

Exploring Options for Producer Involvement in Wheat and Barley Variety Development

Final Report

*Prepared for
Wheat and Barley Variety Working Group*



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***Collaborating for Success
in the Agri-Food Sector***

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Executive Summary

Value Capture by Producers and Rationale for Producer Involvement

Development of wheat and barley varieties creates significant value for wheat and barley producers in western Canada through improved varieties that increase yield and/or have disease resistance and/or have traits desired by users. A fundamental factor that impacts who in the grains value chain funds variety development is the self-pollinating nature of wheat and barley, which allows producers to seed harvested grain with minimal loss in efficacy in subsequent years. This means that producers capture the value of a new variety for a number of years without having to purchase certified seed. In turn, private sector plant breeders have difficulty capturing enough of the value they created to make large investments into developing new varieties. This feature of wheat and barley results in variety development being an industry or public good, which is why public sector investment accounts for the largest share of overall annual investment for both wheat and barley.

Approximately \$56 million is invested annually in wheat and barley variety development, with taxpayers providing 72% of the funding, with producers and the private sector investing the remainder in similar amounts. Producer investments have typically funded specific variety development initiatives at mostly public institutions, such as Agriculture and Agri-Food Canada (AAFC), the University of Saskatchewan (U of S) (also referred to as the Crop Development Centre), the University of Manitoba, (U of M), the University of Alberta (U of A), and the Field Crop Development Centre (FCDC) in Alberta.

Producers have considerable self-interest to ensure that investment in variety development is at least maintained, but more realistically that investment increases to create even more value for the production sector to remain competitive with other crops grown in Canada, and to enhance competitiveness with wheat and barley production worldwide. Based on the proposition that public sector investments into variety development do not increase, there are two general approaches available for increased investments which involve either the private sector or producers. One approach involves producers and increases the amount of annual check-off funds ear-marked for variety development. The other uses a royalty system based on intellectual property rights which attracts additional private sector investment in variety development. These approaches are not mutually exclusive.

Furthermore, there are a variety of ways in which producers can be involved in variety development and producers have a number of reasons to be involved in variety development. This report provides a compelling case for increased producer involvement in wheat and barley variety development. One obvious reason is that producers want some influence over variety development as long as producer dollars through check-off levies are used to fund variety development.

Producers Want to Gain a Better Understanding of Some Issues

Producers are currently involved to achieve desired outcomes that include: (1) wheat and barley being competitive with other crop kinds in western Canada; (2) providing traits desired by producers such as disease resistance, and (3) providing specific quality traits desired by end users. Going forward, the extent of producer involvement can be determined with a better understanding of:

- ❑ whether producers need to own and operate a seed company, or whether involvement in variety development is through partnerships and leveraging of funds;
- ❑ whether producers should capture royalties on investments producers fund, or whether the payback is through improved varieties for improved on-farm returns;
- ❑ whether producers should support an End Point Royalty (EPR) system, or whether variety development should primarily be funded through refundable levies;
- ❑ whether a more centralized and coordinated approach is required to have an effective approach to maximize the contribution of producers' provincially based check-off funds that are invested in variety development; and
- ❑ whether one approach applies to the cereal sector, or whether crop specific approaches may be required (e.g., for barley: feed, food, or malt uses).

Potential Options for Producer Involvement Models

How producers could be involved in variety development is explored in this report. Producer involvement can range from continuing the current approach where investments are made by provincially based wheat and barley Commissions and the WGRF, to possible options with more coordination and information sharing amongst current organizations, to creation of new organizations and/or partnerships that focus on directing producer funds in a centralized and coordinated manner, and to options where producers have ownership in a plant breeding company.

To assist producers in their exploration and on-going discussion of options for producer involvement, five models for producer involvement are discussed in this report. The potential options selected are:

- Model A - Current Approach with More Coordination and Information Sharing;
- Model B - Eight Provincial Commissions involved in Variety Development Research Programs;
- Model C - One Non-Profit Producer Body: Wheat and Barley West;
- Model D - Australia North: Separate Partnerships for Pre-Breeding and Breeding/Finishing; and,
- Model E - Producer Ownership in a Cereal Breeding Company.

Model A referred to as the "**Current Approach with More Coordination and Information Sharing**" and (Model B) labelled as "**Eight Provincial Commissions Involved in Variety Development Research Programs**" are modifications of the current approach. Both of the options do not involve creation of any new institutions and builds on current processes and ensures that producers are involved, particularly when check-off levy funding continues for variety development. Without an EPR system, the key risk associated with these two models is that sufficient private sector funding may not be attracted into the sector. As well, producers are not positioned well if AAFC decides to devote fewer resources to variety development, such as not finishing varieties. An additional risk with Model B is that administration costs increase and the potential for increased duplication and possibly fewer strategic investments in variety development.

A third option (Model C) which is referred to as "**One Non-Profit Producer Body: Wheat and Barley West**" (WBW), has a new formal structure between the Commissions, such as a joint venture that focuses on funding high priority variety development projects. This model is a more structured approach than either Models A or B where WBW contracts out research or partners with others on priority variety development projects. WBW can more easily enter into partnerships with public sector institutions and private sector seed companies to foster specific variety development initiatives. The producer's share of royalty payments and license fees collected by any developed partnership would be used to fund additional producer directed variety development projects.

The consultants' view is that model option of WBW is likely more appropriate for producers than either Model A or B. Reasons include centralization through a formal structure and associated lower administration costs, avoidance of potential duplication and redundancies, allowing for larger one-time investments, and enabling more producer influence and leadership. The preference for Model C over Model A and Model B occurs in the case when there is no EPR system and, as well, when EPRs can be collected on newly released varieties. This preference is based on continuation of a meaningful allocation of check-off levies to fund the producers' contribution to variety development. If producer contributions diminish, so does producer voice and influence. There is a strong rationale for higher levels of producer investment in variety development.

A potential risk with Model C is that some governance issues may arise if certain groups representing specific classes or wheat and barley become dominant, which may lead to dissention. As with the above two models, WBW has the risk of not attracting enough producer investment if an EPR system is not in place to incent more private sector investment in variety development.

The current system and its variants of Model A and Model B can easily transition into Model C (WBW), with minimal disruption to variety development efforts in either the public or private sector.

The fourth option (Model D) is a variation of the Australian system, which is referred to as “**Australia North: Separate Partnerships for Pre-Breeding and Breeding/Finishing**”, where a producer body such as WBW and AAFC enter into a partnership (or joint venture) which become responsible for all pre-breeding activities (or basic discovery research) in an entity referred to as the Wheat and Barley Variety Development (**WBVD**) Corporation. AAFC assets used for variety development and associated staff become part of WBVD, which are co-funded by producer levies and by the federal government.

Over time, WBVD fosters development of for-profit P4 partnerships (which could include, for example, WBVD, a university breeding facility, and a private sector seed company). The model evolves to a structure where WBVD focuses on industry good projects (such as germplasm development) and the P4 breeding companies efforts are on breeding, finishing and commercialization. The Australian model includes EPRs for a royalty stream based on successful new varieties. Evolving to this option from the current structure may not be easy, requires adoption of an EPR system, and involves some risks during the transition.

One risk with the WBVD option is the potential failure to achieve the desired structures due to the considerable change that is required in overall structures and the transfer of some public assets and employees into WBVD. As well, overall taxpayer funding of variety development could decrease with this option, as federal funding could be limited to the co-funding of WBVD. The emergence of only for-profit breeding companies (via the partnerships) presents a risk that small class crops may be underserved through new varieties.

Our analysis indicates Model C (WBW) is preferred to Model D (Australia North). However, if over time a transition to Model D is desired; Model C is a platform for transitioning to Australia North.

The fifth option (Model E) “**Producer Ownership in a Cereal Breeding Company**” is where all producers have ownership shares in a prairie-wide cereal breeding company (**Seed Corp**). Each producer’s levy contribution to the for-profit Seed Corp becomes their shareholding and ownership has producers directly involved in plant breeding. Seed Corp would have its own staff and breeding program, as well as enter into partnerships with other entities, such as AAFC, CDC, FCDC, and private sector companies. A risk with this option is that producer funding of variety development at public institutions may cease, which can reduce the research capacity at universities and other public institutions. Without an EPR system, this option is highly dependent on an increase in producer funding through check-off levies. With an EPR system, Seed Corp is in direct competition with private sector seed companies, with sustainability based on marketplace success.

A risk associated with this option is the loss in overall public investments since all producer funds are directed to Seed Corp and the company may not continue with current investments in variety development research at universities or fund projects in concert with AAFC. Some Commissions may not support Seed Corp as they may view as unacceptable the arrangement where levy funds ear-marked for variety development are forwarded to Seed Corp. As well, a prairie-wide for-profit breeding company may decide to focus only on large acreage varieties, which disadvantages small acreage classes.

Over an intermediate term horizon, we view Model C (WBW) as more appropriate than Model E (Seed Corp) due to some of the risks, and potential disruptions to variety development at public sector institutions. Notwithstanding, over time Model C can serve as a platform for a transformation from WBW to a prairie-wide Seed Corp.

Response to Areas Where Producers Wanted to Gain an Understanding

As noted above, producers want a better understanding in a few areas. Our analysis suggests that producers do not need to own and operate a prairie-wide seed company to achieve desired outcomes. Producers can provide necessary leadership, influence and direction on variety

development through partnerships and leveraging of producer funds. Owning a seed company can create more risk for producers without necessarily gaining additional rewards. However, individual producers can continue to participate in start-up and smaller scale seed companies if they wish to seek an ownership position.

The analysis also indicates that producers capture value each year through the release of new varieties and this on-farm value capture is likely higher without an EPR system. With an EPR system, producers (through their investments in variety development initiatives) can also capture value through licensing of technologies and sharing in royalties through appropriate agreements on varieties that producer funding helped develop. EPRs also provide returns to public sector breeding.

An EPR system has a number of benefits, including providing incentives for additional private sector investment in variety development, and the high potential for greater total investment in wheat and barley variety development. The findings suggest that producers should continue with meaningful funding of variety development through a refundable levy system when an EPR system may be in place, since such producer funding enables producers to continue with leadership and direction of variety development. An idea for consideration is to have an ear-marked per tonne of check-off levy for variety development and that a sizeable portion of such value is not refundable. With producer support, an EPR system creates an incentive structure for much larger investments in variety development and will benefit producers – and producer leadership and influence can continue based on on-going levy contributions to variety development, particularly in the pre-breeding stages of variety development, and through selected strategic partnerships on certain initiatives. With an EPR system, mechanism such as licenses and agreements can help to ensure that germplasm and information sharing occurs between plant breeders.

This report suggests that an approach using a formal prairie-wide structure is preferred, such as with Model C (WBW) which allows for scale economies, consolidated producer voice, and larger and/or more focused strategic investments.

A prairie-wide seed company (Model E) entails some risk. As occurs in the private sector, investments are usually made on larger acreage varieties, with less attention paid to smaller classes and cereals for smaller regions with lower realized returns. This suggests that flexibility is required in the approach taken by producers as they become more involved in variety development. Such flexibility can be achieved through Model C (WBW) and as well through Models A and B.

Strategic Choices for Producers

There are two strategic choices facing producers. The first choice is how producers should be involved in variety development, including whether producers need to own assets or contract with institutions that own necessary assets. The options provided on the type of model for producer involvement can assist in the on-going dialogue between producers on the merits of each option, and which one best meets the needs of wheat and barley producers.

The second choice is whether or not to support an EPR system. An EPR will provide additional revenue for producer/public supported breeding programs and will in all probability increase the level of private sector investment into wheat and barley variety development.

An issue for producers is what Model option best serves producer interests with an EPR system. The path to be decided upon by producers rests on the confidence of whether or not producer influence can be maintained with an EPR system and have continued improvement in varieties. An EPR system enables needed private sector investment, and producers can maintain influence by maintaining levy funding of producer directed variety development projects and potentially through producer ownership in a cereal breeding company.

Producer involvement in wheat and barley variety development may evolve over time through more than one of the options described in this report.

1.0 Introduction

Wheat and barley producers in western Canada have been involved in variety development through the Western Grains Research Foundation (WGRF) since the early 1980's, mainly through funding varietal development at public institutions. With recent changes in the operating environment affecting plant breeding and variety development, an opportunity exists for wheat and barley producers in western Canada to examine how producers would like to be involved in variety development for wheat and barley in the coming years.

Changes include the Agricultural Growth Act, enacted in early 2015, which had a number of features designed to encourage innovation. A key provision included amendments to the Plant Breeders' Rights Act (PBR Act) that result in Canada being in line with the 1991 Act of the International Convention for the Protection of New Varieties of Plants (UPOV 91). These amendments were designed to encourage increased investment in plant breeding. Over the last decade another change has been the lower levels of federal funding directed toward plant breeding. As well, over the last few years, each provincial government recently established producer-elected and producer-directed wheat and barley Commissions that have the authority to collect producer funds through check-offs on grain sales. These check-off funds can be used for a number of initiatives that support the competitive position of producers, including the improvement of wheat and barley varieties.

These changes provide the opportunity for producers to engage in discussions on the nature and role of producer involvement in variety development. These discussions can ultimately lead to decisions on the nature and form of producer involvement in wheat and barley variety development.

To ensure a collaborative and cohesive western Canadian approach on how producers are involved in variety development moving forward, producer organizations and provincial Commissions formed a Wheat and Barley Variety Working Group. Member organizations include:

- ❑ Alberta Barley Commission
- ❑ Alberta Wheat Commission
- ❑ British Columbia Grain Producers Association
- ❑ Manitoba Wheat and Barley Growers Association
- ❑ Saskatchewan Barley Development Commission
- ❑ Saskatchewan Wheat Development Commission
- ❑ Saskatchewan Winter Cereals Development Commission
- ❑ Winter Cereals Manitoba

The WGRF, a prairie-wide body, is a facilitator for this Working Group.

The Working Group met in late 2014 and decided that they needed to work together as a group to look at alternatives to the status quo and explore options on how producers could be involved in variety development. A driving force was to ensure long term sustainability through variety development that focused on competitiveness and higher net profitability to grain farmers. The Working Group met again in February of 2015 and agreed that they needed to explore options for producer (i.e., Commissions and Associations) involvement in variety development. The Working Group indicated that their goal is to *“have world class sustainable wheat and barley variety development programs contributing to increased net profitability per acre for Canadian farmers through continual improvement of wheat and barley varieties”*. In March, the Working Group commissioned the JRG Consulting Group¹ *“to conduct an objective business case analysis of a range of options for producer involvement in wheat and barley variety development”*.

¹ The project team includes John Groenewegen (JRG Consulting Group), Richard Gray (University of Saskatchewan), Bob Hyde (Scott Wolfe), and Shelley Thompson (SJT Solutions).

Producers Have Been Involved in Variety Development

The breeding programs of former producer cooperatives, such as the Saskatchewan Wheat Pool and United Grain Growers, is a prior model of producer involvement in variety development.

Producers have also been involved in variety development of wheat and barley in western Canada² for over three decades through the WGRF, a non-profit organization, where producer organizations are well represented on the WGRF's Board. The WGRF was created in 1981 as a research funding organization that would partner with research providers, with initial funding provided by the federal government when the Prairie Farm Assistance Act was no longer in effect. The Canadian Wheat Board (CWB) used to collect Wheat and Barley Check-offs as a deduction on final payments (\$0.30 per tonne for wheat and \$0.50 per tonne for barley), and in 1993 these funds were then administered by WGRF. The funds are used by the WGRF to support variety development³.

The 2012 change in the status of the CWB required a different approach to collecting the check-offs that supported WGRF's investments in variety development. Currently, the check-offs are collected by first receivers and forwarded to and administered by the Alberta Barley Commission (ABC)⁴, with this authority expiring on July 31, 2017. This temporary program (The Western Canada Deduction) was put in place to allow some time for the industry to develop a long term funding model for important programs such as variety development.

The WGRF invests check-off funds into wheat and barley breeding research through long term agreements and individual projects with public institutions. The WGRF has contracts for wheat and barley development through 2019. In the last crop year, the WGRF collected \$7.7 million in wheat check-offs and invested \$6.1 million in variety development. For barley, just under \$1 million was collected through the WGRF check-off and \$1 million was invested in variety development. WGRF leverages this money by sharing the costs of public research with governments and other contributors to wheat and barley breeding programs. WGRF invests in wheat and barley breeding programs at AAFC institutions and the three prairie universities: the University of Manitoba (U of M), the University of Saskatchewan (U of S), and the University of Alberta (U of A) and at the Alberta Field Crop Development Centre (FCDC). WGRF has assisted in the development and release of more than 200 new wheat and barley varieties over the past 20 years, many of which are today seeded to large portions of the cropland in Western Canada.

The Alberta Barley Commission has also supported variety development programs at the FCDC through their check-off system, which has been in place since 1991. The recent creation of the other provincial wheat and barley Commissions and their provincially based check-off authorities provides a greater opportunity for producer involvement in variety development. In the last crop year, these organizations received \$16 million in check-off levies, and made investments of approximately \$1.5 million in variety development⁵. The level of investment in variety development by these Commissions is expected to increase as the Commissions become more established. Annex B can be referred to for more detail.

Producers have also invested in seed/genetics companies, such as seed growers starting for-profit companies Canterra Seeds and FP Genetics. As well, SeCan is a not-for-profit farmer-membership based seed distribution enterprise which is the largest seed distributor in Canada.

² See also Annex A.

³ The WGRF's Endowment Fund is also used to fund wheat and barley variety development, as well as other research-related initiatives.

⁴ The ABC manages this temporary program since the ABC collected check-off funds to support barley research since 1991.

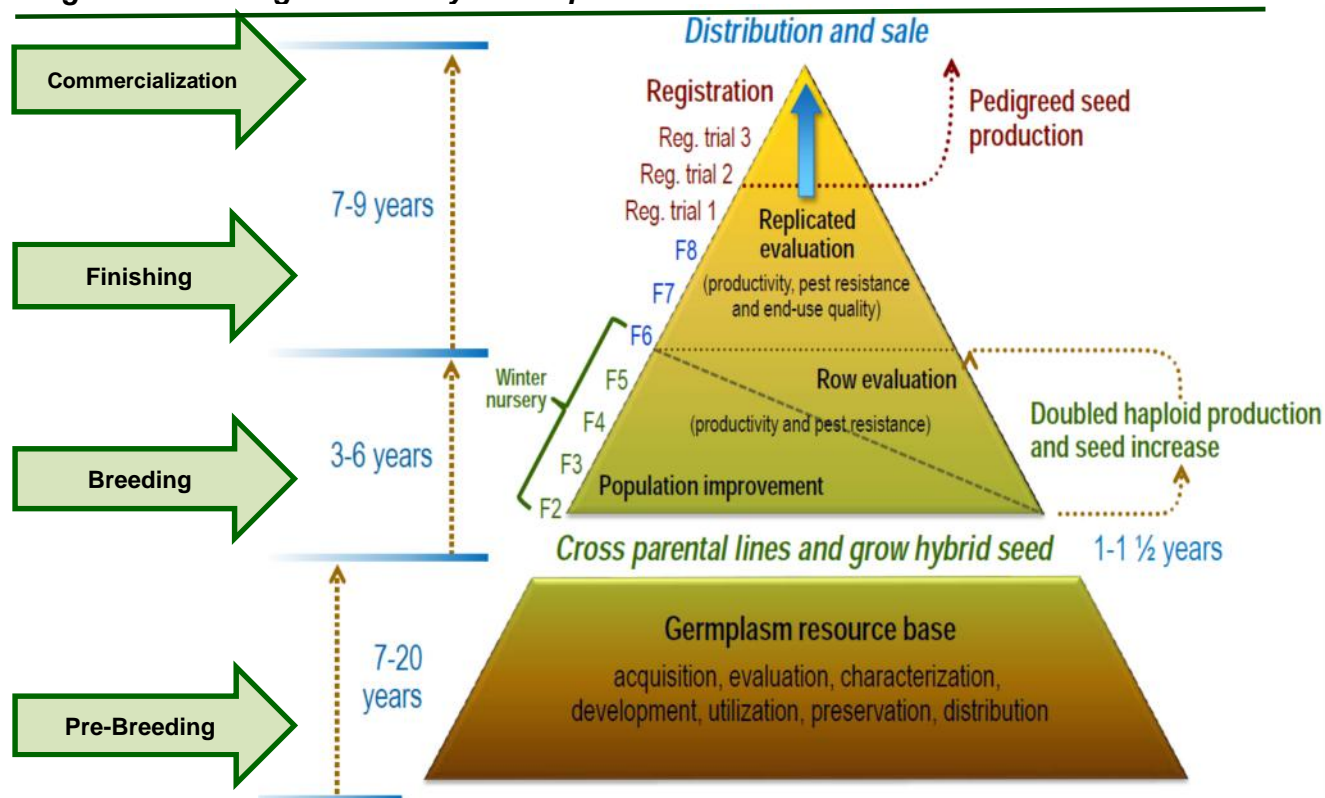
⁵ These check-off funds can be used for other areas such as agronomic research, marketing, promotion, etc.

Stages of Variety Development

The terminology “variety development” is used rather than the more familiar term of plant breeding, since variety development encompasses more than plant breeding. Stages of variety development, as used in this report and as shown in Figure 1.1, include:

- ❑ Pre-breeding, which includes discovery, germplasm development, genomics, development of breeding tools, development of evaluation, etc.;
- ❑ Breeding, which is the breeding of a number generations (e.g., F1 to F7) of a crop kind;
- ❑ Variety finishing, includes finishing, replication, and registration; and
- ❑ Commercialization, which is the distribution and sale of a registered variety.

Figure 1.1 Stages in Variety Development



Source: The major portion of Figure 1.1 is from “AAFC and the Future of Cereal Breeding”, presentation by Drs. Stephen Morgan Jones and George Clayton, Science and Technology Branch, AAFC.

The term pre-breeding is used in this report to describe the discovery research that precedes actual plant breeding activities. Pre-breeding activities typically generates “knowledge” and “know how” that can be used in breeding programs, and these outcomes are typically public goods. All Canadian plant breeders do not use this pre-breeding terminology.

Pre-breeding has been defined in Australia⁶ as “R&D intended to contribute to genetic improvement for a trait or traits of economic value. It is often undertaken outside a commercial breeding program, but with the intent of providing improved germplasm, screening technology or breeding methods. Pre-breeding may include gene discovery, trait identification, developing markers, phenotypic screens and information generation”.

⁶ “Grains Industry, National Research, Development and Extension Strategy”, Australia 2011, Primary Industries Standing Committee – R&D Subcommittee April 2011.

Breeding begins with the crossing of two in-bred parental lines (the F1 generation) to create the F2 generation, from which breeders select and replicate through successive generations as highlighted in the above schematic.

These stages in the variety development process will be referenced a number of times throughout the report. There is a direct linkage between the stage of variety development and whether it is a major focus of public sector institutions, and/or the private sector. For example, most discovery research (or pre-breeding) is conducted by public institutions, such as universities and AAFC, particularly when the resulting knowledge can be freely used by others⁷. Private sector firms (i.e., seed companies) in western Canada tend to focus more on commercialization, finishing and some breeding. The institutional focus is largely due to the nature of the good being developed – is it a public or industry-wide good that can be easily shared, versus the private good focus of a for-profit company.

⁷ GMO technology was developed by the private sector since the value of the technology could be captured through licensing and/or seed sales.

2.0 Economic Considerations Influencing Variety Development

Involvement by the private sector, the public sector, and by producers in variety development is heavily influenced by the economics of wheat and barley variety development. The self-pollinating nature of wheat and barley and the minimal yield drag that occurs with replanting of these self-replicating cereals has a significant impact on who does what in cereal variety development.

Variety Development Creates Value

Variety development provides benefits to wheat and barley producers through improved margins per acre, with these higher returns due to varieties that either provide higher yields, better disease resistance, improved drought tolerance, and/or genetic traits that are desired by end users. Studies have shown that wheat yields have increased by 1.4% to 1.8% per annum⁸, with some evidence indicating that approximately 50% of this yield gain is due to better agronomic and management practices and 50% due to genetic improvement in newly released varieties. In other words, variety development adds approximately 0.7% to 0.9% to net returns each year, assuming price received remains the same. This is a benefit received by each wheat and barley producer, assuming they utilize newer proven varieties. Over a 10-year period the cumulative increase is approximately 8% yield gain. These value creating improvements are captured by producers as they adopt new proven varieties. The cost to the producer of this additional value is embedded in the price of certified seed when first purchased.

With a \$6 to \$7 billion wheat and barley crop, an annual increase in yield of 0.8% due to improved genetics is an annual industry wide benefit of approximately \$50 million, which continues into the future, providing a cumulative value of approximately \$500 million (using a 5% discount rate and a 5% depreciation rate). This is new value created every year based on the release of new varieties.

Producers capture value through the improved returns and producers' ability and decision to reuse the seed each year, without any yield drag. This is a result of farmer-saved-seed (FSS) and the inability of product developers to exclude producers from on-going benefits of a purchased variety, unless there is a form of intellectual property rights (IPR) attached to the variety planted.

Value Created in Variety Development Can Be Readily Available

The characteristic of yield improvement is available for a number of years; even though the certified seed is purchased only in the first year of adoption suggests that this value creation is readily available to producers. In this context, variety development is considered to be an industry good, where continued use is difficult to exclude by the product developer. This is in contrast to a private good where sufficient value can be captured each year by a developer requiring repurchase by producers each year, such as with hybrid seed.

Table 2.1 illustrates the major difference between private goods and industry goods⁹. Private goods are excludable, when use by others can be excluded. This is the case with hybrids and varieties with IPR. Industry goods are non-excludable, which mean that use by others and/or use by a producer in subsequent years cannot be prevented. With self-pollinating crops, such as cereals, planting harvested seed cannot be prevented by a product developer unless the variety has some form of IPR protection.

As a result, without a form of IPR it is rather difficult for product developers to capture the value that was created through their product offering. The term "spillover" is used when others, such as

⁸ See Annex C for some references and supporting data.

⁹ Table 2.1 also refers to public goods, where all of society benefits, whereas with industry goods benefits are more limited to the industry, such as the wheat and barley industries.

farmers using saved seed for planting (FSS), benefit from variety development expenditures without paying the full cost. Such spillovers, where value cannot be captured by the investor, results in underinvestment by the private sector and the corresponding necessity of public investment to generate overall growth in returns within the grain economy. This has been the case, and without a form of IPR, will likely continue to be the case for wheat and barley.

Table 2.1 Public, Industry and Private Goods in Variety Development and Crop Production

Public Goods (non-excludable)	Industry Goods (non-excludable)	Private Goods (excludable)
Basic Science Research	Crop genomics, germplasm, unprotected varieties	IP Protected crop varieties/traits/processes
Science literacy/ ecology /chemistry/ biology	Agronomy/ best management practices	Protected production process
Business management	knowledge dissemination product, input testing	Patentable mechanical innovations
Human and model crop Genomics	Crop disease research, biological control systems	Chemical Pesticides Inoculants
Pathogen Research	Quality standards/systems Market access	product and market development

Source: Gray (2014)¹⁰

The very nature of the wheat genome creates challenges for plant breeders. It has been very difficult for private¹¹ sector organizations to capture significant value due to the self-pollinating characteristic of wheat and barley, which has resulted in mostly public investment in wheat and barley breeding. Introduction of commercial wheat and barley hybrids is occurring on a small scale in the EU¹²; however, due to self-pollination, high seeding rates, and limited hybrid vigor it may take a number of years before a breakthrough technology allows for a cost effective method of producing hybrid wheat and barley seed for use in western Canada. If (or when) this occurs, these cereals become private goods due to the excludability that occurs with hybrid crops, where re-use as seed results in inferior yields.

The recently enacted *Agricultural Growth Act*, which brings Canada in alignment with the provisions of UPOV 91, can provide product developers with the ability to earn royalty income. This Act creates the foundation for the establishment of contract based End Point Royalties (EPRs)¹³, which are currently used in other countries such as France, Australia, and the United Kingdom. An EPR system can shift farmers saved seed from being a non-excludable good (in the eyes of the seed company) to an excludable good. This allows the product developer to capture the value of the technology embedded in the farmer saved seed when the crop produced using farmer saved seed is sold into commercial channels. This can increase the incentives for the private sector to invest in wheat and barley variety development.

¹⁰ Gray, Richard. "Solutions to the Agricultural Research Funding Conundrum" *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie* 62.1 (2014): 7-22.

¹¹ In this report, the term "private sector" refers to private corporate sector and does not include producers since the term "producers" is used to allow for necessary differentiation between these two groups.

¹² The per unit cost of hybrid seed is lower in the EU than in western Canada due, in large part, to the higher EU yields.

¹³ The recent amendments to the PBR Act also allows for the continuation of FSS, and the prohibition of farmer sale of FSS for use by other producers.

Capturing the Value Created

Variety development in wheat and barley creates value for the grain industry. ***Which stakeholder(s) of the value chain capture(s) the value created by variety improvement is at the core of how producers could (or should) be involved in variety development.*** Value capture outcomes can be where:

- ❑ Producers capture value through higher per acre margins, with this value captured in subsequent years through use of farmer saved seed;
- ❑ Seed companies capture value through royalties and built in premiums on certified seed sales, and through use and re-use agreements on their seed; and/or
- ❑ Public institutions capture value through licensing of technology to seed companies.

The private sector by its very nature must be focused on its capability to capture value relative to costs incurred. If a positive margin cannot be captured by the business, the business will fold or exit the sector. The traditional government role is to provide for public goods and the focus is more on creating value for the benefit of society as a whole, to the benefit of society. While government can capture some value through licensing of technology and germplasm, this is not its prime focus as public goods are created through taxpayer funding of variety development initiatives.

Under the current system there are clear industry-wide benefits to wheat and barley variety development – the value creation – with product developers seemingly not able to capture enough of the value to create a stand-alone for-profit business¹⁴. With publically funded varieties, producers capture the value through the improved returns and their ability to reuse the seed each year, without any yield drag.

There are a few ways that developers of new cereal varieties can capture value that they create. These include:

- ❑ Providing hybrid varieties, which requires the purchase of new seed each year, which is currently not available in western Canada due to the high costs of cereal hybridization;
- ❑ Having use agreements based on intellectual property rights (IPR) that cover conditions of use of the seed, such as one time use or paying a use fee in subsequent years;
- ❑ Having an EPR system that allows breeders to capture a royalty payment based on the continued use of the seed (such as being collected at time of marketing); and,
- ❑ A levy system on all grain marketed paid by producers, with a portion of this levy distributed back to plant breeders¹⁵.

Currently public institutions receive approximately \$5 to \$6 million per annum in royalty payments and license fees, which is significantly less than their annual expenditures on wheat and barley variety development (of approximately \$41 million)¹⁶. This outcome is a characteristic of an industry good, where the value is captured by the industry – primarily by wheat and barley producers. To have on-going growth in the industry, public and/or collective industry investment is required.

This situation where annual revenues received by public breeding institutions is much less than their expenditures highlights the known fact that it is difficult, at best, to have a for-profit business in wheat and barley variety development. This stems from the fact that value is not being captured by product developers every time their seed is planted. Rather, producers capture this value through yield improvement and use of farmer saved seed.

¹⁴ This contrasts with canola, corn and soybeans where due to technology use agreement and/or hybrids product developers are able to capture some of the value created.

¹⁵ The levy system can be used to reward successful product developers through mechanisms such as the “Pay for Performance” system used by the Saskatchewan Pulse Growers, where the number of acres planted to a variety is a major factor in the performance system.

¹⁶ See Annex B where estimates are provided of government contributions to variety development.

Comparing Benefits of Variety Development to Costs Incurred

The industry wide benefit of variety development has been measured, either as an internal rate of return or as a benefit to cost ratio. Benefits have been measured for western Canada farmers with benefits being 20 times larger than the total costs of breeding programs supported by the check-off levy funds paid by producers¹⁷. The majority of new varieties are released by public institutions such as AAFC, the FCDC, the Crop Development Centre (CDC) at the U of S, the U of M, and the U of A. (See for example Table A. 5 to Table A.13 in Annex A).

This approximate annual benefit of \$50 million (as noted above) compares to the \$7.5 million in check-off funds that were directed to variety development over the last year, and results in a rough benefit/cost calculation of 6.7:1. This simple one-year view also only considers producer contributions, which suggests that every producer dollar invested in variety development has a return of \$6.70. This simple calculation does not include costs funded by taxpayers nor future benefits, which if included results in a larger return to variety development.

Comparing benefits to costs can also be based on variety development efforts undertaken by the public sector and private sector seed companies. The majority of variety development efforts are undertaken by the public sector based on taxpayer funds, with public sector involvement in all stages of variety development estimated at \$40.5 million per annum, with producers contributing \$7.5 million through check-off funds, and another \$7.9 million by the private sector. In this context, the annual industry wide expenditures of \$56 million are just slightly less than one-tenth of the estimated annual \$500 benefit of ongoing yield improvement, with a benefit/cost ratio of just under nine (9:1). This return does not account for other genetic benefits such as disease resistance and development of specific traits, which if accounted for would result in benefits being more than nine times the variety development costs.

Another view on the benefits of variety development is to account for the cost to producers by accounting for a premium paid for certified seed purchases. The annual cost to wheat and barley growers is estimated based on an assumption of 20% of the 29 million acre crop is planted using certified seed, and with a presumed \$4.50/acre premium¹⁸, and the resulting incremental cost is approximately \$26.1 million. This suggests a benefit/cost ratio of 19:1 at the industry wide level (when annual benefits are in the \$500 million range as note above)¹⁹. Assuming certified seed use is 10% of planted wheat and barley acreage, and then the resulting benefit-to-cost ratio for the producer community is in the range of 38:1. As above, this suggests there are considerable net benefits to investments in variety development.

Desired Future Trend in Variety Development Expenditures

The above measures indicate that producers have benefited from public investments in variety development, and from producer contributions to variety development projects. For the farm sector to continue to realize additional value (through improved per acre margins) based on release of new varieties, the amount expended on variety development should, at a minimum, continue at current levels. When contrasted with other countries, the annual level of expenditures on variety development in western Canada should likely increase. For example, in Australia variety development expenditures are 2.7 times the amount invested in Canada, when measured based on

¹⁷ As noted on the WGRF website based on a study conducted by Richard Gray, Cecil Nagy, and Alper Guzel, "Returns to Research; Western Grains Research Foundation Wheat and Barley Varietal Development"

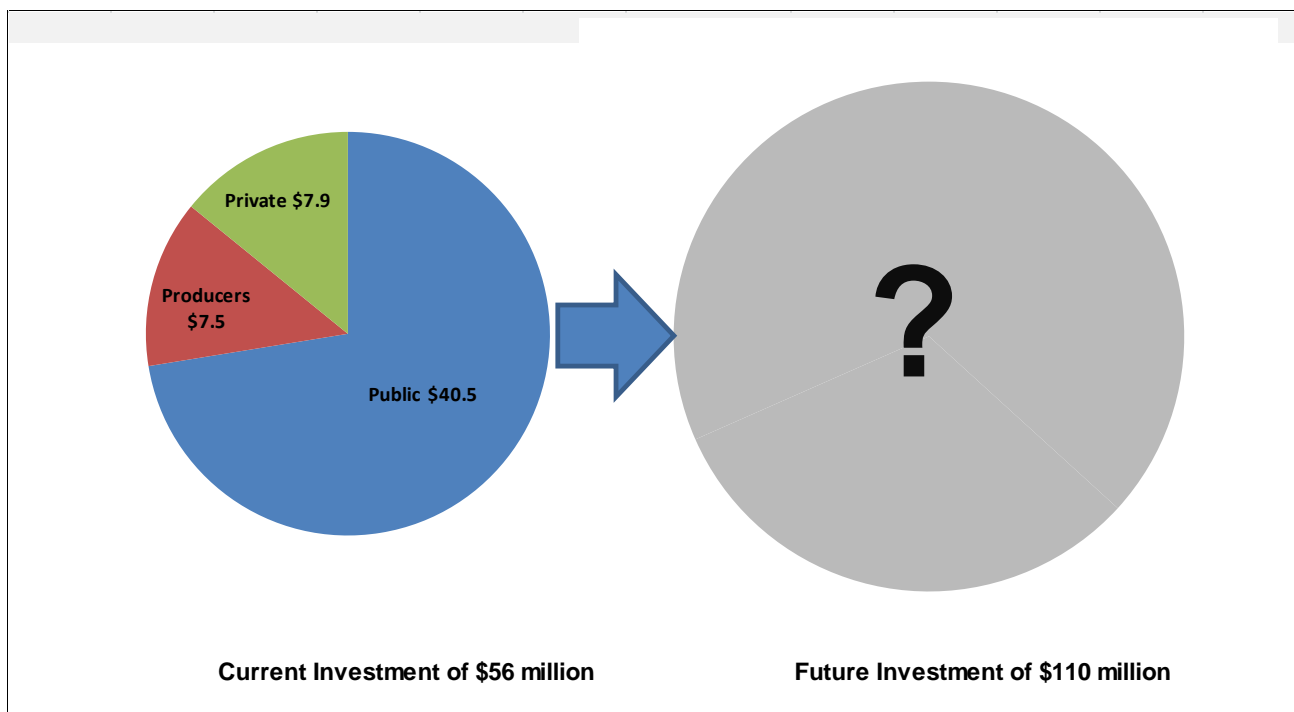
¹⁸ Using a certified seed premium of \$3/bu. and 1.5 bushels of seed per acre over the costs associated with using bin-run FSS.

¹⁹ If the annual levy contributions to variety development at of \$7.5 million are also included, the annual cost to producers increase to \$33.6 million with a resulting benefit /cost ratio becomes 15:1. This calculation does not account for other improvements such as improved disease resistance and quality parameters required by downstream users.

tonnage of wheat produced. When measured on a per acre of wheat planted, Canada falls well behind Australia, the UK and France, for example²⁰. In recent years, the amount invested in wheat variety development in Australia has been just over \$100 million per year, which has a lower production volume than in Canada²¹.

The current distribution of investment in variety development for wheat and barley by the public, producers, and the private sector²² is illustrated on the left-hand side of Figure 2.1 with producers contributing 14% of overall investment of \$56 million and the public at 72% of total investment in wheat and barley variety development. A stretch goal for wheat and barley in western Canada could be a \$110 million investment per annum, to match just the overall investment in wheat in Australia. A larger investment by the public sector, the private sector, and by producers through check-off levies accomplishes this goal. The right-hand side of the figure uses a question mark to avoid being prescriptive on the potential future distribution of investment. For example, a \$1.00 per tonne check-off levy ear-marked for variety development can result in producers investing \$35 million per annum.

Figure 2.1 Current and Potential Future Distribution of Variety Development by Investor



An increase in the total investment provided by a combination of the public sector, producers, and private seed companies should better enable wheat and barley to remain competitive with other crop kinds in the competition for what crops are planted across western Canada. Producers are the beneficiaries of improved varieties and a following section covers why, how, and where producers could be involved in variety development.

²⁰ See Annex D which also summarizes approaches used in some other crops and jurisdictions, with per investment in wheat variety development in Canada is \$2.13/acre, which compares to just over \$3.00/acre in Australia and France and \$7.31/acre in the U.K.

²¹ The distribution of investment by producers, private and the public is shown in Annex D, with producers contributing 37% through their levy system

²² In this report, the term “private” sector does not include producers since a distinction is made between “producers” in the non-public sphere and other private interests such as a for-profit seed company.

3.0 Strengths, Weaknesses, Opportunities and Threats (SWOT)

The current operating environment has a number of very positive features, and as well some weaknesses and possible threats that impact on variety development. The strengths and weaknesses of the current operating environment and its impact on variety development of wheat and barley, as well as the opportunities and threats are summarized below²³. This SWOT of the current system provides some additional context for producer involvement in variety development.

Strengths

Strengths of the current wheat and barley variety development system include:

- ❑ Dedicated geneticists and plant breeders exist at universities and in government agencies;
- ❑ A few centres in western Canada with expertise in various aspects of variety development;
- ❑ A high rate of return to producer and public investments in variety development has occurred in the past;
- ❑ Producer check-off funding is potentially available for variety development;
- ❑ Funding model used by WGRF invests in smaller classes of wheat and barley in addition to large acreage classes;
- ❑ Producer funding (through WGRF) of variety development at public institutions provides producer access to germplasm;
- ❑ There is the ability to respond quickly to issues such as low gluten strength;
- ❑ Producer investment promotes producer needs and assists in influencing priorities;
- ❑ Recent public funding of network projects has created partnerships that can address some of the pre-breeding challenges;
- ❑ Many producer-lead groups exist to participate in variety development management;
- ❑ Existing groups and organizations allow for producer participation in co-ordinated research.

Challenges and Weaknesses

Current challenges and weaknesses of the current operating environment that impacts on wheat and barley variety development include:

- ❑ Wheat and barley production can occur with minimal yield drag using farmer saved seed that in turn discourages private sector investment in variety development;
- ❑ There is limited opportunity for value capture by for-profit plant breeding companies, which is due to biological and economic reasons;
- ❑ There is low level of private corporate sector investment in variety development of wheat and barley (\$7.9 million per annum) due in part to the inability to exclude recurring use of a variety;
- ❑ A low probability of a disruptive technology in wheat that results in much higher yields;
- ❑ There is lower level of overall investment in wheat and barley plant breeding when compared to other crop kinds (e.g., canola, corn and soybeans), or to other jurisdictions (e.g., Australia and the EU)²⁴;
- ❑ Moving forward, there is no single obvious producer-led group for coordinating variety development research, creating leadership uncertainty;
- ❑ There is no coordinated system for EPR collections today, making it difficult for breeders to use EPRs as a way to capture value;
- ❑ Royalty-free farm saved seed using existing varieties may limit the willingness of producers to pay for and adopt new varieties if an EPR system was in place on new varieties;
- ❑ The increased use of project-based network funding has made it more difficult to make long term investments in human capital and research facilities.

²³ Annexes A through C provides more detail on the current variety development system for wheat and barley in western Canada.

²⁴ Annex E provides information on producer involvement with other crops kinds, such as canola and pulses.

Opportunities

Opportunities for variety development include:

- ❑ The new *Agricultural Growth Act* enables the implementation of an EPR system to create a royalty revenue stream to plant breeding companies and resulting incentive to invest more funds in variety development;
- ❑ UPOV 91 enables product developers to capture value through use agreements and contracts;
- ❑ Private sector partnering can occur with producers and public sector research entities on variety development initiatives;
- ❑ Heightened levels of producer involvement (investment) in variety development;
- ❑ Tools that allow for easier breeding (e.g., marker assisted selection) are available to use and supported by on-going research;
- ❑ There is a base of experience, expertise, and elite germplasm (in the public sector) for the sector to build from;
- ❑ Research capacity in basic discovery and pre-breeding activities could be strengthened.

Threats

Some threats to wheat and barley variety development in western Canada include:

- ❑ With substantial reliance on project-based funding for pre-breeding research, the sector is vulnerable to non-renewal of these types of projects;
- ❑ A unilateral move by AAFC to exit wheat breeding without a well-funded alternative could leave wheat and barley producers without a viable breeding system;
- ❑ Fewer research dollars provided to universities will reduce the supply of newly trained graduates in genetics and plant breeding;
- ❑ Fewer public funds are available for plant breeding efforts, particularly funds available for basic discovery;
- ❑ Producer Commissions could decide not to collaborate/coordinate on variety development efforts, which will reduce the efficiency of funds collected for variety development;
- ❑ Without strong producer leadership, an EPR based royalty system could result in most royalty revenues accruing to private shareholders rather than as investment in breeding;
- ❑ Continued investment in research and resulting higher value-returns at the producer level for the production of other crops rather than wheat and barley, which could limit future wheat and barley growth;
- ❑ Expansion of corn and soybeans in parts of western Canada replacing wheat and barley.

Critical Issues Requiring Resolution

The above SWOT indicates that from a producer perspective there are some critical issues that require resolution. These include the following:

- ❑ What should producer involvement in variety development look like?
- ❑ How can farmers best lead and influence variety development?
- ❑ What models or approaches can be used to ensure that the appropriate level of pre-breeding research be sustained?
- ❑ Should the system evolve to enable a royalty revenue stream to product developers to reward variety development successes;
- ❑ How should producers capture value based on their involvement and investment – through improved varieties, or through better varieties and a royalty stream to fund more varietal development?
- ❑ What actions, if any, are required to improve the competitiveness of wheat and barley to other crops kinds in western Canada?
- ❑ Are structural changes necessary to improve the future efficiency of producer funded/directed research?

Some options for how producers are involved in variety development can impact on these critical issues.

4.0 Revisiting Producer Involvement in Variety Development

Producers are currently involved in variety development through a transfer of levy funds (of \$7.5 million per year). A broad question that needs consideration is why producers, collectively, are involved in variety development and/or why producers should be involved in variety development.

Why Producer Involvement in Variety Development?

The answer to the question of “*why producers should be involved in variety development*” can be answered in the following ways:

- ❑ Producers are involved through annual levy contributions to variety development, and accordingly, producers want to have some control over how these funds are directed towards variety development initiatives and priorities. Direct involvement rather than third party funding give producers additional control over their investment;
- ❑ One practical argument of why producers should be involved in variety development is to have meaningful influence (also referred to as having significant “voice”) on the direction of variety development, with such influence typically in proportion to the amount of funding provided by producers;
- ❑ Producers need cereals in their crop rotations for agronomic reasons and want wheat and barley to be competitive with other crop kinds and resulting acreage share, and this is a desired outcome for any producer involvement;
- ❑ Producers are beneficiaries of variety development when new varieties improve returns per acre planted, and have necessary self-interest to be involved in providing direction and input on priorities in variety development;
- ❑ The need for producer involvement in wheat breeding also comes from experience in other crops and other countries that have demonstrated that public breeding systems can be vulnerable to policy choices that cut resources and transfer vital germplasm to private breeders. The UK wheat breeding experience provides a salient example of a privatization failure²⁵;
- ❑ Investments in variety development should likely increase (based on comparative analysis with other jurisdictions and crop kinds²⁶) and since producers are paying for variety development through either levies and/or royalties captured by breeders, then producers should position themselves through partnerships to influence the direction and focus of variety development;
- ❑ Public funding is potentially under threat and resulting basic discovery research may diminish; and, accordingly, producers need to have a strategy in place with financial commitment to support continuation of public involvement in variety development;
- ❑ Producers, who best understand their production needs, would like traits built into seeds versus requiring a crop protection product sold by a life sciences company;
- ❑ Producers desire to have varieties that are suited to different agronomic conditions across western Canada;
- ❑ Producer involvement increases the likelihood that selected private sector tools and technologies can be accessed to benefit producers as new varieties are being developed;
- ❑ Producers indicate that they want a competitive seed market in western Canada;
- ❑ The general level of under-investment in wheat and barley variety development by the private sector, which is due to a number of reasons (e.g., self-pollination, high usage of farmer saved seed, complexity of the genome, lack of hybrids or GM varieties); this limits the amount of funds that seed companies can collect on seed sales and in turn used to fund additional variety development;

²⁵ See Annex F which provides information on variety development in the U.K.

²⁶ See Annex B.

- ❑ Producer involvement can increase overall investment and contribute to desired variety development outcomes of (1) wheat and barley being competitive with other crop kinds; (2) traits available that are desired by producers (e.g., harvestability and disease control); (3) providing attributes for specific markets (e.g., necessary quality standards); and (4) higher per acre profits (yields).

The above listing indicates that there are a number of significant reasons why producers should be involved in variety development. Given a strong rationale for being involved, a subsequent consideration is how producers could be involved in wheat and barley variety development.

How Producers Could be Involved in Variety Development

Our review of variety development in some other jurisdictions and crop kinds indicate²⁷ that there are “*many ways how producers could be involved in variety development*”. The ways in how producers could be involved include:

- ❑ Funding of variety development, which to date has been mostly via check-off funding which in turn has been used to fund specific variety development initiatives and projects in mainly public institutions (government and universities);
- ❑ Helping establish direction setting on breeding and targets;
- ❑ Providing leadership, appropriate governance, identifying gaps and influence on priorities;
- ❑ Providing necessary information on marketplace needs;
- ❑ Funding contracted research to third parties based on stated breeding objectives;
- ❑ Having some ownership in a breeding company that has necessary in-house capability;
- ❑ Using a variety of business structures including partnership models to leverage resources and capability;
- ❑ Capturing the value created, which results from producer funding of variety development, through improved wheat and barley varieties; and
- ❑ Capturing the value created, which results from producer funding of variety development, through royalty revenues received by producer based organizations, which can be reinvested in variety development.

The number of ways (how) producers can be involved in variety development, which can be further refined as one considers the various stages of variety development and where producers could be involved.

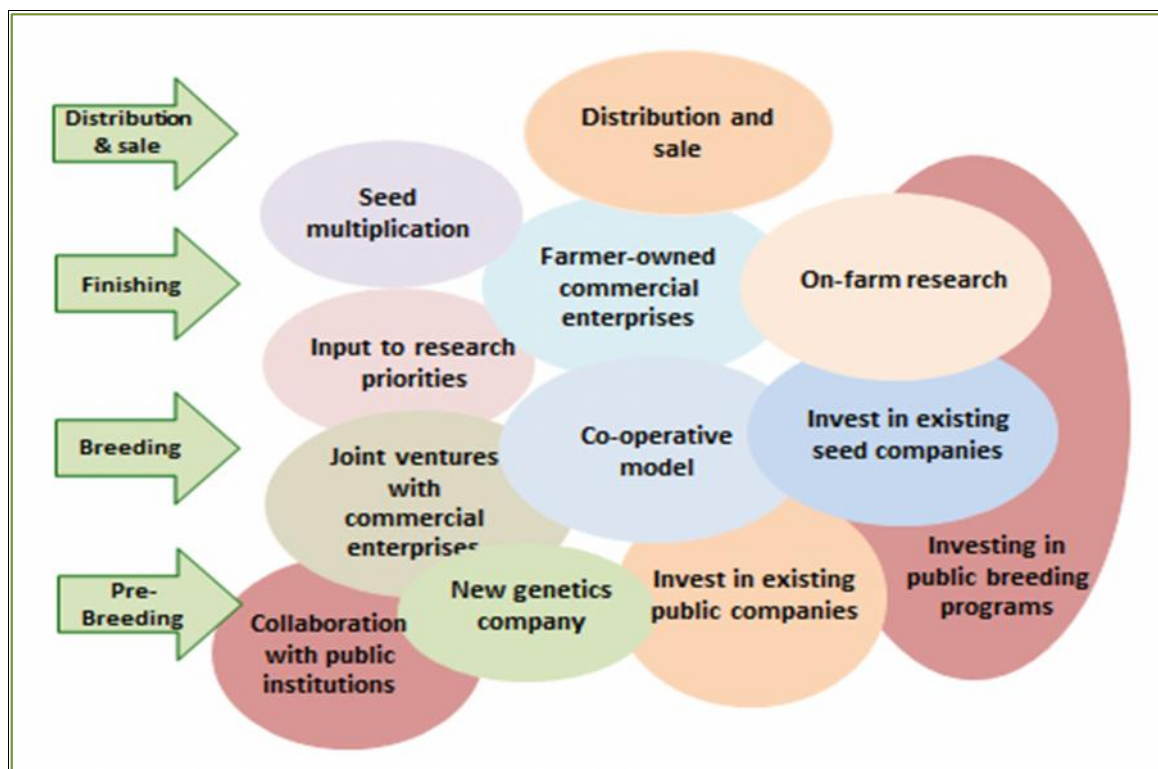
Where Producers Could be Involved In the Variety Development Process

There are a number of stages in variety development and a decision can be made on which areas of the variety development process is most logical for producer funding and involvement. The majority of resources could be directed to variety finishing, or they could be directed towards industry goods, where seed companies are less prone to invest funds. (see Figure 4.1).

Producer involvement in wheat and barley variety development could occur at each major stage in the variety development process is illustrated in Figure 4.1. Involvement could potentially be focused on a number of activities based on collaboration and coordination and/or through partnerships. The type of involvement could range to include approaches where producers have an ownership position in genetics/seed companies. Current producer involvement is also illustrated on the right hand side of Figure 4.1 with producers investing in public breeding programs, from pre-breeding through to finishing of varieties.

²⁷ Please refer to Annexes D through G, where Annex D is a short summary of the following Annexes.

Figure 4.1 Range in Potential Producer Involvement in Variety Development (How and Where)



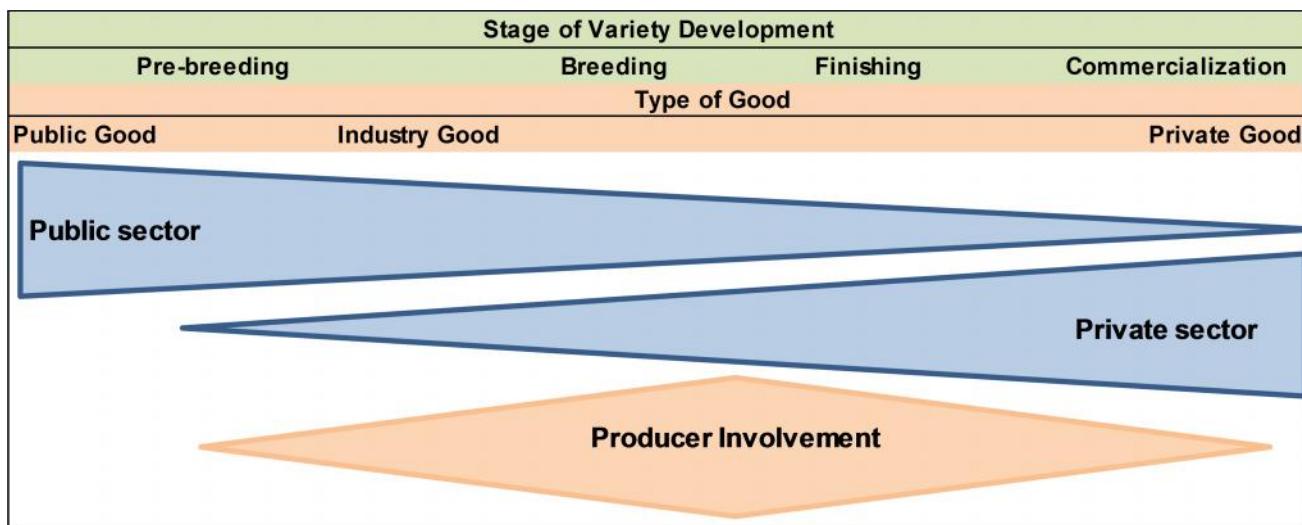
Producer Involvement Shaped by Some Economic Realities

Where producers should be involved in the variety development process can be shaped by some economic realities. Certain stages of variety development are essentially collective industry goods, such as genomics and germplasm development in the pre-breeding stage, and private industry has minimal self-interest in generating these knowledge goods based on discovery with long and uncertain pay-back periods. This has been the primary reason why government, through their own facilities (such as AAFC), and through supporting breeding programs at universities, have provided these industry goods (and potentially public goods).

Continuation of this basic research and discovery in public institutions is potentially at risk with government continuously assessing priorities and associated funding. Producers are beneficiaries of these industry goods, such as improved varietal performance; and accordingly producers have the self-interest to ensure their continuation. Producer involvement in this stage of variety development through partnerships with public institutions is one way to ensure that such discovery research continues, and provides benefits to the wheat and barley industries.

Figure 4.2 illustrates how the public, the private sector and producers could be involved in variety development. The public sector has a larger focus on public goods and industry goods – where value cannot necessarily be captured (by the private sector) due to non-excludable properties such as knowledge. Mechanisms are required to ensure that these industry goods are provided to the benefit of all. The private sector has the predominate focus on private goods – goods where value can be captured and the user pays, such as with a new seed variety²⁸.

²⁸ While current private sector involvement at \$7.9 million is not as large as the public sector at \$40.5 million, the illustration is designed to show area of focus.

Figure 4.2 Public, Private and Producer Focus on Variety Development

Potential producer involvement is shown to focus across the stages of variety development, with more involvement ranging from providing industry goods, which benefit producers, through to private goods and release of new varieties.

Producer partnerships with the public (either government or universities) ensure the knowledge, the basic tools, and the technologies are available for further productivity gains. It is acknowledged that there can be spillovers, with free riding by other countries; however reciprocal arrangements with other jurisdictions or research facilities can be mutually advantageous with these non-excludable industry goods (e.g., knowledge).

Reasons for Looking at Some Options for Producer involvement

A compelling case can be easily made for producer involvement in wheat and barley variety development; however, there are a number of approaches that are possible, as noted above in Figure 4.1. A number of potential options are provided in a following section for consideration and discussion. Some of the reasons for having a number of options for consideration by producers include:

- ❑ Producers would like to understand whether they need to own and operate a seed company, or whether involvement in variety development is through partnerships and leveraging of funds;
- ❑ Producers would like to understand whether they should capture royalties on investments they fund, or whether the payback is through improved varieties for improved on-farm returns;
- ❑ Producers would like to understand whether they should support an EPR system, or whether variety development should primarily be funded through refundable levies;
- ❑ Producers would like to understand whether a more centralized and coordinated approach is required to have an effective approach to maximize the contribution of their provincially based check-off funds that are invested in variety development; and
- ❑ Producers would like to understand if one approach applies to wheat and barley, or whether crop specific approaches may be required (e.g., for barley: feed, food, or malt uses).

5.0 How Producers Can Fund Variety Development

Producers have funded variety development through check-off levies. The recent changes in IPR for product developers does allow for new regulatory provisions where product developers can use EPRs as a means to capture some of the value they create. EPRs can be viewed as a partial substitute for check-off levies, and can have impact how producers are involved in, and fund, variety development. EPRs and levies are not mutually exclusive and can be part of a common approach.

Levy Funded Variety Development Compared to EPR Funded Variety Development

An EPR can be collected at the first point of sale such as when grain is delivered by a farmer to a country elevator or to a processor. In such a case, on the surface an EPR appears to be similar to a check-off levy; however they are quite different.

Some of the notable differences include:

- ❑ An EPR captures value for the product developer (and provide a return to successful product development), while levy funded variety development has a value creation focus (for producers);
- ❑ EPR funds typically flow to product developers (unless a provision exists for a portion of the EPR be used for industry good research), while levy funds flow to provincial Commissions;
- ❑ A levy system allows producers to directly fund variety development activities, while with an EPR system the marketplace determines level of funding for variety development;
- ❑ EPR funds provide direct rewards to developers of successful varieties – a demand pull system – while levies that support variety development need not have a direct connection between a variety’s marketplace success and revenues based on levies collected²⁹;
- ❑ EPRs require information systems that capture acreage planted by seed variety to enable rewarding successful varieties, while a levy based system does not require such information;
- ❑ EPR revenues are a return to successful variety development activities, whereas levies are used to fund a number of activities, ranging from agronomic and variety development to communications and advocacy;
- ❑ Unless established by policy or regulation, the amount of the levy that is used to support variety development is discretionary - a Commission has some discretion on how these producer funds (the levy revenues) are allocated and invested across these competing end uses³⁰;
- ❑ EPRs do not go to producer organizations meaning no resulting producer control, unless a breeding company is owned by producers or it involves a royalty payment based on a licensed technology;
- ❑ Levies can be used to support public research into variety development, while EPRs will be used internally within a breeding company and used within non-federal public institutions³¹;
- ❑ Levies can create pools of funds that can be used by producers for strategic investments, while EPR funds flow back to the product developer; in the private sector EPR funds can be used for any purpose, whether for reinvestment or as dividend payments to shareholders; and in federal institutions the central Treasury receives the EPR funds;
- ❑ Check-off levies collected by Commissions can be refundable³², while EPRs are not;
- ❑ If an EPR is too high, the amount of requested levy refunds could increase (an unintended consequence);

²⁹ As a result, small classes or newly formed programs may be underfunded with only EPR.

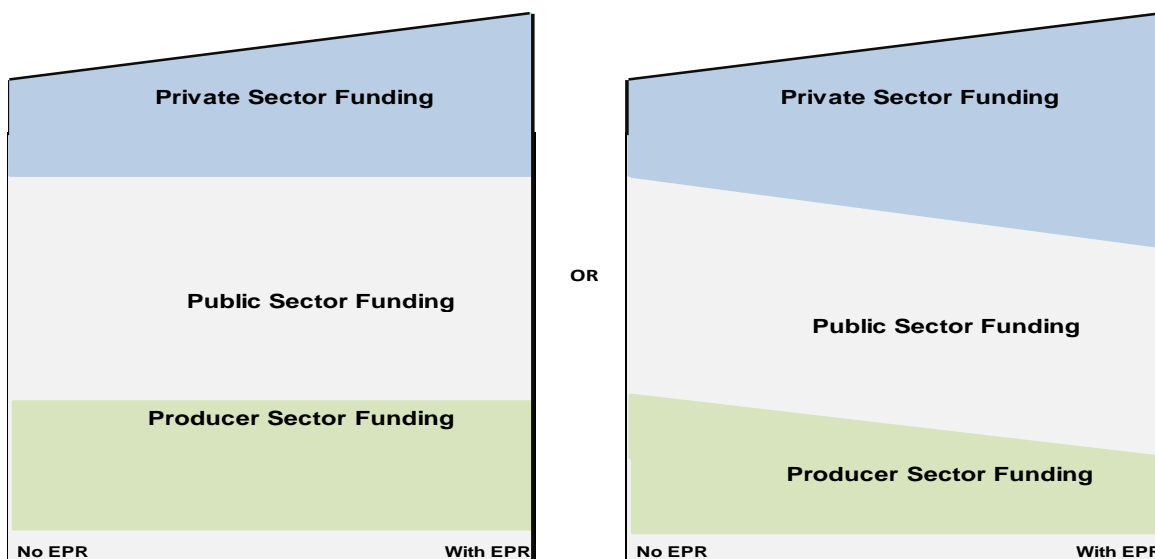
³⁰ A pre-determined amount of the per tonne levy could be dedicated to variety development.

³¹ In the case of federal institutions, EPRs would go to the treasury and not directly to the breeding program.

³² An issue is what portion of the levy amount should be subject to a possible refund.

An EPR system and use of check-off levies offers a policy choice on how variety development is funded. There are advantages and disadvantages to either funding model, and these advantages/disadvantages vary based on whether a producer or a product developer perspective is taken. Figure 5.1 illustrates the shift to an EPR system with more private sector investment, and whether producer funding remains the same (as in the left hand panel). Producers may decide to not decrease current funding levels when an EPR system is in place to ensure an increase overall investment dollars, and to continue with producer influence. The right hand panel illustrates fewer levy-based producer funds when there is a larger private sector investment.

Figure 5.1 Variety Development Funding Potential With and Without an EPR System



The major advantages and disadvantages from a producer perspective are summarized below. One major advantage of a levy based system is that it allows for some producer control on the direction of variety development, while with an EPR system (and no levies) the level of producer influence can be diminished (unless producers also own a plant breeding company).

	Producer Advantages	Producer Disadvantages
Check-off levies	Producer control and influence; Ability to make strategic investments.	Potential insufficient investment; Levy funds can be allocated to competing uses; Levies are refundable.
EPR	Creates an additional incentive for private sector investment; Provides a prospective return to public breeding programs and producer groups that own varieties.	Less producer control and influence; Amount of producer levy dollars directed to variety development could decrease; Information and germplasm sharing may decrease and affect potential variety improvement; No requirement for EPR's to be invested back into breeding; Small classes underfunded compared to current system; Potentially lower investments in germplasm.

A potential disadvantage of an EPR system is that producer support for check-off levies supporting variety development may decrease, resulting in lower funding levels for variety development by provincial Commissions. This may compromise current leveraged producer funding of pre-breeding

and discovery research at public institutions. A consequence of having an EPR system is that there may be less spillover – sharing of germplasm and information between breeders – which may limit potential varietal improvement³³, such as improved disease resistance or drought tolerance. Another disadvantage to producers with EPRs is that smaller classes and small breeding programs will likely be underfunded compared to the current levy based funding model.

As noted in the (following) table there are few private sector developer advantages with a check-off levy system; however, a levy based system can be used to incent breeders through a pay for performance system, where levy funds are directed to those varieties with commercial success. From a private sector product developer point of view, an EPR system is preferred over a levy based system, since by its design an EPR system ties together commercial success and marketplace rewards and provides an incentive structure for investing into new varieties.

	Developer Advantages	Developer Disadvantages
Check-off levies	Potential producer funding for variety development	Funding of investments based on contracts and agreements.
EPR	Direct rewards for marketplace success based on producer use and re-use of specific varieties and technologies.	IF EPR rate too high, adoption of new varieties could be low; Potentially lower level of check-off funds supporting variety development, particularly pre-breeding.

With EPRs, the varieties that have the market share, as chosen by the producers, earn royalties, and any breeder whether public, private, or one that is also a recipient of Commission levies, can compete for these royalties.

The above EPR discussion is primarily from a private sector product developer perspective. In the public sector, a few nuances should be noted. First, at federal institutions EPR funds are not received by the breeding program, but rather are received by the central Treasury. The breeding program would only benefit if there was an agreement to have program funding increased by the amount of the collected royalty payment. As well, the focus of public breeders, particularly those in the university system that are rewarded through their teaching, research, and publications, may be less influenced by commercial success and breeding efforts may remain focused on smaller breeding programs.

EPR systems have been used that apply only to newly released varieties as in Australia, and a uniform EPR rate that applies to all varieties planted such as in France, for example. With newly released varieties an EPR system can be established where a uniform EPR rate, or one where product developers can establish unique EPR rates, for each newly released variety; which we refer to as a “**restricted EPR**”.³⁴ Product developers can have discretion as to how long an EPR rate applies; however, since royalties are collected on FSS, it is likely the case that the EPR rate will remain for a number of years.

An EPR system can have a uniform rate on all varieties planted, which we refer to as a “**universal EPR**”.³⁵ An advantage of a universal EPR is that a royalty stream is available to product developers

³³ These spillover issues were identified in the Australian system in Russell Thompson, “*The Yield of Variety Protection*” Amer. J. Agr. Econ. 97(3): 762-785 (2014)

³⁴ Collecting an EPR on newly released varieties requires a regulation change to the applicable Act.

³⁵ Having an EPR apply to all seed planted, including varieties released prior to the change in the PBR Act, requires an amendment to the Act, and not a more simple regulatory change as with an EPR on newly released varieties.

once the system is in place, while with a restricted EPR system, a considerable time lag exists before an EPR can become a significant revenue source for plant breeders. A potential disadvantage of having a uniform EPR rate applied to all varieties planted is that producers may feel that they are paying twice – once through the levy that supported public research into development of a pre-EPR variety and then again through the EPR on the same variety³⁶.

In the next section of this report, the implications of proceeding with an EPR system versus continuing with levies only is discussed for various potential producer involvement models.

Costs and Returns for a Producer Owned Cereal Breeding Company

One potential option is for producers to have ownership in a plant breeding company, which could be acquired and funded through check-off levies. At issue is whether owning a cereal breeding company is in the financial best interest of producers.

The discussion on spillovers with industry goods and no IPR and funding of variety development with a levy based system highlights the basic economics and the business case for operating a for-profit wheat and barley breeding company. Data assembled on public expenditures in western Canada are \$40.5 million, which increases to \$48 million when producer levy contributions are considered, and can be viewed as annual expenditures by taxpayers and producers on a prairie wide wheat and barley breeding company³⁷. These operating costs may not include up-front capital costs, or amortization of the original investment in land, buildings and equipment.

There are currently 19 public wheat and barley plant breeders operating in western Canada; this suggests an ongoing annual investment of at least \$2 million per plant breeder. The on-going cost structure of a plant breeding company has been suggested to be \$1.5 million per plant breeder, which excludes necessary up-front capital costs (e.g., for labs, equipment, etc.). This would suggest an ongoing annual investment of at least \$29 million (based on \$1.5 million per breeder). Up-front capital costs can range from \$10 to \$20 million or more to build necessary infrastructure for a plant breeding company³⁸, which if amortized over 20 years can account for \$1 million in annual costs.

The revenue side can be significantly less than operating costs, based on the fact that self-pollinating seed can be reused without any yield drag when a form of IPR is not in effect. Anecdotal information has been provided that public institutions receive approximately \$5 million per annum in royalty revenues, and this combined with current producer levy contributions of \$7.5 million suggest a revenue flow of \$12.5 million. In such a situation, the annual operating deficit is likely in the range of \$28 to \$35 million per year. This is only sustainable if there is significantly more value capture and/or with a significant and continual public sector investment.

With a presumed royalty structure captured by one prairie wide seed company equal to \$4.50/acre based on certified seed sales when 20% of the acreage is planted to certified seed, then on 5.8 million acres using certified seed, the revenue flow is \$26.1 million for one prairie wide wheat and barley breeding company. These revenues are less than current expenditures of at least \$40 million. This aggregate prairie wide view clearly indicates that **there is no business case for**

³⁶ As noted by a number of Working Group members, producer support for an EPR system may be predicated on having an EPR system apply only to varieties released after EPRs can be legally collected.

³⁷ This is before considering the reported \$7.9 million of private sector expenditures.

³⁸ In 2009 Bayer CropScience invested \$15 million to expand the Canola Research and Breeding Centre in Saskatoon (Business Agronomist Magazine, "What's in the Works for Wheat Breeding", Dec. 9, 2014) and Bayer invested \$17 million (in US funds) for their Breeding and Trait Development Station in Nebraska (Lincoln Star Journal, "Bayer CropScience, UNL extend collaboration to soybean germplasm" May 13, 2015).

variety development without any form of effective IPR. A prairie wide plant breeding company would need to be subsidized by producer levy contributions and/or taxpayer contributions, unless use of certified seed increases to be a much larger share of total acreage planted each year.

The above analysis changes once an effective form of IPR is in place, such as EPRs and/or licenses/use agreements. Doing so allows for a much larger revenue flow. On a 35 million tonne wheat and barley crop, a \$1.50/tonne EPR rate across all grain sold into commercial channels can generate \$52.5 million in annual revenues, once all wheat and barley planted are based on varieties planted after EPR introduction. In this situation, projected revenues are comparable to operating costs.

This financial position does not occur in year one, unless the EPR system is applied to all seed planted (universal EPR) and not just to newly released varieties (restricted EPR). The Australian experience indicates that many years are required once restricted EPRs are introduced before a meaningful revenue flow occurs, since the EPR revenues depend on introduction and adoption of varieties released after the introduction of EPRs. To bridge the gap during a transition period, producer levies and taxpayer support are required for at least a decade.

A take-away is that any **direct ownership by producers in a cereals breeding company should likely be based on the knowledge that an effective form of IPR is in place** to allow for a future revenue flow that can sustain cereal breeding operations. This principle is also used by private sector breeding companies, namely that IPR allows for necessary value capture.

The caveat for producers is that direct ownership can still occur when an effective form of IPR is not in place, such as no EPRs, if there is guarantee that a certain level of check-off levy funds will continue to be available for funding the breeding company.

6.0 Potential Models for Producer Involvement in Variety Development

Five different models are used to illustrate the potentially different approaches regarding how producers could be involved in variety development, and what activities they focus on. The selection of these five potential models was guided by the insights and lessons learned in our review of several existing approaches³⁹ where producers are involved, and by additional input from the Working Group. These models were chosen to cover a range of how producers could be involved in variety development. This range of potential approaches should facilitate discussion within the producer community on the approach to producer involvement that is likely best suited for wheat and barley producers.

These potential models highlighted in this section are:

- Model A - Current Approach with More Coordination and Information Sharing;
- Model B - Eight Provincial Commissions involved in Variety Development Research Programs;
- Model C - One Non-Profit Producer Body: Wheat and Barley West;
- Model D - Australia North: Separate Partnerships for Pre-Breeding and Breeding/Finishing;
- Model E - Producer Ownership in a Cereal Breeding Company.

The discussion of all models begins with no EPR system in place, with the exception being Model D (Australia North).

Design Elements

These potential models were developed using a common set of design elements, or features. These elements that can characterize potential models and the associated grouping under headings are noted below:

<p>Governance</p> <ol style="list-style-type: none"> 1. Board appointment 2. Advisory 3. Legal entity <p>Assets and Infrastructure Support</p> <ol style="list-style-type: none"> 4. Assets used 5. Management and human capital 6. Acquisition of existing organizations <p>Operations</p> <ol style="list-style-type: none"> 7. Variety development focus 8. Partnerships 9. Training of plant breeders/geneticists 	<p>Coordination</p> <ol style="list-style-type: none"> 10. Coordination between producer organizations 11. Centralized coordinating body 12. Role of Commissions <p>Policy/Regulatory</p> <ol style="list-style-type: none"> 13. End Point Royalty 14. EPR and industry goods 15. EPR and farmer saved seed 16. Flow of check-off funds <p>Funding of Operations</p> <ol style="list-style-type: none"> 17. Start-up funding 18. Funding on-going operations 19. Royalty stream
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Annex H provides a description for each of these elements and the potential approaches that could be used for any of these elements. Annex I provides an initial mapping of a number of models that were initially considered and served as the basis for the above five potential models described in the following sections.

³⁹ See Annexes D through G on approaches for variety development used in selected other jurisdictions and crops.

Necessary Conditions and Criteria for Producer Involvement Models

Some necessary conditions for producer involvement in variety development were noted by Working Group members⁴⁰. These necessary conditions are that the approach:

- must be saleable to producers, affordable and workable within western Canada;
- provides traits desired by producers (e.g., disease control) and attributes (e.g., quality parameters) desired in specific markets;
- allows for a continuation of the current check-off levy system;
- allows for producer leadership and influence; and
- is consistent with the need for effective governance and necessary producer control.

The Working Group also identified a number of criteria that should be used to further guide development of potential model options and also used to provide an assessment of the models once they were fully developed. The following list is a combination of the necessary conditions and the criteria agreed to by the Working Group, and are grouped under five general headings.

1. Allows for a Robust Variety Development Sector

- Provides access to necessary technologies and germplasm;
- Models must be financially sustainable⁴¹, secure, and robust;
- Allows for flexible approaches;
- Can apply to smaller grain classes and is scalable;
- Minimizes risk of losing the benefit of past investments;
- Minimizes risk of the public sector withdrawal from certain stages of variety development;
- Promotes knowledge sharing/ limited duplication of effort;
- Does not hinder investment by others;
- Allows for a mix of private, producer and public breeding;

2. Allows for Producer Leadership and Influence

- Provides for direction/influence by producers;
- Enables on-going producer engagement and voice;
- Promotes producer control;
- Utilizes effective governance model(s);
- Allows for effective partnerships;

3. Ease of Transition to Proposed Model

- Leverages existing capacity;
- Is realistic and easy to implement for all participants;
- Is saleable to producers;
- Approach is affordable for producers;
- Meets federal and provincial government ambitions;

4. Provides Incentive for Investment

- Captures value/royalties for reinvestment – and potential self-funding over time;
- Attracts investments;
- Promotes a competitive seed market;

5. Leads to Desired Outcomes

- Enhances wheat and barley competitiveness with other crop kinds;
- Can provide traits desired by producers (e.g., harvestability and disease control);
- Can provide attributes for specific markets (e.g., necessary quality standards);
- Results in higher per acre profits (yields).

⁴⁰ At the July 27, 2015 workshop.

⁴¹ Sustainable includes concepts such as (1) continuation of necessary research, (2) provides benefits to farmers, and (3) some cost recovery.

Model A – Current Approach with More Coordination and Information Sharing

A potential option for consideration is to use the current organizations and structures and have additional processes in place that result in more coordination and information sharing between the provincial Commissions, the producer organizations, value chain bodies, and the WGRF.

The **main features** of this potential approach (with no EPR system) include:

- ❑ All variety development investments by producers are through contract research;
- ❑ No new institutions are created;
- ❑ Taxpayers and producers continue to fund variety development at institutions such as AAFC, U of S, U of M, U of A, and FCDC;
- ❑ A third party has a prominent role in coordinating variety development projects (such as the WGRF does now), while each Commission has the flexibility to enter into and fund variety development initiatives that are priorities for their producers;
- ❑ Any organization can enter into P3 and P4 partnerships, and can include the private sector, and government and universities in the public sector;
- ❑ An EPR system is not introduced, resulting in check-off funds being the only direct source of producer funding of variety development;
- ❑ Variety development can be allocated a portion of the \$25 million in check-off levies currently received by WGRF and provincial Commissions;
- ❑ A portion of check-off funds used for variety development flow to the WGRF for funding discovery research, with remaining funds allocated by provincial Commissions – although they can pool funds with other organizations/Commissions/WGRF for any leveraging;
- ❑ Universities are a recipient of funds, based on projects and/or long term partnerships which allows for training of new plant breeders;
- ❑ The WGRF and each provincial Commission can receive royalty revenues based on technologies and varieties that are commercialized based on their funding;
- ❑ Each of the Commissions participate in wheat or barley research coordinating bodies, which are organized by the Wheat and Barley Committees within the WGRF structure;
- ❑ With such coordination across the western provinces, the WGRF (as a central body) primarily coordinates discovery type research, while provincial Commissions primarily ensure that local and applicable smaller class variety development needs are addressed; and,
- ❑ The WGRF has a role in this model, even though its current check-off funding through the transitional Western Canadian Deduction on wheat and barley will no longer apply in 2017.

This model of more coordination and collaboration is summarized below (in a text box) based on a selected approach by each design elements.⁴²

A **rationale** for this potential model for producer involvement in variety development is that new institutions do not need to be created. The approach builds on the current level of collaboration, and through more coordination and information sharing; investments into variety development will flow to priority areas, with minimal duplication and/or redundancy. As well, producers at a provincial level can direct funds into areas where the potential benefit is seen to the greatest.

This approach does not require investments in new infrastructure, with an easy transition from current structures and approaches, and results in a nimble approach that has flexibility for necessary change. An additional supporting rationale for this approach is that producer support of variety development at public institutions continues, and producers through partnerships can encourage investments by others.

⁴² In Annex I, the approach by design elements is highlighted in yellow in the applicable tables.

Model Option A – Approach by Design Element**Governance**

- Board appointment - is by producers;
- Advisory body - has producer, public and private sector representation;
- Legal entity - is a non-profit organization;

Assets and Infrastructure Support

- Assets used - is by funding of research contracted out to third parties;
- Management and human capital - is through use of staff and resources provided by WGRF;
- Acquisition of existing organizations - no organizations are acquired;

Operations

- Variety development focus - is on all stages of finishing, breeding, and pre-breeding;
- Partnerships - are with the private sector, universities, and government;
- Training of plant breeders/geneticists - is provided by funding universities;

Coordination

- Coordination between producer organizations - is through a centralized body (e.g.. the WGRF) for decision making and funding of variety development including discovery research, and uses provincial Commissions for local/small class requirements;
- Centralized coordinating body - is the existing organization of the WGRF through the Wheat and Barley Committees;
- Role of Commissions - is to participate in research coordinating body and to fund and coordinate research on behalf of levy payers;

Policy/Regulatory

- End Point Royalty - is not used (as part of the base case);
- Flow of check-off funds - funds remain with the provincial body, and flows to a central body on a case by case basis;

Funding of Operations

- Funding on-going operations - is through use check-off levies and royalty payments;
- Royalty stream - based on licensing of technology and royalties with certified seed sales.

This approach satisfies the necessary conditions articulated by the working group (refer back two pages). In terms of the assessment criteria, as shown in the following table this approach (with no EPR) scores an “A” on (2) allows for producer leadership and influence⁴³, and (3) ease of transition to proposed model. For (1) allows for a robust variety development sector, scores an “B” since the criterion of minimizing risk of public sector withdrawal is viewed as not being fully met.

Assessment Group Heading	No EPR	Restricted EPR	Universal EPR
1 Robust Variety Development Sector	B	B +	A -
2 Allows for Producer Leadership & Influence	A	A	A
3 Ease of Transition to Proposed Model	A	B	B
4 Provides Incentive for Investment	C	A -	A
5 Leads to Desired Outcomes	B -	A -	A -

Note: Each assessment group heading is scored between A and C based on criteria listed on page 22.

⁴³ This “A” scoring is based on meeting the various criterion listed under the general heading on page 22.

The proposed model does not score as high on (4) provides an incentive for investment with a “C” and has a “B -” for (5) leads to desired outcomes arising from the model not enabling wheat and barley being competitive with other crop kinds. The lower scores in these two assessment group headings is mainly a result of not having an EPR system that enables product developers to capture the value created when their product is re-used in subsequent years as FSS.

The **risks** with this option (with no EPR) are that sufficient investment may not be attracted into wheat and barley variety development. This can result in these crops not being competitive with other crop kinds in certain growing regions. Another risk is that if public sector investment decreases, there may be insufficient overall investment in cereal variety development. Producers are not positioned well with this option if AAFC decides to devote fewer resources, such as not finishing varieties.

Introducing an **EPR system** can change the outcome and scoring of this potential model. An EPR system will create incentives for additional investments, particularly from the private sector, which will result in a (4) provides incentive for investment being scored an “A – or A” versus a “C” (as reported in the two right hand columns in the above table). An “A” scoring is provided for a universal EPR based on this EPR system being able to generate significant funds in the first year that a legislative change allows for collecting an EPR on all varieties planted. Using a \$1.50/tonne EPR generates \$52.5 million on a 35 million tonne wheat and barley crop in year one. This provides significant incentive for breeding companies to invest in new varieties. In contrast, a restricted EPR will take many years to capture royalties since royalty collection depends on introduction and adoption of new varieties. For this reason, the restricted EPR is scored slightly lower on (4) provides incentive for investment. The (1) robust variety development sector scores higher with a universal EPR providing more financial stability in a much shorter period of time.

With an EPR system, producers can continue with leadership and have some control on the direction of variety development if sufficient levy funds are still collected and directed towards variety development initiatives and/or partnerships.

A **risk** to producers with an EPR system is the potential loss in producer influence and control, with such loss proportional to the reduction in producer funding through check-off funds. The risk is larger with a universal EPR system, since the amount of check-off funds directed by producer Commission to variety development could be more likely to decrease with a universal EPR system. However, it should be noted that under current WGRF agreements 50% of AAFC wheat and barley royalties (including EPR’s in the future) flow to WGRF for reinvestment, and if continued allows for some producer influence⁴⁴. With private sector involvement and minimal producer involvement, another risk is that public sector germplasm may go to the private sector, which further reduces producer influence and development of varieties with traits desired by producers. A universal EPR also provides significant incumbent advantage since private sector breeding companies with some current market share will have an advantage to newly formed entities that do not have varieties being seeded⁴⁵.

Another risk to producers with an EPR system is that plant breeders may be less willing to share germplasm and information, which is prevalent between publically funded breeders⁴⁶. With less sharing, this can limit the yield potential on newly released varieties, which can disadvantage producers. This risk can be minimized through a combination of incentives, licenses, funding arrangements, and agreements⁴⁷.

⁴⁴ This source of producer funds could potentially offset any reductions in levies.

⁴⁵ This can potentially be offset by breeding companies acquiring the rights of public varieties.

⁴⁶ This risk applies to all five options.

⁴⁷ See also Galushko, Gray, and Oikonomou, “*Operating in an Intellectual Property World: Knowledge Sharing among Plant Breeders in Canada*”, Canadian Journal of Agricultural Economics, 60 (2012), pp 205-316

Model B – Eight Provincial Commissions Involved in Variety Development Research Programs

After July 31, 2017, the WGRF will not have direct access to check-off levies, and all check-off authority will be transferred to the provincial Commissions. In this environment, having provincially based wheat and barley Commissions fund variety development initiatives can be an alternative to the approach suggested in Model A above. This approach with each Commission directly funding variety development can also be viewed as a continuation of the current approach used in western Canada. Alternatively, this model can be viewed as having eight Saskatchewan Pulse Growers type of operations focused on wheat and barley across the prairies.

The **main features** of this model based on an EPR system not being introduced includes:

- ❑ Each of the provincial wheat and barley organizations separately fund and coordinate variety development via contract research;
- ❑ Each of the organizations remains structured as a non-profit corporation and invests in pre-breeding, breeding, and finishing conducted by governments and universities;
- ❑ The provincial Commissions can be independent of each other, if they choose to do so;
- ❑ Each Commission would enter into partnerships with government, universities and the private sector, as applicable;
- ❑ The role of the WGRF would likely be reduced, particularly after 2017;
- ❑ Producers are elected or appointed by the provincial minister of Agriculture for a fixed term;
- ❑ Funding of universities allows for training of new plant breeders;
- ❑ A guaranteed portion of the provincial check-off levy is the major source of funding;
- ❑ Ongoing operations are funded by levies and through royalties and licenses;
- ❑ The public plant breeding institutions pay a share of royalties to each provincial organization providing the funding; and,
- ❑ Royalties and licensing revenues are re-invested into wheat and barley variety development.

This model is summarized in the text box (on the following page) by noting the approach used for each design element. A **rationale** for considering this model is that it provides for provincial autonomy and allows producers to direct funds to local variety development needs and classes of grain grown in their region, as well as for prairie-wide initiatives. This model option also allows for significant producer input by province and by crop kind.

This Commission-centric model does meet the necessary requirements identified by the working group. Using the assessment criteria, this model scores somewhat similar to Model A, for (2) allows for producer leadership and influence, (3) ease of transition to proposed model, and (4) provides economic incentives for breeding as noted in the following table.

Assessment Group Heading	No EPR	Restricted EPR	Universal EPR
1 Robust Variety Development Sector	B -	B	B +
2 Allows for Producer Leadership & Influence	A	A	A
3 Ease of Transition to Proposed Model	A	B	B
4 Provides Incentive for Investment	C	A -	A
5 Leads to Desired Outcomes	B --	A --	A --

When compared to Option A, this model's potential weakness is the possible duplication and redundancies that could occur. At a minimum, there will be some duplication of administration and other activities in each of the Commissions that could be centralized at lower overall costs. These saved funds could be directed to variety development projects. Having a cost effective variety development system is not part of the assessment criteria; however, this factor plus the potential duplication has Model B ranked slightly lower than Model A.

Model Option B – Approach by Design Element

Governance

- Board appointment - is by producer elections;
- Advisory body - is composed of only producers;
- Legal entity - is a non-profit organization;

Assets and Infrastructure Support

- Assets used - is by funding of research contracted out to third parties;
- Management and human capital - is through use of internal staff;
- Acquisition of existing organizations - no organizations are acquired;

Operations

- Variety development focus - is on all stages of finishing, breeding, and pre-breeding;
- Partnerships - are with the private sector, universities, and government;
- Training of plant breeders/geneticists - is provided by funding universities;

Coordination

- Coordination between producer organizations - is through a centralized body or network that enables collaboration among provincial Commissions;
- Centralized coordinating body - would be the network of Commissions;
- Role of Commissions - is to fund and coordinate research;

Policy/Regulatory

- End Point Royalty - is not used (as part of the base case);
- Flow of check-off funds - funds remaining with a the provincial body, and can flow to a central body on a case by case basis;

Funding of Operations

- Funding on-going operations - is through use check-off levies and royalty payments;
- Royalty stream - is based on licensing of technology and royalties with certified seed sales.

The **risks** with Model B are similar to Model A above. These risks involve the overall amount of investments funds that are used to sustain and increase variety development efforts. These risks can be addressed depending on whether a restricted or universal EPR system is adopted. Another risk with this model is the potentially much higher cost of overall administration, the potential for duplication, and potentially fewer strategic investments in wheat and barley variety development. Another risk is the potential fragmentation and resulting effectiveness of producer voice through eight organizations, versus one centralized producer voice. Some of these risks can be minimized through coordination and collaboration mechanisms.

With a restricted **EPR** system in place, this producer involvement model has higher scores on (1) robust variety development sector, (4) provides incentive for investment, and (5) leads to desired outcomes. Retaining high scores on (2) allows for producer influence and control very much depends on a continuation of check-off levies being used to invest in variety development initiatives. If this did not occur, then producer leadership, influence and control diminish. With a universal EPR system, if check-off levies devoted to variety development significantly decrease, then so will producer leadership and influence.

With an EPR system, the **risk** (to producers) shifts to one of whether producer leadership and influence is compromised. With eight Commissions that collected check-off levies and directly fund variety development, producer voice may be fragmented when decisions are made to scale back on levy funded variety development, with the consequence of less producer leadership and influence.

Model C – One Non-Profit Producer Body: Wheat and Barley West

This model is an enhancement of the status quo (or Option A above) and centralizes activities in Option B through a formal structure between each of the Commissions. In this option (Model C), producers through their Commissions establish a non-profit joint venture arrangement, Wheat and Barley West (WBW). It has a Board of Directors appointed by the producer Commissions, and is a separate organization and has its own senior staff⁴⁸. The characteristics and structure of the potential model for producer involvement is summarized by design element in the following text box.

Model Option C – Approach by Design Element

Governance

- Board appointment - is by producers;
- Advisory body - is composed of only producers, but could include the public and private sector representatives;
- Legal entity - is a non-profit organization which can be a joint venture between Commissions;

Assets and Infrastructure Support

- Assets used - is by funding of research contracted out to third parties;
- Management and human capital - is through hiring of necessary internal staff; however this could be provided by a third party (e.g., WGRF);
- Acquisition of existing organizations - no organizations are acquired;

Operations

- Variety development focus - is on all stages of finishing, breeding, and pre-breeding;
- Partnerships are with the private sector, universities, and government;
- Training of plant breeders/geneticists - is provided by funding universities;

Coordination

- Coordination between producer organizations - is through a centralized body (WBW) for decision making and funding of variety development;
- Centralized coordinating body - is the new organization WBW;
- Role of Commissions - is to forward check-off funds ear-marked for variety development to WBW and to have representation in the research coordinating body (of WBW);

Policy/Regulatory

- End Point Royalty - is not used (as part of the base case);
- Flow of check-off funds - funds flows to the central body (WBW);

Funding of Operations

- Start-up funding - is through use of check-off levies;
- Funding on-going operations - is through use check-off levies and royalty payments;
- Royalty stream - is based on licensing of technology and royalties with certified seed sales.

The **main features** when producer funding is only through levies and an EPR system is not in place include:

- A formal structure is created (WBW), likely through a joint venture arrangement between each of the Commissions;
- Variety development funded by producers via WBW occurs through contracted out research;

⁴⁸ An option could be for WGRF to administer the functions of WBW.

- ❑ WBW enters into partnerships with public sector institutions and the private sector;
- ❑ WBW invests in the public sector (AAFC, universities, AARD) in the pre-breeding, breeding, and finishing spaces, as deemed appropriate;
- ❑ This model is flexible and could allow WBW to take over the finishing of AAFC varieties if required;
- ❑ The private sector would continue to run its own operations in variety development; and would continue to be the sole participant in commercialization;
- ❑ Providing funding to universities would ensure that future plant breeders are trained;
- ❑ Checkoff funds provide the necessary start-up money, with provincial Commissions forwarding the variety development portion of the check-off levy to the central organization;
- ❑ On-going operations are funded by a combination of levy funds and royalties on licensed technologies; and,
- ❑ In return for investment by the WBW, public institutions pay a share of royalties to WBW, which are re-invested into wheat and barley variety development.

This option creates a business model that enables producer involvement into variety development in a centralized and coordinated manner. Supporting *rationale* for this model includes the efficiencies and avoidance of redundancies and duplication that can be achieved through a more formalized approach, and associated scale economies. A centralized approach also allows for larger one-time investments in specific priority areas. A potential weakness of the prior two model options is the possibility of duplication and not being able to achieve efficiencies when each Commission is involved in identifying research priorities and then contracting out necessary variety development research⁴⁹.

Model C also meets all of the necessary conditions established by the Working Group and offers more stability than the prior two options.

A scoring of this model using the assessment criteria group headings is provided on the following Table, (see first column for when there is no EPR system). As with the prior models, this option scores well on (2) allowing for producer leadership and influence, and scores lower (to a “B”) on (3) ease of transition to the proposed model. The scoring on (1) allows for a robust variety development sector increases to a “A –” compared to prior models based on being a more formal organization and resulting expected efficiency gains. The scoring on (5) leads to desired outcomes is a “B” a small increase relative to Model options A and B, due to the centralization of activities through WBW and a faster realization of desired outcomes.

Assessment Group Heading	No EPR	Restricted EPR	Universal EPR
1 Robust Variety Development Sector	A -	A	A +
2 Allows for Producer Leadership & Influence	A	A	A
3 Ease of Transition to Proposed Model	A	B	B
4 Provides Incentive for Investment	C	A -	A
5 Leads to Desired Outcomes	B	A	A

Without an EPR system, this option does not score an “A” on the last two assessment group headings based on the *risk* and overall ability to attract sufficient investments and a system where the potential of being competitive with other crop kinds is less likely to be achieved when contrasted with a system that includes EPRs. Another risk of this Model C is that with WBW there could be some governance issues where certain groups of classes of wheat and barley could be more

⁴⁹ In model A the Wheat and Barley Committees allow for a centralized approach however it does not exclude the possibility of Commissions making independent funding decisions.

dominant in WBW, which could lead to producer dissention and possibly some operational difficulties.

A **rational** for this model with an EPR system in place is that more investment can occur in wheat and barley variety development through the use of EPR system. This allows private sector seed companies to capture the value of their technologies and varieties. If desired, a portion of the EPR as well as a portion of levy funds can be used to fund industry good research. And, at the same time, producers are involved by directing a portion of check-off funds, in a coordinated and centralized manner into variety development projects which are considered important to producers.

With a **restricted EPR** system (an EPR is collected on only varieties released after necessary regulatory changes are in place) the scoring by assessment group headings increases as noted in the above table. Scoring increases in the areas of (1) a robust variety development sector due to the prospective mix of private, public and producer investments. Scoring on (4) provides incentive for investment and on (5) leads to desired outcomes also increases with an EPR. Scoring is lower on (3) ease of transition based on potential concerns over an EPR system by some stakeholders.

With a **universal EPR**, the scoring on (4) provides incentive for investment is higher due to the EPR system providing immediate funding to incumbents and the resulting investments that can be made in year one of having this EPR system. The score on (3) ease of transition to the proposed model is similar with either a restricted EPR or a universal EPR system. The former takes a number of years for achieving significant funds and the latter can be viewed as a double payment on older varieties (once through earlier producer investment through levy funds and then through an EPR rate on all marketings).

Introducing an EPR system can positively impact on investment attraction and achievement of desired outcomes. As with other options, achieving the desired outcomes is heavily dependent on producers continuing to support check-off levies that are used (or ear-marked) for variety development. This enables producers to have influence and have variety development on genetics that deliver on traits desired by producers.

The additional **risk** with this model and an EPR system in place is that lower producer investments can lead to less producer leadership and influence on the direction of variety development for wheat and barley. There can be a trade-off between producer influence/control and having economic incentives for private sector breeding. This trade-off is more accentuated when producer funding through levies diminishes. Another risk, which can be mitigated, is the potential for producer Commissions to possibly reduce the amount of levy funds allocated to variety development.

In some assessment areas, such as (1) robust variety development sector and (2) leads to desired outcomes, Model C scores higher than with either Model A or B due to the creation of a formal structure and resulting centralization of producer voice within the newly created WBW.

Model D – Australia North: Separate Partnerships for Pre-Breeding and Breeding/Finishing

Australia has a much different approach to variety development than in Canada, as highlighted in Annex F. The main features of the Australian approach include:

- (1) producer involvement through the Grain Research and Development Corporation (GRDC), which is a partnership between producers and government;
- (2) the primary GRDC focus is on pre-breeding activities and generation of industry goods;
- (3) breeding companies are established through P4 partnerships that included GRDC as a partner, with the GRDC fostering such partnerships through up-front financial contributions;
- (4) the variety development focus of the P4 breeding companies is on plant breeding, finishing and commercialization
- (5) check-off levies (of 1% on 25 field crops) and government contributions (co-funded at 0.5%) fund the GRDC and its variety development programs;
- (6) in 2014, the GRDC received \$200 million in revenues (\$120 million in levies, \$60 million in national government contributions and \$20 million in royalties and interest revenues);
- (7) an EPR system on varieties released after the introduction of EPRs (a restricted EPR) provides a royalty stream back to plant breeders, with Australia now having \$50 million per annum in wheat royalties due to EPR.

The Australian approach results in producer involvement through both (1) the GRDC and (2) an ownership position in for-profit breeding companies (via their stake in the GRDC).

This Australian approach is one business model for consideration in western Canada, where significant producer levies matched by government contributions and has an EPR system, and this model option is referred to as Australia North. Since the Australian system is built on the foundation of an EPR system, this model option is first developed with a restricted EPR, and then the implication of no EPR system is discussed. The Australian system has two main components, with the first being the GRDC which is the producer/government partnership that is also the recipient of producer levies and government contributions, with the GRDC focus on pre-breeding and helping establish P4 for-profit breeding companies. The second main component is the P4 breeding partnerships where GRDC has an investment position, and these for-profit breeding companies also receive EPRs on varieties that they release.

With Australia North, a Wheat Barley Variety Development (WBVD) not-for-profit corporation would be established that exclusively funds and undertakes research that benefits wheat and barley variety development, and WBVD would assist in forming cereal breeding P4 partnerships. The **main features** of the WBVD, with its **discovery and pre-breeding focus**, are summarized in the following box insert and noted below.

- ❑ The WBVD is a newly created producer-public partnership operating as a non-profit corporation;
- ❑ Producers on the WBVD Board are appointed by provincial Commissions and the federal government appoints its representatives on the Board;
- ❑ The WBVD is the central body that coordinates variety development research priorities, and would not be involved in agronomics as in Australia;
- ❑ A major focus of WBVD is on discovery research (pre-breeding), with all pre-breeding efforts centralized through WBVD;
- ❑ The WBVD would contract out research with universities and other research organizations;
- ❑ All technologies developed through WBVD are licensed on a non-exclusive basis to all seed companies;
- ❑ Licensing of technologies to breeding companies becomes a source of revenues for on-going operations;

- ❑ The WBVD enters into P4 partnerships (producer-public-private) that focus on plant breeding and commercialization;
- ❑ Sources of funds would be a fixed portion of current check-off levies and co-funding by the federal government (at 50% or 100% of the producer levy with some smoothing using acreage seeded to account for drought years), as well as licenses fees for technologies provided to plant breeders; and
- ❑ A specific level of provincial Commission (per tonne) levy would be forwarded to WBVD (some levy amount would remain with Commissions for other Commission activities such as agronomics, advocacy, policy, etc.).

Model Option D – Approach by Design Element for Discovery Research at WBVD

Governance

- ❑ Board appointment - is by government and producers;
- ❑ Advisory body - is composed of only producers, but could include the public and private sector representatives;
- ❑ Legal entity - is a non-profit organization;

Assets and Infrastructure Support

- ❑ Assets used - is by funding of research contracted out to third parties;
- ❑ Management and human capital - is through hiring of necessary internal staff at WBVD; and this could be provided by a third party;
- ❑ Acquisition of existing organizations - no organizations are acquired;

Operations

- ❑ Variety development focus - is primarily on pre-breeding (discovery research);
- ❑ Partnerships - are with the universities, and government;
- ❑ Training of plant breeders/geneticists - is provided by funding universities;

Coordination

- ❑ Coordination between producer organizations - is through the centralized body (WBVD) for decision making and funding of variety development;
- ❑ Centralized coordinating body - is the new organization WBVD;
- ❑ Role of Commissions - is to forward check-off funds ear-marked for variety development to WBVD and to have representation in the research coordinating body (of WBVD);

Policy/Regulatory

- ❑ End Point Royalty - is used and applies only to varieties released after necessary regulatory change; however, this is not a significant revenue source for WBVD unless WBVD owns some varieties with revenues based on licensed technologies paid by through EPRs;
- ❑ Flow of check-off funds - ear-marked funds for variety development flow to the central body (WBVD);

Funding of Operations

- ❑ Start-up funding for the central body WBVD - is through use of check-off levies and government funds;
- ❑ Funding on-going operations - is through use check-off levies, royalty payments and government funds (linked to levies collected);
- ❑ Royalty stream - is based on licensing of technology and royalties associated with seed varieties that were funded through WBVD participation in breeding partnerships.

For the breeding through to commercialization stages of variety development, for-profit partnerships are created; with WBVD facilitating such partnerships through financial contributions and a resulting ownership position. These are P4 partnerships (producer-private-public), with a focus on using the germplasm and technologies provided by the WBVD (a producer-public partnership). It is expected that a number of these P4 plant breeding partnerships will be developed, with minimally one each for wheat and another for barley.

The **main features** of the P4 partnerships focused on **breeding and providing varieties** to the industry are noted below and also summarized in the following text box.

- ❑ For-profit organizations are created where producer ownership is through the WBVD;
- ❑ The P4 breeding companies would have assets (breeding infrastructure) and staff provided by former public agencies and the private sector;
- ❑ Breeding and finishing activities undertaken by government are transitioned into the created partnerships;

Model Option D – Approach by Design Element for P4 Partnership Breeding Companies

Governance

- ❑ Board appointment - is by the shareholders;
- ❑ Advisory body - is composed of only producers and private sector representatives;
- ❑ Legal entity - is a for-profit organization;

Assets and Infrastructure Support

- ❑ Assets used - are in-house research capacity based on ownership and operation of a seed/genetics company;
- ❑ Management and human capital - is through internal staff;
- ❑ Acquisition of existing organizations - the partnerships acquire public assets and as well partner with public organizations (e.g., universities);

Operations

- ❑ Variety development focus - is on the stages of breeding, finishing, and commercialization;
- ❑ Partnerships - are with the private sector, and universities;
- ❑ Training of plant breeders/geneticists - is based on partnerships with universities;

Coordination

- ❑ Coordination between producer organizations - is through the centralized body (WBVD);

Policy/Regulatory

- ❑ End Point Royalty - is used and applies only to varieties released after necessary regulatory change;
- ❑ EPR and industry goods - a portion of the EPR flows to WBVD to fund discovery research, as well as any licensed technology and associated royalties that are paid to WBVD (funded by EPRs collected);
- ❑ Flow of check-off funds - funds flow only to the central body (WBVD);

Funding of Operations

- ❑ Start-up funding - is through funds invested by WBVD and other partners
- ❑ Funding on-going operations - is through a large portion of EPRs collected on varieties released by the partnerships;
- ❑ Royalty stream - is based on EPRs collected on certified seed sales and FSS for varieties released by the partnerships.

- ❑ Plant breeding P4s would focus on the breeding, finishing and commercialization activities;
- ❑ Initial funding is through the WBVD until a sufficient level of royalties accrue;
- ❑ On-going operations are also funded through an EPR that only applies to the release of all new varieties;
- ❑ The producer contribution is initially through some portion of levy funds, and then through their share of EPR funds; and
- ❑ EPR applies equally to use of certified seed and FSS (when not restricted by a license agreement).

A **rational** for considering Model D - the Australia North model - for producer involvement is that this model operates in Australia, it generates considerable investment dollars, and its success could be replicated in western Canada. The option allows for producer involvement, which is in close collaboration with government through WBVD, through WBVD's partnerships in cereal breeding companies, and by producers being on advisory boards of both WBVD and the P4 breeding partnerships.

This option does meet the necessary conditions provided by the Working Group, and does allow for a level of producer influence and control. Check-off levies continue with this option even as a **restricted EPR** system is in place. The levy system is a foundational part of the option since it is required to have linked government co-funding, such as a fixed percentage of producer levy contributions.

From an assessment perspective, this model with an EPR system allows for a robust variety development sector and can be scored with a "B -" (see the middle column of the following table) since the EPR system provides the incentive for investments and enables the mix of private, producer and public breeding through the partnerships. This option does not score as well on promotes knowledge sharing and can apply to smaller grain classes due to the predominate for-profit focus.

Assessment Group Heading	No EPR	Restricted EPR	Universal EPR
1 Robust Variety Development Sector	C	B -	B
2 Allows for Producer Leadership & Influence	B	B	B
3 Ease of Transition to Proposed Model	C	C-	C -
4 Provides Incentive for Investment	C	A -	A
5 Leads to Desired Outcomes	C	B	B

With producers contributing an assumed ear-marked \$0.50/tonne check-off levy to WBVD and government matching producer contributions, WBVD revenues are expected to be \$35 million per annum⁵⁰. These funds are used to support necessary pre-breeding discovery research and a portion would be set aside in a reserve to enter into partnerships with the private sector and universities to create P4 partnership cereal breeding companies. As noted above, a breeding company with 3 plant breeders would have annual operating costs of \$4.5 to \$6 million per year. The necessary infrastructure and capital required for breeding programs is assumed to be provided by universities, government and the private sector into the partnerships.

It is anticipated that current levels of federal government expenditures would continue and WBVD funds be provided to the P4 partnerships until EPR revenues allow for a sustaining revenue flow to each cereal breeding company.

⁵⁰ If government contributions are 50% of producer contributions as in Australia, then the annual revenue flow decreases to \$26 million.

With a restricted EPR system in place, it will take at least a decade for the for-profit breeding companies to have a revenue base that covers annual expenditures. For example, if 20% of acreage is planted to varieties where an EPR can be collected and the EPR is \$1.50/tonne of grain marketed, then the prairie wide seed industry can capture \$10.5 million per annum. It may take 10 years to achieve a 50% adoption rate of newly released varieties, where then annual EPR revenues are \$26 million, which allows for the operating costs of 17.5 plant breeders (based on \$1.5 million per breeder. This will require that either government or the WBVD corporation, as a shareholder, fund P4 activities until EPRs provide the necessary annual flow of funds. This may take more than a decade for EPR revenues that exceeds annual operating costs to allow for the P4 partnerships to have a sustainable revenue base.

The option also allows for (2) necessary producer leadership and influence, through funding of WBVD and being on advisory bodies of both WBVD and the P4 breeding partnerships; however the score is lower with a “B” due to somewhat less producer voice compared to the prior three Models. As well, through the use of EPRs (4) necessary incentives are provided for investing (resulting in an “A –” score and comparable to other options with a restrictive EPR). Desired outcomes can be achieved using this option, such as being competitive with other crops kinds. The for-profit nature of this model (for the breeding companies) may not result in the system providing all of the traits desired by producers or by certain market segments due to the prospective size of market. Achieving these desired outcomes is based on ensuring that a royalty structure is in place for protected varieties.

This option scores the lowest (3) on ease of transition to the proposed model at a “C -”. The option requires all (current) government discovery research to be within WBVD, which would have assets and employees transferred into the WBVD organization. This transition may encounter some difficulty and/or opposition and may not be saleable to all producers. Discovery research at universities would remain at universities and contracted by WBVD, as required. As well, government employees and supporting assets and infrastructure that are currently involved in breeding through to finishing activities would become employees in the P4 breeding partnerships, which may also face some resistance.

There are some **risks** associated with this option. Achieving the proposed structure could fail due to the amount of transition that is required in relation to current structures. Such change requires time, and the policy development process to achieve the necessary change could create significant uncertainty for a number of stakeholders. As well, current public sector employees and assets would need to be transferred into WBVD.

Another risk is the reduction in public financing of variety development. The federal government could indicate that with the formation of WBVD the upper limit on its funding of variety development is the co-funding based on the linkage to check-off levies collected. With government contributions of approximately \$40 million per annum, this is much greater than government co-funding at 50% or 100% of producer levy contributions. To continue with current government investment levels requires approximately \$1.00/tonne of government annual contribution. This may require producer contributions to increase to result in a \$1.00/tonne variety development check-off levy. Unless check-off levies become mandatory, there is a risk that requested refunds may increase to result in overall lower government contributions. To reduce such risk there should be an agreement with government to continue with minimal levels of government investment, whether through WBVD or through current funding structures.

With a for-profit focus on breeding (since current public breeding activities will migrate to the for-profit breeding partnerships) a risk is that small acreage crops and smaller classes will not receive current levels of attention, and these producers will be dissatisfied with the overall approach to variety development.

The model, when fully implemented, creates only for-profit private sector cereal breeding. This raises the risk of whether the desired level producer leadership and influence can be achieved. This has been raised as a concern in Australia. Such risks can be addressed through the partnership agreements and the resulting governance structures (including producer advisory bodies). Producer influence continues through the on-going funding of WBVD and its focus on pre-breeding and germplasm development.

Another risk with an EPR system, which applies to all of the options, is that without proper incentives, licenses, and funding agreements in place, sharing of knowledge and germplasm between breeders can decrease. This has been identified to occur in Australia once the EPR system was fully in place⁵¹.

Some parties may not support the reduced role of Commissions with this option to one of collecting levies for variety development and only directly funding agronomic research. However, producer influence is still achieved through WBVD and by being on advisory bodies.

With a **universal EPR**, this option scores marginally better on (4) provides incentive for investments. This is due to the fact that the for-profit breeding companies that exist, or are established by WBVD, have a royalty revenue stream in proportion to their overall market share in year one. There is also a slight improvement in (1) a robust variety development sector.

When **no EPR** system is in place, government contributions, levies and license fees are the only revenues sources. The absence of an EPR system will in all probability result in few, if any, P4 partnerships involving the WBVD, public institutions and the private sector. The ability to capture value will be reduced unless use agreements involving FSS (re-use of seed) is used on most newly released varieties. Not having an EPR system limits the ability to attract necessary investments into wheat and barley variety development. The scoring of this option with no EPRs is provided in the above table, and indicates that this option without any EPR scores much lower than this model with an EPR system. The Australian model is closely tied to having an EPR system to create the incentive for private sector investments.

⁵¹ See Russell Thompson, "The Yield of Variety Protection" Amer. J. Agr. Econ. 97(3): 762-785 (2014).

Model E – Producer Ownership in a Cereal Breeding Company

In this model producers invest check-off dollars, through the producer controlled check-off Commissions to purchase shares, creating an independent producer owned for-profit breeding corporation⁵² named “Seed Corp”. This model has some common features with Model D (Australia North), such as producers having involvement in a breeding company, and a difference is that a WBVD is not contemplated where producers and government formally partner for discovery research. As well, the breeding company does not have access to EPRs; rather check-off levies are earmarked for funding Seed Corp. This model also shares some features of the ownership and control of Limagrain, the highly successful producer owned multinational seed firm⁵³.

Seed Corp would be set up to with the objective of developing and commercializing new cereal varieties for the benefit of producer shareholders. This model is summarized in the text box below.

Model Option E – Approach by Design Element

Governance

- ❑ Board appointment - is by the shareholders, which include individual producers;
- ❑ Advisory body - is composed of only producers and private sector representatives as required;
- ❑ Legal entity - Seed Corp is a for-profit organization, where all levy contributors become shareholders;

Assets and Infrastructure Support

- ❑ Assets used - are in-house research capacity based on ownership and operation of Seed Corp, as well as through partnerships;
- ❑ Management and human capital - is through Seed Corp's internal staff;
- ❑ Acquisition of existing organizations - the company can acquire a seed company or build a seed company, and can include partnerships/joint ventures;

Operations

- ❑ Variety development focus - is on the stages of breeding, finishing, and commercialization;
- ❑ Partnerships - can be with the private sector, universities, and government;
- ❑ Training of plant breeders/geneticists - based on providing project funding to universities;

Coordination

- ❑ Coordination between producer organizations - is through a centralized body such as WGRF, which may or may not be a shareholder in Seed Corp;
- ❑ Centralized coordinating body - is Seed Corp for variety development;
- ❑ Role of Commissions - is to participate in the research coordinating body and to forward check-off funds to Seed Corp;

Policy/Regulatory

- ❑ End Point Royalty - is not used (as part of the base case);
- ❑ Flow of check-off funds - an ear-marked portion is transferred to Seed Corp;

Funding of Operations

- ❑ Start-up funding - is through levy funds;
- ❑ Funding on-going operations - is through check-off levies and royalty payments and license fees;
- ❑ Royalty stream - is based on licensing of technologies and royalties on certified seed sales and end use agreements

⁵² The option is based on a for-profit model, and a cooperative structure can also be considered.

⁵³ See Annex F.

This model does not rely on an EPR system; rather a commitment of check-off levy funds is a requirement for achieving financial viability.

For the initial start-up period, all wheat and barley Commissions would use check-off funds to purchase shares in Seed Corp. Farmers who contribute to the check-off would be issued a corresponding number of Class A shares in Seed Corp, which would accumulate as investments were made overtime. Start-up capital includes check-off funds, and potentially equity contributions by other shareholders such as certified seed growers. Some debt capital may be required based on whether a seed company is acquired in the early years or debt capital required for necessary organic growth into plant breeding.

Seed Corp would then invest in breeding and commercialization activities on behalf of farmers. This would initially include investment in public breeding programs in return for a share of the varieties created. Seed Corp would then work with public and private firms to commercialize these varieties and earn royalty income. Over time, Seed Corp would have its in-house breeding capability, either through acquisition or organic growth.

Seed Corp would be governed by a board of directors elected by Class A shareholders. This might be done from the time of establishment, or it might operate with an appointed board of directors during a period of establishment. Class A shares would be converted to non-voting Class B shares (or surrendered⁵⁴) at the time when a producer ceased to be an active farmer, to insure that only active farmers continued to control Seed Corp. While Seed Corp would not directly report to the existing cereal Commissions, it would have an incentive to work with the Commissions to maximize benefits for the members given the flow of levy funds.

The **main features** of this model include:

- ❑ A for-profit structure with producer shareholders (commercial producers and seed growers), versus Commissions or other producer organizations as shareholders;
- ❑ Breeding, finishing and distribution activities are provided by Seed Corp;
- ❑ Continued public institution involvement in trait and technique development, with a strong pre-breeding focus, and public-good traits;
- ❑ Considerable partnering (P4 partnerships) and licensing agreements by Seed Corp with public institutions and the private sector;
- ❑ Producers capture value through (1) improved innovation and productivity for all producers, and (2) returns to the seed company through royalty streams, and (3) over time as a return on investment as a shareholder;
- ❑ Royalty streams can be through multiple sources of (1) certified seed sales; (2) licensing of developed technology/innovation to 3rd parties;
- ❑ Seed Corp is a single body to coordinate breeding and commercialization activities for wheat and barley;
- ❑ Direct producer ownership prevents any particular Commission or group being under/over represented in the Seed Corp relative to their investment;
- ❑ This model does not interfere with the autonomy of the existing Commissions; and,
- ❑ The corporate structure gives Seed Corp greater flexibility in future partnerships and business arrangements.

This model can be based on producers acquiring a genetics company or producers starting a new seed business. The start-up of a seed/genetics company by producers is not a new concept in Canadian agriculture. Examples can be found in most species. In the grain sector, seed growers have been instrumental in starting such companies as Canterra Seeds and FP Genetics. These

⁵⁴ Limagrain shareholders must be active farmers and must surrender their shares upon retirement.

companies have secured the rights to varieties of seed from different breeders for distribution. Integration into the breeding of varieties is possible and contemplated. For example, Canterra Seeds has recently partnered with Limagrain in integrating its operations to now include a cereals grain breeding operation, Limagrain Cereals Research Canada. This venture has included Limagrain acquiring a minority stake in Canterra. Starting a new seed company does require a “champion” to see to it that the new venture gets off the ground and is successful.

SeCan is another farmer-based seed distribution enterprise. It is the largest seed distributor in Canada. However, it is an alternatively structured organization, where it has farmer-membership and is not-for-profit. To date, SeCan has returned more than \$70 million in royalties and research funding to breeders of cereals, oilseeds, pulses and forage varieties.

A **rationale** for this model for producer involvement is that it allows for individual producers to have ownership in a wheat and barley breeding company that focuses on release of varieties with traits of interests to producers. It allows for traits to be included in varieties that the private sector life science companies may choose not to include, such as fusarium resistance. This type of model with a producer controlled breeding company there can be producer direction on plant breeding priorities, and producer control on the use of check-off funds. Another rationale for this option is that if there is a lack of focused infrastructure for variety development and innovation, and if effective partnering with existing public and private organizations cannot be developed, then producers may need to be directly involved in a breeding company.

This model where producers have an ownership position in a cereal breeding company meets the necessary conditions (prerequisites) as identified by the Working Group.

This model with **no EPR** has an “A” score in the area of (2) allowing for producer leadership and influence. The direct producer owned corporate structure has an impact on governance and long run security of the breeding activities.

The other categories receive lower scores. In the grouping (4) provides incentive for investment, the incentives are there for Seed Corp; however, this does model does not attract additional private sector investment, resulting in a “C” score. When an EPR is introduced, private sector investment is encouraged. The ease of transition to the proposed model is also scored with a “B -“ since there are changes in relation to the current operations, with levy funds now used to invest in Seed Corp, versus contract research, and most if not all variety development ear marked funds would be for Seed Corp.

Assessment Group Heading	No EPR	Restricted EPR	Universal EPR
1 Robust Variety Development Sector	C -	C	C +
2 Allows for Producer Leadership & Influence	A	A	A
3 Ease of Transition to Proposed Model	B -	B	B
4 Provides Incentive for Investment	C	A -	A
5 Leads to Desired Outcomes	C	B	B

Some of the desired outcomes can be achieved with a producer funded and controlled seed company, and this assessment group heading receives a “C” score for the same reasons as in Model D. With a for-profit emphasis, there is a risk that small acreage crops/classes will not receive enough focus in order to meet the needs of some producers.

The model is affordable to producers since the current levy structure can provide the seed capital for Seed Corp. Levies can provide an annual revenue flow of \$17.5 million, based on ear-marked funds of \$0.50/tonne for variety development. This provides a revenue base that can enter into

partnerships on certain variety development initiatives, and as well support breeding programs associated with 3 to 7 cereal breeders – at an annual operating cost \$4.5 to \$10.5 million. Debt capital and/or shareholder contributions can finance the necessary capital requirement for a new seed company. With this model current producer commitments to supporting public research can be maintained, whether through Seed Corp, or through existing Commission and WGRF partnership agreements. With producers having direct ownership in Seed Corp, there may be producer support for higher levy rates, or a higher portion of levies that are allocated to variety development.

The assessment group (1) robust variety development sector scores an “C -” due to this system not necessarily allowing for a mix of private, producer and public breeding and there is a risk that the benefit of past investments may be lost. There are some other **risks** with this option. The first risk is the loss of public investments in variety development since the option has most, if not all, levy funds (ear-marketed for variety development) going to Seed Corp. This could jeopardize some public initiatives since producers’ funds would no longer support these public initiatives. Furthermore, this new arrangement between producers and public institutions may result in producers losing access to what they have already invested in. A re-allocation of levies away from currently supported researchers and public institutions reduces overall efficiency and viability of wheat and barley variety development in western Canada. A robust variety development sector requires necessary human capital in terms of both plant breeders and knowledgeable management.

Another large risk is that insufficient producer funds could be ear-marketed for Seed Corp, resulting in potential bankruptcy. Producers may also not agree on whether ownership structure should be based on volumes of wheat and barley marketed. A further risk is that some producer groups (Commissions) would not support a Seed Corp since they may see that their interests are not well served by a prairie-wide cereal breeding company, when contrasted with the current system or with other models for producer involvement.

There is also a risk that such a venture could fail because of a lack of experience in Seed Corp, its inability to attract talented plant breeders, and the risk of few (if any) profitable and successful varieties. With the for profit emphasis, there is a risk that small acreage crops/classes will not receive enough focus in order to meet the needs of producers. Another risk is the company being taken over through a merger or an outright sale.

This model can also have an EPR system. Having a **restricted EPR** system, where EPRs collected on all varieties released and marketed by Seed Corp and by other breeding companies (on varieties released after an EPR is recognized by regulation) creates an incentive structure for additional private investment in variety development. An EPR system also enables more market place revenues to be realized by Seed Corp. This has the advantage of having additional funds for investing in variety development, increasing the probability of being financially self-reliant after a number of years and less reliance on check-off funds as more varieties are adopted, and providing dividends to shareholders, which are individual producers). The assessment table indicates that when an EPR is introduced, and levy funds are available for a number of years, the model is superior to not having an EPR. Producer control and influence is not lost by producers having an ownership position in Seed Corp, and by being on the advisory board. Overtime as royalties increase, Seed Corp can generate significant revenues, which should be reinvested in breeding activities. If the Seed Corp generated profits, which did not need to be invested into variety development activities, the Board could decide to have dividend payments to shareholders.

A **universal EPR** system does not provide any additional benefit to Seed Corp; unless it has acquired a breeding company with existing varieties with a reasonable market share. There could be a disadvantage as Seed Corp must compete with other breeding companies for royalty revenues as the business is being built. With an EPR system, the **risk** of a Seed Corp having a negative impact on public variety development programs remains.

7.0 Moving Forward on Producer Involvement in Variety Development

The prior section described five potential options for producer involvement, as well as an assessment of these models. The assessment scores provided across Models A to E with, and without, an EPR system is provided in Table 7.1.

In a policy regime with no EPR system, in the assessment area (1) **providing for a robust variety development sector** Model C (WBW) meets the criteria (as listed on page 22). The formal organization embodied in Model C allows producers with necessary flexibility in preparation for potential changes. Models A and B rank somewhat lower, followed by Model E and D.

In terms of (2) **allows for producer leadership and influence**, Models A, B, C, and E rank the highest, with Model D (Australia North) ranked lower primarily due to the system being a for-profit plant breeding system.

In the assessment area of (3) **ease of transition to the proposed model**, the first three models meet all of the criteria and have a much higher ranking than Models D and E. Considerable change is required to adopt an Australian North model or to have all levy funds directed to producer ownership in a cereal breeding company.

Table 7.1 Summary of Assessment Group Heading Scores

Model		1 Robust Variety Development Sector	2 Allows for Producer Leadership & Influence	3 Ease of Transition to Proposed Model	4 Provides Incentive for Investment	5 Leads to Desired Outcomes
A - Current Approach with More Coordination and Information Sharing	no EPR	B	A	A	C	B -
	restrictive EPR	B+	A	B	A -	A -
	universal EPR	A-	A	B	A	A -
B - Eight Provincial Commissions Involved in Variety Development Research Programs	no EPR	B -	A	A	C	B --
	restrictive EPR	B+	A	B	A -	A --
	universal EPR	B+	A	B	A	A --
C - One Non-Profit Producer Body: Wheat and Barley West	no EPR	A -	A	A	C	B
	restrictive EPR	A	A	B	A -	A
	universal EPR	A+	A	B	A	A
D - Australia North - Separate Partnerships for Pre-Breeding and Breeding/Finishing	no EPR	C	B	C	C	C
	restrictive EPR	B -	B	C-	A -	B
	universal EPR	B	B	C-	A	B
E - Producer Ownership in a Cereal Breeding Company	no EPR	C -	A	B -	C	C
	restrictive EPR	C	A	B	A -	B
	universal EPR	C+	A	B	A	B

Without an EPR system, all options are ranked low on (4) **provides incentive for investment**, none of the models provide much economic incentive for breeding and attracting new investment, aside from currently royalties systems. While not scored above the other models, it can be noted that Australia North (Model D) has committed levels of check-off levies and matching government

contributions as a funding base for variety development that in all probability is larger than with the other models.

In the assessment area of (5) **leads to desired outcomes** and no EPR system, Model C (the formally organized WBW) ranks above the other Models. Model C is ranked above Models A and B due to a more formal organization and should produce desired results faster in relation to eight independent bodies (Model B) or a more collaborative approach (of Model A). Without an EPR system in place, Models D (Australia North) and E (Seed Corp) do not rank any higher than Models A, B or C in any of the assessment group areas.

With an EPR system in place, all five Models have comparable scores on (4) provides incentive for investment. Models D and E score slightly lower than the other Models on (5) leads to desired outcomes and lower on (1) robust variety development sector. This ranking is based on the outcomes associated with predominately a for-profit variety development sector with the potential for less sharing of information and germplasm and less emphasis on smaller classes and on certain desired traits.

Preference Ranking of Options

Based on the above assessment areas summarized in Table 7.1, our scoring results in the following ranking of Models:

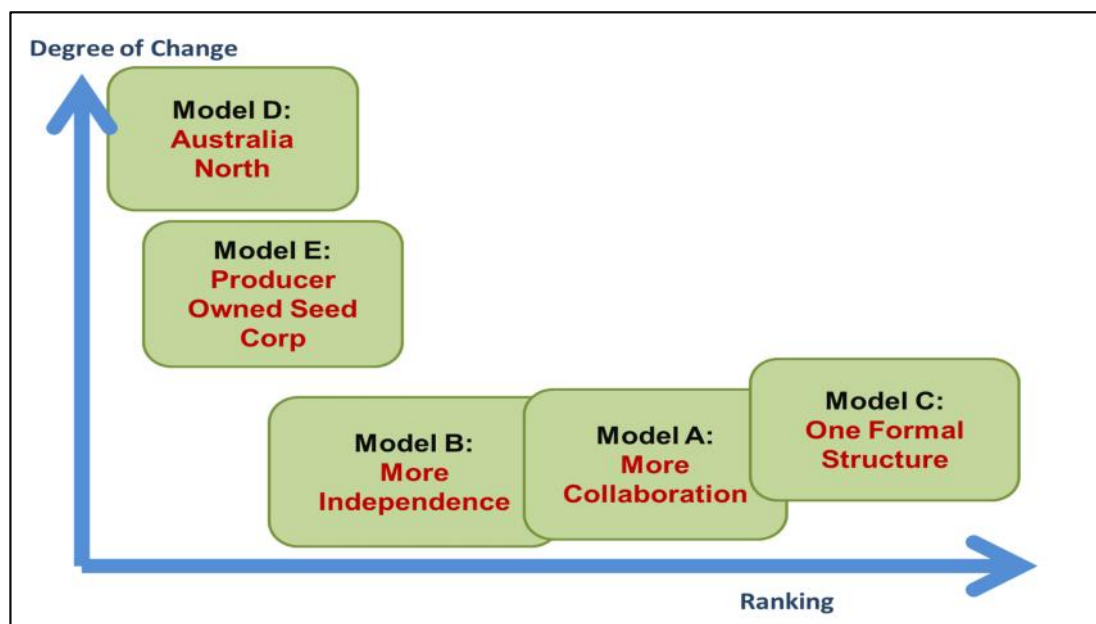
1. Model C - One Non-Profit Producer Body: Wheat and Barley West
2. Model A - Current Approach with More Coordination and Information Sharing
3. Model B - Eight Provincial Commissions Involved in Variety Development Research Programs
4. Model E - Producer Ownership in a Cereal Breeding Company
5. Model D - Australia North: Separate Partnerships for Pre-Breeding and Breeding/Finishing

Model C, Wheat and Barley West (WBW), is the most preferred option in the intermediate term and can be viewed as a more “*formal structure*” option that provides benefits to producers with little risk and allows producers to position themselves in case federal support to variety development decreases. With this option there is no significant change, producers have influence and leadership, and centralization through scale economies enables a quicker realization of benefits. This ranking is also supported by the scoring on (1) robust variety development sector, and (5) leads to desired outcomes.

The second most preferred short term option is Model A, which is the current approach with more “*collaboration*” that is easy to implement and allows for producer control. In relation to Model C, minimal change occurs, however, producers are not positioned as well for any unexpected change and duplication can occur which reduces effectiveness and benefits. This option is ranked behind Model C on (1) robust variety development sector and (5) leads to desired outcomes.

Model B, which can be characterized as eight “*independent*” organizations also has minimal change from the current approach and based on how the provincial Commissions operate can be somewhat similar to the collaboration option (Model A). This independent option is ranked slightly lower than either Model A and C since fewer net benefits are expected due to duplication, and the model can be less stable over time.

Models D and E are longer term options and are ranked lower than the prior three models. Figure 7.1 (on the following page) provides a view of the ranking by Model option and the degree of change required to transition from the current state to the state contemplated by each option. The figure illustrates the significant change by adopting an Australia North model (option D), and the lower overall ranking, and Model E (Producers Own a Cereal Breeding Company) involves somewhat less change.

Figure 7.1 Ranking and Degree of Change for the Five Model Options, with no EPR

Model D and Model E scored much lower on (3) ease of transition to proposed model. Compared to Model D (Australia North), Model E (Seed Corp) scored lower on (1) a robust variety development sector.

Model E where there is prairie-wide producer “ownership” of a seed company entails risks and may be less supportive of smaller classes. Associated risks include the difficulties of establishing the producer owned seed company, its share structure, and a negative impact on current relationships between producers and public institutions supporting variety development. Whether this option creates more value for the producer community is worthy of debate.

The “Australia North” option – Model D - ranks the lowest. One of the main reasons is the difficulties of implementing the system and structures and the considerable transition required from the current state to a structure as contemplated with the Model D option. Plant breeding would evolve to a private sector only system, which can negatively affect knowledge and germplasm sharing, and smaller classes, which in the longer run will reduce producer benefits. The Australian system was designed with an EPR system in mind to incent variety development⁵⁵.

Transition and Adoption of Producer Involvement Model Options

In terms of the options for producer involvement, Model A (*collaboration*) and Model B (*independence*) are variations on the current approach used in western Canada. A rather smooth transition can be expected from these two models to Model C (WBW – with a formal structure), the option that is ranked as most preferred (from a producer perspective), with such a transition occurring in a short period of time (see also Figure 7.2).

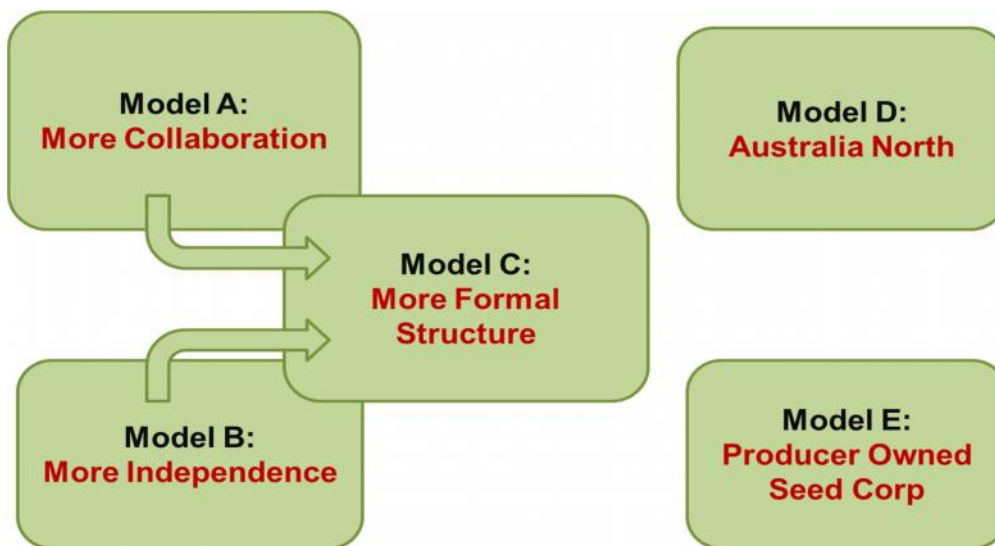
Once adopted, Model C (*a formal structure*) can be the model that remains in place for a considerable period of time, and from this model producer partnerships (P3s and P4s) can be developed that focus on specific varietal development initiatives that serve wheat and barley producers. An example is a P4 partnership that develops a fusarium resistant wheat variety.

⁵⁵ When an EPR system is introduced, the relative ranking changes does not materially change.

Model C when combined with producers partnering with private sector and public sector institutions on certain breeding initiatives has some similarities to Model D. The major difference is that a WBVD type of organization, a co-funded partnership between WBW and AAFC, is not in place. In Model C, WBW and AAFC have not merged operations as in WBVD (Model D), and only WBW enters into potential partnerships with private sector and public sector institutions.

As well, Model C can be the platform where producer involvement evolves into either Model D or Model E. With Model D, the WBW would be the body that jointly develops a WBVD (a GRDC type of structure) with AAFC, and then uses levies, government contributions, and potentially a portion of EPR funds to foster development of P4 for-profit breeding companies. This does not preclude private sector investment that may be involved in variety development outside of any partnership with producers.

Figure 7.2 Potential Time Path of Model Transformation and Adoption



Equally, Model C could be the springboard for WBW to become the producer owned prairie wide cereal breeding company (Model Option E) as illustrated above in Figure 7.2.

Potential Impact of New Technologies

There are some potential new technologies that can capture a significant share of wheat and barley acreage and the private sector can capture the value of the technology; examples are hybrid cereals and production contracts for some varieties. If such a situation arises there could be a significant impact on the Model options, and whether the above ranking may change. A few considerations may need to be thought through. First, with these types of technologies, there may not be a need to move to an EPR system since the technologies themselves allow for the value capture by the developer and overall investment in variety development for these cereals should increase.

Second, if an EPR system existed, a product developer may prefer a restricted EPR system over a universal EPR system. This is based on the developer's desire not be locked into a fixed uniform EPR rate that applies to all varieties⁵⁶. As well, with a restricted EPR system, a developer has the

⁵⁶ This view of preferring a restricted EPR may be offset by the appeal of a universal EPR which provides significantly more revenues to product developers with varieties already in the marketplace.

option to choose to not use the EPR system since royalties can be captured on each year's seed sales.

Third, with a large acreage base using these technologies, some producers may choose to not support a check-off system for variety development, since they are paying for variety development through their annual seed purchase.

Fourth, there are some potential consequences for producer involvement and the Model options. With such technologies, there is likely minimal reason for producers to support transitioning to Model D (Australia North) or Model E (Seed Corp) since there will probably be significant private sector investment in these technologies. Producer involvement is required to continue leveraging public investment in basic research (pre-breeding), and this can be achieved using either Model C (*formal structure*), Model A (*collaboration*) or Model B (*independence*).

The potential consequences of technologies that may disrupt the current system, and a potential new model for producer involvement should be considered and understood by producers. This understanding should extend to decision makers guiding the direction of producer involvement in variety development for wheat and barley.

Producer Influence with an EPR System and Minimal Levy Support

Our rankings with an EPR system is based on the assumption that levies continue to fund producer involvement in variety development, which would enable desired producer leadership and influence. With an EPR system that has been in place for a period of time, there is a possibility that fewer producer dollars via check-off levies would be available.

Producer influence and control is a concern when an EPR system is in place, particularly when few of the check-off levies are used by Commissions to fund variety development projects. If such a situation occurs, a few of the model options allow for producer influence and leadership. Model E, where producers have ownership in a cereal breeding company, allows for the necessary influence through the producers influenced breeding program. This also applies to Model D, the Australia North model. The implication is for producers to continue funding variety development through the current levy check-off system with whatever EPR system may unfold. Moreover, this EPR related risk is also somewhat mitigated with producers' royalty sharing agreements with public institutions which allows for some influence on how future funds are invested.

Impact of Higher Producer and/or Private Investments in Variety Development

As noted in Section 2.0, there is a considerable benefit to producers of significantly higher levels of investment in variety development and a stretch goal of \$110 million in annual investment was suggested. The goal is achievable when producers decide that higher check-off levies are warranted given the resulting benefits, such as; (1) \$1.00/tonne variety development levy on wheat and barley, and (2) private sector investment also increases based on the opportunity to capture value with successful varieties (as illustrated in Figure 2.1). As well, even with no EPR system, producers may decide that the on-farm returns to variety development warrant a levy rate of \$1.50/tonne or more⁵⁷. With much higher levels of producer investment, an issue that may require some consideration is which Model option meets the needs of producers when producer funding of variety increases from under \$10 million per year to \$35 million to possibly \$75 million per year, for example.

⁵⁷ The levy rate in Australia is 1% of farm value, which corresponds to \$2.00/t on \$200/tonne wheat.

In terms of Models A to C, Model C (WBW) with its centralized approach is better suited to investing large and strategic investments. Model D (Australia North) would operate well with these much higher levels of producer funds; however this does not take away from some of its weaknesses and inherent risk as outlined earlier. Model E (Seed Corp) would have significant funds for investing in its own variety development efforts; and as well its relative ranking would not significantly change.

Strategic Choices for Producers

There are two strategic choices facing producers. The first choice is how producers should be involved in variety development, and do producers need to own assets or contract with institutions that own necessary assets. The options provided on the type of Model option for producer involvement can assist in the on-going dialogue between producers on the merits of each option, and which one best meets the needs of wheat and barley producers. The consultant's perspective is that a more formal structure, such as Model C based on a joint venture arrangement, rather than the current system or Model A or Model B, can provide the necessary scale and flexibility.

The second choice is whether or not to support an EPR system. An EPR will provide additional revenue for producer/public supported breeding programs and will in all probability increase the level of private sector investment into wheat and barley variety development. Notwithstanding the biological challenges in wheat breeding, an EPR provides an incentive to the private sector to invest in variety development and reap marketplace rewards. Higher levels of private sector investment in wheat and barley variety development should also provide more choice for producers. An EPR system will, over time, allow for higher investment levels in wheat and barley variety development.

An issue for producers is what Model option best serves producer interests with an EPR system. The path to be decided upon by producers rests on the confidence of whether or not producer influence and leadership can be maintained with an EPR system and have continued improvement in varieties. An EPR system enables needed private sector investment, and producers can maintain influence by maintaining levy funding of producer directed variety development projects and potentially through producer ownership in a cereal breeding company.

Producers have considerable self-interest to ensure that investment in variety development is at least maintained, but more realistically that investment increases to create even more value for the production sector to remain competitive with other crops grown in Canada, and to enhance competitiveness with wheat and barley production worldwide.