. In Canada, the first national-scale PPB program is managed by the University of Manitoba and facilitated through The Bauta Family Initiative on Canadian Seed Security (BFICSS). Participating organic farmers have been collaborating to produce PPB varieties of wheat and oat since 2013. Many farmers have developed the PPB grain varieties to the point where they wish to commercialise them, but there is uncertainty regarding which markets and value chains are appropriate for PPB material in light of existing cultural, economic, and regulatory contexts. The lack of information on commercial pathways for PPB varieties in Canada makes it difficult for farmers to invest further in PPB for primary production, scaling up, and variety registration.

Discovery and demonstration of successful PPB value chains can offer guidance to current farmers, value chain actors, and consumers on the value of PPB and the varieties that come out of it. A clear and accessible outline of the potential market scales, locations, and pathways would be a useful tool to help different market actors make educated decisions regarding where and how they sell, advertise, and distribute PPB materials. Value chain research can also be useful to researchers and breeders who are considering conducting PPB grain work themselves. Demystifying Canadian PPB value chains not only supports the admirable breeding work of farmers, but also domestic, organic agriculture as a whole. To address this need, we aimed to understand and outline the structure and qualitative characteristics of Canadian PPB grain value chains, as well as potential risks connected to PPB commercialization.

Methods

A value chain is the full range of activities, actors, and movements a product goes through from conception to production to distribution to disposal, being considerate of socioeconomic conditions and potential opportunities for growth.1 In this study, researchers interviewed farmers using an exploratory interview approach to uncover current and potential value chains for PPB products.

We invited all past and present PPB program participants via email to take part in this study. From this, we included 10 program participants in the study from regions across Canada. We conducted interviews by telephone or virtual video call from March - June 2021. We conducted open-format interviews with participants, prompting them with a set of questions to delve into their experiences in conducting PPB, examining the value chains

for their PPB material, identifying factors influencing those value chains, and gathering their perspectives on PPB commercialization.

Once all interviews were complete, we coded and organised data into key themes. We then presented data in an explorative value chain summary, value chain diagrams, and farmer case studies (the former two are available in this report, the latter case studies are only available in the full report).

Results and discussion

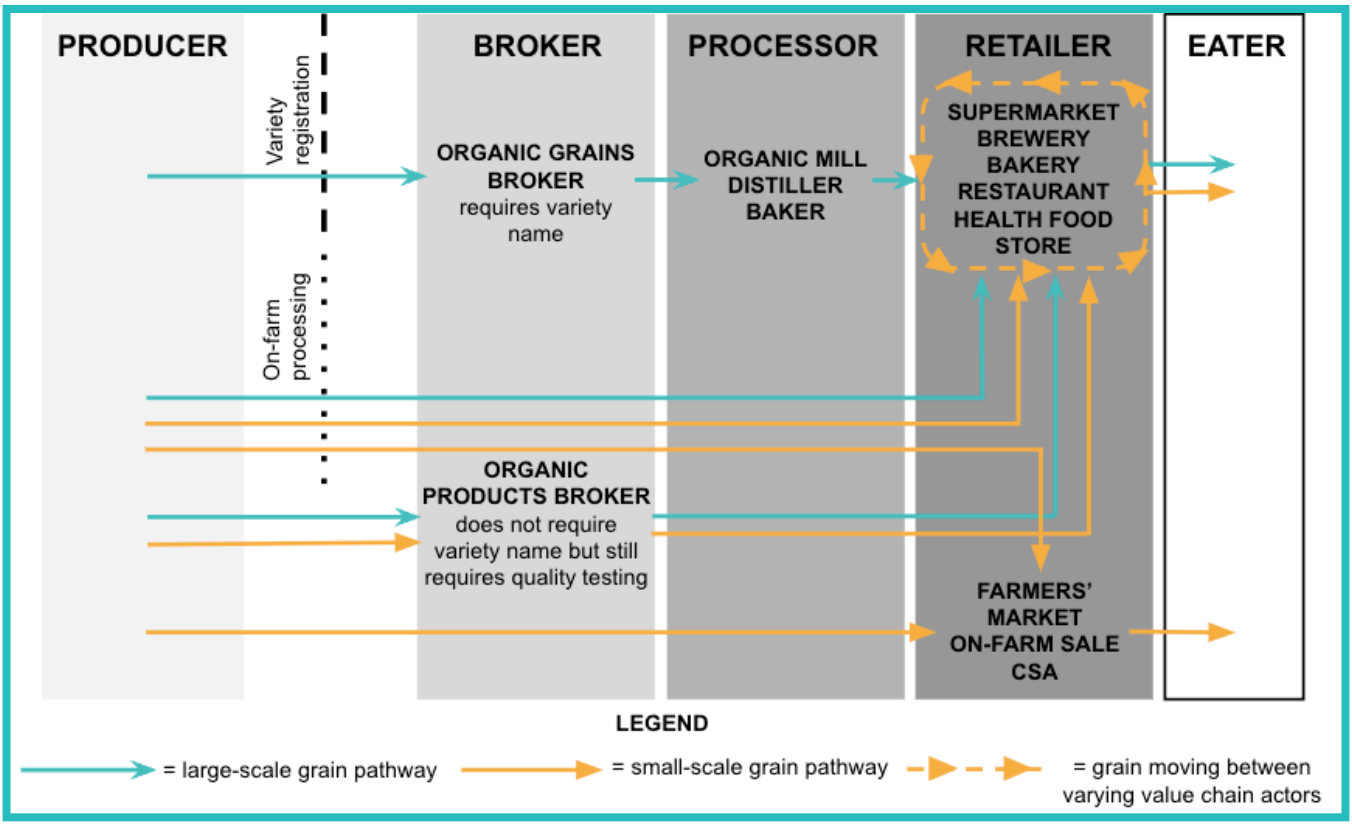
Structure and characteristics of PPB grain value chain

The existing structure of grain value chains is complex, with various factors influencing the flow of goods and supply chain actors. The major determinants of grain value chains that impact the commercialization of PPB grains are:

- **Quantity of grain produced.** The quantity of grain produced determines how much material must then be sold. As a result, farmers must consider which buyer or combination of buyers can handle the quantity of material they are looking to move. Large-scale producers commonly use brokers as the first step in the value chain because brokers have more capacity to purchase bulk quantities of grain. The role of the producer in this large-scale value chain ends when they sell their products to brokers, who then facilitate the movement of grain products to downstream value chain actors like mills, retailers, bakers, and other processors. On the contrary, small-scale producers more commonly participate in diverse combinations of value chain arenas and markets. Because producers at this scale have smaller amounts of grain to move, they often interact directly with the value chain actors and can be more choosy about who will be processing or selling their product.
- **Regional market access.** Different regions have variability in their population density, urban proximity, and food culture that influence market chain access. Farmers closer to denser, urban areas that have a robust food culture have more access to direct markets that often buy material with the goal of supporting local farmers and food. This was true for various farmers in Quebec and Southern Ontario that have various artisan outlets to sell grain to bakeries and specialty stores. In comparison, more rural farmers in less populated areas rely more on indirect markets like grain elevators or mills. This was common for farmers in the Prairies where they had limited access to artisan outlets and more access to grain brokers or processors.
- **On-farm processing.** Farms with no on-farm equipment to process grain are limited to selling to whole grain markets, while farms with on-farm equipment (like grain mills, crimpers, or rollers) can sell grain, processed grain, and/or flour. This influences value chains by potentially cutting out processors, but also provides opportunities for selling value-added products. This also provides opportunities for farms to cut out value chains altogether by internalising their product, for example, a farmer who feeds their oats to their livestock, which encourages farm self-sufficiency and resiliency.

Figure 1 shows the varying value chain pathways and flows that farmers can commercialise their grain through. Farms can operate outside of these descriptions depending on the wants and needs of the farmer, region, and local markets. Farmers can also split their operations up to occupy different combinations of these factors to access varying areas of these value chains.

Figure 1. Value chain pathways that grain can access and move through, split up by scale.



These overarching structural factors of PPB value chains have implications for the characteristics of grain as they move through value chains. Table 1 highlights how the fungibility, value, and marketing of grain can change depending on what pathway of the value chain the grain occupies. Fungibility in this context refers to the degree to which grain can be integrated into generalised organic grain markets upon transfers to brokers. Once transferred to brokers, the unique identity of the grain like its' producer, agricultural history, and agronomic performance is lost, and "organic" becomes the only retained characteristic. Value refers to the cost that value chain actors are willing to pay for the grain. Marketing refers to the amount of resources (like time, materials, labour, designing, advertising) producers must put into selling their product to value chain actors. Similar to the structural value chain factors, Table 1 describes a generalised guide, not a rule, on the characteristics of grain as it moves through the value chains.

Table 1. Summary of how major structural value chain factors impact downstream characteristics of value chains.

Major value chain factor	Type	Fungibility or identity preservation	Value	Marketing
Regional market access and **Quantity of grain produced**	Closer to urban centres Small-scale	• Grain is non-fungible and the identity of the grain is preserved • Urban retailers and consumers want to know and support the local farmers that grow their food	• Grain valued higher • Customers willing to pay premium prices for local, organic, regenerative, and/or ethically produced food	• More resources are put into small unit packaging and product advertising • Grain often goes to artisan markets that seek unique stories, flavours, and characteristics in their grain
	Further away from urban centres Large-scale	• Grain enters fungible organic markets upon transfer to brokers which erases the original identity of the producer • Grain mixed with others to become a generalised organic commodity	• Grain brokers and processors most often choose the cheapest grain that meets their basic quality standard • Farmers pressured to accept or reject prices offered by the market	• No marketing necessary as grain is sold directly to bulk grain brokers and/or processors
On-farm processing	No on-farm equipment	• Identity of grain lost if farmers sell their grain to brokers and/or processors • Identity of grain preserved if selling to artisan outlets	• Grain valued lower if being sold to brokers and/or processors • Grain valued higher if being sold to artisan outlets	• Marketing is not necessary if being sold to grain brokers and/or processors • Marketing is necessary if being sold to artisan outlets
	Access to on-farm equipment	• Grain is non-fungible and the identity of the grain can be preserved and diversified through value-added products	• Processed grain products can be sold as value-added products for a premium price	• Processed grain products packaged into units and marketed with their agronomic history

Farmer perceptions and experiences on the commercialisation of PPB grain

While the range of value chain pathways for organic grain is diverse, the opportunities for commercialization of organic PPB grain are limited but growing. Grains sold through grain elevator systems in Canada need to go through the variety registration process, a multi-year test where a variety is grown and tested for its agronomic performance, quality, and stability. The official variety registration process is lengthy, expensive, and resource-intensive and not all farmers have the capacity to make this investment for their PPB grains.. There is no alternative and more accessible regulatory system for the registration of PPB grains that allows them to be sold through grain elevator systems. Because of this, farmers generally do not want to change their established value chains to accommodate the PPB grain they grow. Any shift or establishment of new value chains or value-added opportunities for PPB would have to make clear financial sense.

Various farmers mentioned that they would like to find "closed loop systems" in which to sell their PPB grain, which are informal or alternative markets that do not require variety registration. This would provide dedicated value chains that move PPB grain materials from field to consumer without interacting with the broader commercial system. Examples of pathways that some farmers have found to commercialise their PPB grain in this way are:

- Farmer Jim Greishaber-Otto who has successfully marketed and sold PPB grain through his Community Supported Agriculture (CSA). Customers were interested in the culinary potential, genetics, and breeding story behind the grain population, with specific feedback that the PPB grain was great to make bread with.
- A farmer in BC was able to successfully sell their PPB potatoes through farmers markets. The potatoes were well received by customers and had strong marketability as they were colourful and visually appealing. They did encounter some poor reactions to the PPB story of the potatoes, with some customers automatically associating the act of plant breeding with Genetically Modified Organisms (GMO). This highlights the challenge of describing PPB in a clear, compelling, and understandable way.
- Farmers Chris Wooding, Loïc Dewavrin, and Ward Middleton supply organic wheat to small to medium-scale bakers and millers. Because of these close and established relationships, many of these artisan value chain actors have developed vested interest in the potential buy-in of PPB material once populations are ready for commercialization.

Barring the few examples mentioned, commercialization remains aspirational for farmers and is accompanied by varied intentions and expectations. Small farms appear to be more advantaged to facilitate early exploratory commercialization as they often have smaller, more dynamic value chain partners who can more easily accommodate and derive value from alternatives such as PPB. The commercial benefit of PPB to small producers comes from good agronomic performance, unique quality characteristics, and the value-added elements of branding, identity preservation, variety history, and the story of the PPB program. Smaller producers have a broader range of distribution options with no regulatory hurdles, so variety registration is not a priority.

Large-scale farmers are more uncertain about their pathways to commercialization. These farmers foresee having to go through an intense, iterative scale-up process to prepare a PPB variety for commercialization that involves tests, discussions with a few brokers, broker testing, end-use testing, confirmation of quality, scaling up production, and approaching more buyers. **As long as there is no market value added for PPB and variety registration acts as a barrier to market entry, farmers will face significant barriers to putting a variety forth for registration unless a competitive population is achieved and there is a clear market for it to enter. Farmers have done the work to produce PPB varieties, and now they need support from researchers, government, and other value chain actors to support more accessible pathways to PPB commercialization.** Building resources and infrastructure for PPB commercialization would create long-term market viability for PPB grain and offer farmers the revenue needed to continue doing PPB. If PPB populations perform well enough, farmers could also benefit financially from saving their own seed.

Other factors that influence the success and speed at which PPB is commercialised include:

- **Quality:** Objective or subjective qualities of a variety to meet the standards of the target market.
- **Variability**: The range in performance and end-use quality of a variety. While some variability is tolerated in crop breeding, a crop variety that is stable (meaning it has repeated, predictable crop quality over multiple years/environments) is ideal.
- **Grain testing**: Whether a variety has been tested for quality and variability, and other important end-use qualities like disease, nutrition, flavour profile, or any other factors that are important to value chain actors or end-users.
- **Relationship building**: The act of reaching out, discussing, sharing values, and establishing relationships with potential value chain actors. Value chain actors, even larger brokers, are not a homogenous group and carry values into their purchasing decisions. This could build a foundation of mutual trust and valuation of PPB material that prompts commercialization.
- **Cooperation**: Working together with value chain actors in the PPB commercialization process to minimise risk, collectively problem solve, combine volumes, and combine marketing power.
- **Competition**: PPB crops must compete on the market with thousands of crop varieties. Understanding these markets as well as the capabilities, advantages, and requirements of PPB in these markets is essential to stand out amongst competitors.
- **On-farm processing**: On-farm processing of PPB material avoids negotiating the sale of an unregistered grain which gives the farmers the power to add value, circumvent registration, and control the narrative surrounding their product. Purchasers can buy based on demonstrated quality, word of mouth, or relationship with the producer – not just registration status.
- **Marketing**: In a competitive market with thousands of grain varieties, PPB farmers must find ways to make their populations stand out to supply chain actors. The main highlights of PPB varieties can include their improved performance, history or identity, ecological benefits, unique varietal characteristics, or the social and political empowerment related to PPB participation.

- **Communication of PPB**: How well PPB is understood by value chain actors influences how well PPB can be used as a marketing tool.

Barriers: risk, hurdles, and gaps of PPB commercialization

Economic risk is the biggest barrier to PPB commercialization. Risk comes in the form of not just finances, but also time, energy, and other resources. PPB material can be genetically variable, leading to fluctuations in the traits of the population over time and creating unproven end-use quality that could jeopardise the economic relationships and well-being of farmers if they proceed with commercialization. Farmers and value chain partners are unlikely to gamble on PPB unless it shows stable and superior performance over already available varieties. Risk mitigation is the best approach to lowering the risk threshold to maximise chances of successful PPB commercialization. Table 2 outlines current hurdles and gaps that can pose risk factors for PPB commercialization, and how these risks could be minimised.

Table 2. Summary of risk factors related to PPB commercialization and potential mitigation strategies.

Risk factor	Effect on PPB grain commercialization	Risk to farmers	Potential mitigation strategies
Scaling up	Significant volumes of PPB material are required for agronomic testing, quality testing, purchaser demonstration, and marketing. A central paradox in the pursuit of desirable quality characteristics is that testing requires quantities of grain that are difficult to produce without investing in the scaling-up of a population.	• Time, energy, money, and resources (like land and fuel) put into growing PPB grain • Increased investment to scale-up grain • Storage space • Uncertainty in PPB quality before scaling-up • Finding value chain partners of similar scale to the PPB operation so that material is sold efficiently • Access to equipment to grow and process PPB grain at an increased scale • PPB varieties not eligible for crop insurance	• Form relationships with current or potential value chain partners willing to share feedback or buy-in to PPB • Before scaling-up, plan ahead for storage space considerations so that PPB material does not hinder other areas of operation • Share machinery across farms and producers • Develop partnerships with researchers or research associations to support scaling up and testing PPB grain

Risk factor	Effect on PPB grain commercialization	Risk to farmers	Potential mitigation strategies
Knowledge gaps in commercialization	Outside of this PPB program, PPB producers have not yet approached possible value chain partners about commercialising PPB products. Purchaser requirements can include variety name, testing requirements, and quantity and consistency needs, with these varying from one purchaser to another.	• Time and effort required to find fitting value chain partners • Uncertainty in the purchaser requirement process that may require time, effort, and resources • Trade-off between collaboration and competition, i.e., farmers may want to keep their commercialization information confidential	• Gather and share information on the commercialization once individuals start moving forward in the process • PPB program facilitators supporting PPB producers in finding information on the commercialization process and matching them to potential value chain partners
Diverging understanding on PPB methodology	Farmers have divergent understandings of the long-term intentions for PPB germplasm which have an impact on their commercial decision making. While some see PPB as a continuous process of selecting, refining, and adding to organic variety options, others envision keeping and maintaining their final populations. Both pathways lead to differences in variety stability and adaptability, and thus end-user quality.	• Lack of common understanding among farmers in the PPB movement • Confusion about when a variety is ready for commercialization	• Set clear goals from the beginning for PPB populations so that breeding outcomes are tailored to farm and farmer needs
Grain testing	Many questions remain on what are the best practices in conducting quality testing of PPB material. Where and when should it be carried out, and by whom? How much volume is required? What does it cost? Who bears the cost? What are the steps, and at what stages are they taken? When trying to answer questions about stability, it would also be helpful to know how frequently PPB populations will need to be tested. Should it be part of long-term testing to have validity, or is one-off testing of a crop year adequate? Answering these questions and making sure farmers are fully informed about the choices available to them will ensure that commercialization proceeds optimally.	• Having enough volume of PPB material for testing • Time and effort associated with preparing PPB material for testing • Costs associated with testing material, potentially on an on-going basis • Potentially wasted cost for testing if PPB material comes back with poor testing quality • Energy and resources lost trying to meet different quality standards across different value chain partners	• PPB program facilitators supporting PPB producers in clarifying the quality testing process • Gather and share information on testing once individuals start moving forward in the process • PPB program facilitators, government, and other groups with shared interest in PPB finding funds to subsidise the costs associated with quality testing • The establishment of a more accessible grain regulatory system for PPB material that is not as time and cost consuming for farmers

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Diverging understanding on registration and intellectual property (IP)	Farmers have different understanding on the rights to the germplasm coming out of the PPB program, specifically: how they are assigned, who has access to it, and who benefits from it. Some believe the germplasm is open source by nature and do not wish to own their PPB populations, while others understand there to be opportunities for royalties and ownership if a suitable population is developed. If the genetic rights arising from registration are enforced at the discretion of the licence holders, PPB germplasm could remain freely available. In contrast, if the registration system is designed to extract royalties regardless of the interests of the licence holder, this would be a severe impediment to free exchange.	• Lack of common understanding among farmers in the PPB movement • IP, or lack thereof, for developing a germplasm or variety • Lack of free exchange or access to germplasm depending on licence holders	• PPB program facilitators should make clear the options for IP and ownership among program participants • Reach out to PPB program facilitators for support in the registration process • The establishment of a more accessible grain regulatory system for PPB material

Conclusion

This study interviewed PPB program participants to learn about their perspectives and experiences with PPB commercialization and value chain creation. We explored the status of PPB commercialization, participant approaches to commercialization, and the barriers participants encounter in the process. Through farmers' personal experiences and the

themes discovered from the collected interviews, this report offers perspectives that could inform further commercialization.

Farmers have already taken steps towards demonstrating the commercial viability of PPB crops, and now they look towards PPB program facilitators and institutions to support them towards more practical steps towards commercialization. The PPB program should host future programming with farmers on available PPB value chains, demystifying the quality testing process, and ways to market PPB crops that are clear, accessible, and interesting. To build better understanding of PPB in Canada, The BFICSS also published a complementary report that outlines the PPB selection methods used by farmers and their perspectives on PPB in Canada, available to read here.

If you would like to learn more about The BFICSS or participate in any of our programming, please visit us at seedsecurity.ca to learn more.

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