Small Grains in Minnesota: Assessing the Feasibility of Local Supply Chains
Small Grains in Minnesota: Assessing the Feasibility of Local Supply Chains

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I. Executive Summary

Small grains—wheat, oats, barley, and rye—have long been grown in Minnesota and constitute a substantial portion of the state’s agricultural production. While corn and soybeans dominate Minnesota’s farming landscape, small grains continue to remain an integral part of crop rotations statewide, especially in northwest Minnesota.

Over the past 30 years, farmers have harvested fewer acres of small grains throughout the state, largely due to competitive forces (e.g., corn and soybeans) but also due to challenges in processing infrastructure, ability to scale for market demands, and shifts in climatology that make growing small grains difficult. Consumer taste for gluten-free options have also changed demand for certain small grains, as more Americans report difficulty digesting wheat products.

While these challenges have made it difficult for local small grain supply chains to take hold in Minnesota, new opportunities for small grains producers to capture new markets are emerging. Due to declining profit margins for corn and soybeans in recent years, producers are looking for third- and fourth-year crop rotations that provide additional income while also improving soil quality and yields. Demand for organic and specialty products made with local grains, such as craft beer and breads, are creating opportunities, least at a smaller scale, for farmers to grow small grains. New initiatives, such as the Artisan Grain Collaborative and Greenmarket Regional Grains Project, are connecting producers, researchers, food entrepreneurs, and food systems advocates to create new possibilities, for rye, barley, heritage wheat varieties, and other grains that can help to to change the landscape of Minnesota farming for the better.

This research study applies Porter’s diamond analysis technique to assess the challenges and opportunities facing Minnesota local small grain supply chains. Using the scope of wheat, barley, rye, oats, buckwheat, and emerging grains, this report features interviews with stakeholders at all stages of the supply chain, ranging from producer to processor to end-user to research and convener. Combining these perspectives with available market data, the report also offers recommendations to guide players throughout the supply chain to make decisions that will mitigate risks and capture current opportunities.

Because this research study applies a broad stroke to small grains, the ability to dig into crop-specific supply chain feasibility is not possible. However, several aspects of processing and end-use for the small grains in scope are similar, something that has allowed for small grain advocates to convene and create markets for a variety of producers, researchers, processors, and end-users of small grain. This research contributes to those advocacy efforts and provides a glimpse into a potential future for Minnesota small grains.

Keywords: diamond analysis, small grains, local industry clusters, supply chains
II. Introduction

Despite a history of growing small grains, Minnesota food entrepreneurs are struggling to find and secure adequate sources of local, sustainably grown food-grade small grains for their products. At the same time, a number of farmers are interested in growing these grains if there is a viable market. Renewing the Countryside (RTC), in its work with food entrepreneurs and farmers throughout Minnesota and the region, proposed a research project to understand the challenges and barriers to creating regional supply chains for local grains.

By supporting research on the small grains production-demand gap, RTC and its partners (the University of Minnesota’s Regional Sustainable Development Partnerships, the Environmental Initiative, and the Cannon River Chapter of the Sustainable Farming Association) launched a greater effort to understand the local small grains ecosystem in Minnesota. The ecosystem encompasses farmers, aggregators, processors, manufacturers, and consumers, as well as researchers and food systems advocates, and ultimately, both rural and urban communities that support the chain. As a result, a key goal of this research is to bring together stakeholders across the spectrum to share perspectives and foster action to improve the vitality of local small grains supply chain.

Neither of these research goals, however, can advance without addressing local market demand for small grains, identifying which small grains can grow in Minnesota, and what capacity exists to process those grains into a product for human consumption. Though Minnesota has a long-standing history of growing and processing small grains, today’s context looks far different than the early days of growing wheat on Minnesota’s fertile lands.

To address these goals and gaps, this research project focused on three tasks:

- **Developing a basic understanding of the supply chains for these grains.** Knowing the supply chain starts with market conditions for the grains within scope: history, growth viability, processing patterns, and food-grade usage. These steps help create an understanding of trends within the small grains supply chain.

- **Creating a map of stakeholders in the small grains space—from farmer to end-user.** Knowing supply chain patterns also means understanding the players involved in the ecosystem. Though not exhaustive, the map creates a starting point for understanding who is active within Minnesota’s small grains ecosystem.

- **Developing an understanding of challenges and opportunities from stakeholders in the ecosystem.** Early on in the project, it became evident that a full review of local small grain supply chains needed more than just end-user perspectives. Interviews conducted with stakeholders at different points in the supply chain explore the challenges they experience, as well as the opportunities they seek to create—or improve—the market conditions for Minnesota small grains.

With this information in mind, this report also includes a set of recommendations for growing and improving the small grain supply chain in Minnesota. These recommendations are intended for the primary sponsor of this report—Renewing the Countryside—but also are intended to be shared with stakeholders identified throughout the study.
III. Small Grains in Minnesota: A Primer

A. The Ecosystem of Small Grains Definitions

The term “small grains” encompasses a wide variety of crops and specific uses. Small grains can include crops that are defined based on their end-use or features, such as “specialty” or “ancient” grains, and can also include definitions that focus on a grain’s marketing or growth practices, such as “commodity” grains or “organic” grains. Amidst multiple ways to split or define what small grains are, this study uses the more-encompassing Merriam-Webster definition of “small grains”:

“a cereal (such as wheat, oats, barley, rye, rice) having relatively small kernels or sometimes a relatively small plant as distinguished from a plant (such as corn) with large kernels or sometimes from a cereal (such as sorghum) with a large plant but small kernels”

Table 1 lists specialized definitions within the small grains “ecosystem.”

Table 1: Definitions of Small Grain Sub-Groups

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>“True” grains</td>
<td>Edible seeds of grasses belonging to the Poaceae (Graminae) family, encompassing several types of grain.</td>
<td>Sorghum</td>
</tr>
<tr>
<td>“Pseudo cereal” grains</td>
<td>Not part of the Poaceae botanical family, but nutritionally similar and used in similar ways to “true” grains.</td>
<td>Buckwheat</td>
</tr>
<tr>
<td>“Ancient” grains</td>
<td>Small grains that have generally not been processed through hybridization or genetic modification over the last several hundred years.</td>
<td>Spelt, emmer, einkorn</td>
</tr>
<tr>
<td>“Specialty” grains</td>
<td>Small grains grown to be a differentiated product on the basis of fiber or protein composition, dietary or ecological impact, or product features (e.g., taste). USDA definitions for “specialty” crops typically do not apply to small grains, with exception of sweet corn.</td>
<td>Non-lysine corn</td>
</tr>
<tr>
<td>“Heritage grains”</td>
<td>Small grains from a seed that embodies thousands of years of unbroken human-plant co-evolution, effort, and reverence. USDA bears both scientific and cultural relevance, though not always in equal measure.</td>
<td>Red fife or Turkey Red wheat</td>
</tr>
<tr>
<td>“Organic” grains</td>
<td>USDA certified organic foods are grown and processed according to federal guidelines addressing, among many factors, soil quality, animal raising practices, pest and weed control, and use of additives.</td>
<td>Organic field corn (or any organic variety of grain)</td>
</tr>
<tr>
<td>“Commodity” grains</td>
<td>Fungible grains—each unit is identical, can be mixed together, and priced uniformly. Typically grown using conventional practices but can include organic grains.</td>
<td>Soybeans</td>
</tr>
</tbody>
</table>
In simple terms, the small grains umbrella includes well-known and widely grown grains such as wheat, oats, barley, rye, and rice. Small grains can also include a variety of grain that isn’t as widely grown in states like Minnesota, such as millet, buckwheat, teff, einkorn, and several other varieties.

“Small grains” encompass a large set of varieties and purposes for both human and animal consumption. While several small grain varieties, such as oats, buckwheat, and rye, are primarily bred for human consumption, small grains can also be integrated into livestock feed. In addition to physical consumption of small grains, growers are also using small grains for environmental purposes, such as cover crop for controlling weeds and improving soil health. The full scope of small grains typically includes two different strains, cereals and rice, but our methodology focuses solely on cereal small grains: oats, sorghum, barley, rye, millet, spring and winter varieties of hard red wheat, etc.

B. Purpose and Scope of Research

As mentioned in the Introduction, interest in small grains supply chain research arose from a concern over available grain sourcing for food entrepreneurs in Minnesota and potential markets for farmers interested in raising small grains for local food systems. Though researchers and practitioners recognize that small grains likely have broader application for animal feed or other, non-consumption purposes, this study focuses solely on small grains grown for human consumption—i.e., “food grade” grains.

Knowing also there exists a large selection of small grains this research could focus on, this study chooses a handful of grains that are viable to grow in Minnesota or present the greatest opportunities for future growth. These grains include:

- Oats
- Barley
- Rye
- Buckwheat
- Wheat, including heritage varieties (e.g., Red fife)

Alongside these small grains, additional discussion of emerging varieties, such as Kernza, will be included in the statewide overview. Emerging varieties may eventually be introduced to local small grains supply chains in Minnesota over time, but currently either lack any established processing practices or may not have certified seed available for farmers to grow crops.

From the “ecosystem” of small grains mentioned above, this research study emphasizes opportunities for “specialty” grains. As will be discussed further, the options for local supply chains may be best served by the promising nature of differentiated grains in terms of profitability or ability to capture niche markets.

Specialty grains would ideally fall into a class of products in which producers are not “price takers,” as with more conventional commodity grains, but fall in a class of “price makers,” finding some means by which to influence the price of their grains. Price may be influenced by a variety of factors, such as the size of market participants, variation in crop
characteristics, number of close substitutes, storability, transparency of price formation, and ease of transfer between markets. In short, producers in specialty or organic markets may be able to differentiate their product from other grains in some fashion to attain a higher price.

Producers cultivate small grains using a multitude of growing techniques ranging from conventional farming practices seen throughout the United States to USDA-certified organic production practices. Sustainable, renewable, or organic practices add a unique element to small grains as differentiators, as well as marketing small grains as locally-grown. In other words, applying for organic designation is not the only means—or benefit—of differentiating small grains. In fact, pursuing organic certification, for example, may simply direct producers to a specific subset of commodity markets where differentiation may be just as difficult to achieve as conventional farming practices.

While the state of Minnesota presents unique growing diversity for small grains, a key aspect of this research is understanding how the grains in scope are not only grown but processed and aggregated and distributed to the end-user. The end-use—whether entering cereal, baked goods, or a craft beer—dictates local markets and producers and what small grains are likely to be grown in Minnesota.

**C. Literature Review**

Charting supply chains for a specific type of grain helps producers understand upcoming opportunities and challenges, resulting in better planning and decision making. As crop production and processing changes in the United States, so too should stakeholder understanding of supply chains. The progression of growing grains moving to processors or aggregators eventual end-use processing, and finally consuming them may appear simple enough. However, understanding industry dynamics—especially when encompassing a variety of grains as opposed to one—requires an approach that can account for a lack of uniformity across practices and quantitative measures of market demand.

More importantly, the methodology for this research may not benefit from the wealth of literature available focused on grain supply chains around the globe. For example, Wilson, Carlson, and Dahl's study of logistical performance of grain supply chains in the northern Plains states—including Minnesota—focused on quantitative tradeoffs and effects of the factors involved in exporting grain. Other grain supply chain studies focus on sustainability of growing practices and impact on consumer choices, study specific types of grain such as wheat, or take on an approach that is more focused on a nationwide or globalized scale.

Painting an accurate picture of Minnesota’s local small grains supply chain requires mapping the current players involved, understanding their perspectives and contributions to the small grains ecosystem, and then providing a clear assessment of the ecosystem’s obstacles and opportunities To achieve this goal, available literature provided two clear options for a methodology: applying a stakeholder interview process used by Canadian officials to assess their nationwide grains supply chain, and applying the diamond analysis concept found in Michael Porter’s assessments of industry strength.

Commissioned in 2011, the study of Canadian grain supply performed by the Quorum Corporation provides a helpful guide for this research through its use of stakeholder
mapping and interviews. Though the end goal of the Canadian study—informing issues facing railways, freight rail users, and shippers—is far different from this work, Quorum employs several assumptions that guide this report and conducts bilateral interviews with a variety of stakeholders in the field. This approach ensures the study fairly represents the views of industry stakeholders before comparing the results with quantitative measures of grain demand.

Porter’s work stands aside from typical work in the field of grains supply chain or the supply chain management discipline, but his long-standing research approach to clusters—a concentration of related industries within a particular location—can help explain local small grains supply chains in Minnesota. Though not all of Porter’s approach to assessing cluster presence may be applicable, such as the use of location quotients or even cluster mapping, he offers other tools that can support this research, such as a diamond analysis. The diamond analysis can help gauge the demand and factor conditions that support an industry’s strength, as well as understand whether related and supported industries are present to support the cluster.

Ultimately, the purpose of this study is to better understand market opportunities for local small grains and the stakeholder involved in the current supply chain in Minnesota. Combining tools from existing literature—the Canadian supply chain study and Porter’s cluster model—allows for a clear assessment of challenges and opportunities facing local small grains supply chains in Minnesota.

**D. Methodology**

This report takes on two-pronged approach based upon the results of the literature review. A brief overview of the Minnesota local small grain supply chains and an accompanying diamond analysis act as the primary focus of the report, guiding the format of remaining sections throughout. The diamond analysis includes an assessment of factor and demand conditions that impact the small grains within scope in Minnesota, as well as both competing and supporting industries. The other sections of the report follow this analysis, providing a history of the grains in scope in Minnesota, along with markets, growing practices, processing and aggregation uses, a view of organizations involved in supporting small grains, and ultimately, a map of the stakeholder system.

To support this work, interviews were conducted with a variety of stakeholders throughout the Minnesota small grains ecosystem, emphasizing the need to understand market challenges and opportunities for the small grains within scope. Initial interviews took place with stakeholders engaged in framing this research study, with additional interviews conducted after completing a map of stakeholders in the local small grains supply chain.

This methodology resulted in a clear set of trends—both challenges and opportunities—for local small grains supply chains in Minnesota, as well as a set of recommendations directed toward Renewing the Countryside and other key stakeholders in the Minnesota small grains ecosystem. Because the methodology is not focused on specific feasibility scenarios for individual grain types (e.g., oats), this paper’s recommendations focus on steps that can improve the small grains ecosystem as a whole, along with recommendations for additional study.
IV. Minnesota Local Small Grain Supply Chains

A. The Landscape of Small Grains in Minnesota

Small grains in Minnesota occupy a substantial place among crops and natural products produced in the state. In 2017, small grains—which includes wheat, oats, and barley in Figure 1 below—comprised approximately 10.8% of harvested acreage in Minnesota.

Figure 1 illustrates the large place that corn, soybeans, and hay and haylage—which includes alfalfa—take among harvested crop acres in the state of Minnesota. Over 22 million acres of cropland were harvested; well over 70% of harvested acres were used for the purpose of growing field corn and soybeans.\(^{19}\)

**Figure 1: Crop Production in Minnesota by Percentage, 2017 (Source: USDA/NASS)**

The data in Figure 1 above contributes to a much larger picture of economic prosperity for the state. Minnesota ranked fifth in the nation for gross receipts from agricultural commodities in 2016, totaling over $17B—or approximately 4.8% of the nation’s agricultural value. Among Minnesota’s immediate neighbors, only Iowa has a higher level of agricultural production at $26.8B. However, Illinois ($16.2B), Wisconsin ($10.7B), South Dakota ($9.3B), and North Dakota ($8.1B) all still fall in the top 20 states for agricultural production.

For Minnesota, corn production ranks fourth in the nation behind neighboring Iowa and Illinois, and similarly, soybean production ranks third nationally—also behind Iowa and Illinois. Minnesota’s annual receipts from these two crops alone covers 48.1% of all commodity production in the state. Including Minnesota’s wheat production, which ranks 8\(^{th}\) in the nation, these three crops cover over half of Minnesota’s annual crop production.
Clearly, King Wheat no longer dominates Minnesota’s agricultural landscape. The USDA’s state-level profile details the prolific growth of corn, soybeans, and alfalfa, which, due to their current popularity, overshadow small grains. However, the USDA’s report does not tell the full story of Minnesota’s crop production, paying little attention to small grains and their potential for growth as consumer tastes change and as their non-food uses are better documented. To understand the dynamics for each grain within scope, this report takes a slightly deeper dive into the history and specifics of small grains most likely to grow in Minnesota.

### A.1 Oats

Oats, a sweet-tasting grain frequently used for breakfast cereals and as a gluten-free option for humans and livestock alike,\(^{20}\) are not one of Minnesota’s top crops. However, Minnesota is the second largest producer of oats in the United States at \$16.7M\(^{21,22}\) in production (11.7% of all American oat production), trailing only neighboring South Dakota in 2016. These production levels relative to the rest of the nation should come as no surprise, considering the presence of the nation’s largest oat processors in Minnesota (e.g., General Mills).

What may be a surprise, however, is the decline of harvested acres of oats in Minnesota over the past 20 years. Harvested acres decreased by 55.7% between 1997 and 2012, and despite this decline, Minnesota’s position as an oat producer compared to other states actually **improved**.

This phenomenon could be attributed to many things, namely the decreasing usage of oats in livestock feed. One thing is certain: oat production in Minnesota—and around the country—has declined steadily for over 50 years and does not appear to be poised for a quick turnaround. Once one of the Upper Midwest’s most popular crops, oats have struggled to compete with more profitable alternatives, and because fewer farmers have produced the crop, the downward cycle has continued as many elevators in the region have quit handling oats.\(^{23}\)

However, the long-known nutritional value of oats, along with its touted benefits to soil health, may slow down or even stop the decline of oats over time. Recognizing that today’s oats are primarily consumed by humans,\(^{24}\) there may be new market opportunities for oats in Minnesota today and renewed optimism as oats continue to have improved competitive margins against other cash crops in the region.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Acres</th>
<th>US Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>130,729</td>
<td>1</td>
</tr>
<tr>
<td>2007</td>
<td>180,942</td>
<td>2</td>
</tr>
<tr>
<td>2002</td>
<td>231,859</td>
<td>3</td>
</tr>
<tr>
<td>1997</td>
<td>295,250</td>
<td>3</td>
</tr>
</tbody>
</table>
**A.2 Barley**

An annual grass plant used primarily for livestock feed and malting for beer, barley grows at a statewide rate that typically ranks among the top five nationwide. Today, Minnesota ranks eighth nationally in barley production, though American barley production is down significantly in every major barley-producing state, including national leader North Dakota. Barley production in Minnesota is primarily centered on northwest Minnesota as a result of the climate needs for spring barley production.

Much like other small grains in Minnesota’s history, barley once was among Minnesota’s top crop rotations, resulting in the establishment of Rahr Malting in Shakopee—the largest privately-owned malt facility in the world. As the driving ingredient behind beer and several types of whiskey, barley must be carefully sourced using two- or six-row varieties, depending on the type of beer produced. Typically, Minnesota barley has been grown in the six-row variety in the spring, but decreasing yields resulting from climate change—barley thrives on cool weather—have pushed production north and westward. At the same time, the malting industry has largely shifted over to two-row varieties for both higher efficiencies in the malting process and to match emerging craft beer tastes.

That is not to say there is not opportunity for barley production to return to Minnesota. Craft beer has taken on a larger scope of consumer preferences and has created new market opportunities for barley growers. As such, Minnesota producers and plant geneticists are testing two-row winter barley with new progress being achieved.

While it is unlikely that barley will find its primary market in livestock feed or human consumption, its prospects are similar to oats through its value as a cover crop and, if successfully bred, as a potential, profitable addition to crop rotation.

**Table 3: Harvested Acres in Minnesota, Barley**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Acres</th>
<th>US Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>99,642</td>
<td>5</td>
</tr>
<tr>
<td>2007</td>
<td>108,268</td>
<td>5</td>
</tr>
<tr>
<td>2002</td>
<td>149,102</td>
<td>5</td>
</tr>
<tr>
<td>1997</td>
<td>530,184</td>
<td>4</td>
</tr>
</tbody>
</table>

**Figure 2:**
Illustration of Two-Row and Six-Row Barley Varieties
Source – UMN Extension
A.3 Rye

Like barley, rye possesses properties that are well-suited to increased consumer preferences for craft brewing and distilling. Especially in the United States, rye is typically used for creating world-class spirits, something that may not be typically associated with Minnesota’s economic engine. Otherwise, rye is more commonly known for its use as a cover crop or for grazing as well as for human consumption in the form of rye flour or seeds for breads and other baked goods.26

The largest amount of harvested rye acres can be found in some unlikely places—Oklahoma and Georgia27—but the crop may be most uniquely suited to Minnesota’s drought prone soils. In addition, rye is among the most winter hardy cereal crops available. Increasing interest among growers in Minnesota and North Dakota has spurred significant research investment at the region’s land-grant institutions, resulting in updated rye varieties and information on protein and nutrient content. This investment resulted in the creation of hybrid rye, which demonstrates dramatic yield increases and is more actively considered for hog production rations.

Though rye is planted on fewer acres in Minnesota than oats or barley, it does present another grain for consideration in terms of food-grade application, especially as consumer demands for higher quality breads or alcoholic beverages continue to drive growing changes.

A.4 Buckwheat

Though not as common a crop among the Upper Plains states, Minnesota and neighboring North Dakota are among the nation’s top producers of buckwheat, along with Washington and New York. As a relatively low input crop with high yields and a speedy, 30-day maturity rate,28 buckwheat is attractive as a “catch” crop when others have failed, as an option for preparing soil for organic production, and as a cover crop for its weed smothering capability. Alongside its gluten free status and numerous nutritional benefits—similar to oats—buckwheat provides an additional small grain option that may be most useful as an emergency crop.

That status, however, has not boded well for growing outside of niche markets. Only about 60,000 to 70,000 acres of buckwheat have been grown throughout the United States as of 2016,29 with the majority of production occurring in North Dakota and New York. Health benefits aside, buckwheat would not be expected to take on a larger scale as a food source.

Table 4: Harvested Acres in Minnesota, Rye

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Acres</th>
<th>US Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>10,017</td>
<td>8</td>
</tr>
<tr>
<td>2007</td>
<td>17,672</td>
<td>4</td>
</tr>
<tr>
<td>2002</td>
<td>13,980</td>
<td>6</td>
</tr>
<tr>
<td>1997</td>
<td>16,267</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 5: Harvested Acres in Minnesota, Buckwheat

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Acres</th>
<th>US Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>1,038</td>
<td>5</td>
</tr>
<tr>
<td>2007</td>
<td>2,262</td>
<td>3</td>
</tr>
<tr>
<td>2002</td>
<td>4,749</td>
<td>3</td>
</tr>
<tr>
<td>1997</td>
<td>10,253</td>
<td>1</td>
</tr>
</tbody>
</table>
in the United States in the immediate future. However, some potential could exist in export markets, especially as some of buckwheat’s most popular uses—soba noodles—drive demand in Asian markets. This may be an opportunity for Minnesota to take advantage of its history as a soba noodle producer and regain market share on a larger scale.30

Processing, as will be discussed later on, poses a threat to buckwheat production in Minnesota as few elevators or processors handle buckwheat. But today, only a handful of buckwheat processing facilities would be available to Minnesota growers and may be a driving factor in the decline of buckwheat production since 1997.

A.5 Heritage Wheat Varieties

Though wheat varieties take on a larger proportion of Minnesota’s crop production in comparison to other small grains like oats or barley, the majority of wheat grown today in Minnesota looks little like the wheat that made it “king” during the late 1800s and most of the early 20th century. Dr. Norman Borlaug, a University of Minnesota plant geneticist, changed the face of Minnesota—and global—wheat production when he created a new variety of wheat that produced huge quantities of large kernels when heavily fertilized.31 This wheat, which grows lower to the ground to counterweight its kernels and is easier to harvest by machine, is what is commercially milled into 98% of American flour today. The market is driven toward this type of wheat and will likely do so for generations to come, but it comes at a cost—to soil management, future genetic depletion of other wheat varieties, and still-disputed claims of gluten intolerance.

In the same region shaped by wheat’s prolific growth—for better or for worse—growers and millers are beginning to explore the growth of Minnesota’s early wheat varieties. Turkey Red wheat, a high-gluten grain used for “beautiful flour and wonderful bread,”32 and red fife all fall within the context of heritage wheat varieties. Though it does not carry the much larger-scale supply chain available to modern wheat varieties, these wheat varieties have become more widely available in Minnesota through food cooperatives and from direct sellers such as Sunrise Flour in North Branch or Ben Penner Farms in Belle Plaine, MN.

Turkey Red wheat and red fife anecdotally are among the leading varieties of heritage wheats grown in Minnesota, largely as a result of their history as the state’s original wheat varieties brought by German-Russian Mennonites in the 1870s. Grown typically as a winter wheat, these varieties provide similar benefits to the other small grains in this analysis as both a cover crop for weed management and as a means of improving soil health over time. Like rye, Turkey Red wheat and red fife, along with organic varieties of wheat, are primarily grown for human consumption in a variety of breads and baked goods.

A.6 Emerging Small Grains

While there are several other small grains that may be grown in Minnesota, including conventional and organic varieties of corn or popcorn, new research has created additional varieties of small grains that may provide new value for Minnesota growers. Specifically, the emergence of perennial wheatgrass varieties such as Kernza® has created new energy around the potential for small grains in Minnesota.
In the 1980s, farmers identified intermediate wheatgrass as a promising perennial grain candidate related to wheat. Through multiple rounds of inter-mating plants over multiple decades based on yield, seed size, disease resistance, and other traits, plant geneticists were able to eventually create Kernza®. Today, Kernza® stands as a radical departure from other small grains as a perennial crop, meaning little to no tillage required for planting. This provides significant soil benefits, alongside the fact that Kernza® roots reach twice the depth and a greater density than annual wheat roots. In addition, there are potential, large-scale markets that may be of greater interest to producers. Several key food manufacturers have begun to use Kernza® to develop products for mainstream market consumption, such as Patagonia Provisions, Hopworks Urban Brewery, Dumpling & Strand, and General Mills’ Cascadian Farm. Kernza® is also being tested in several restaurant markets, including Minneapolis’ Birchwood Café.

It is important to note that for Kernza® or similar crops, potential for growth does not equate to immediate crop viability. Markets remain in development, though significant progress suggest there may be a high viability for intermediate wheatgrasses in the future. Emerging grains are “emerging” for this reason and should be monitored carefully as additional progress is made.

**B. Diamond Analysis**

In this section, the report analyzes Minnesota’s collective supply chain for the small grains in scope using Michael Porter’s diamond model of advantage (Figure 3). Because this report focuses on multiple, sometimes disparate grain growing and processing models, it is important to retain a view that allows for a mix of both broad and specific analysis of the competitive aspects of the local small grains supply chain.

Porter’s theory asserts that using the diamond analysis of a particular cluster or industry—using supply chain, in this case—reveals how different elements interact to form what would be considered a successful cluster. Porter’s diamond analysis framework is comprised of four elements:

- **Factor conditions**: Locally available inputs with specialized quality or quantity including human, physical, and knowledge capital, and infrastructure. Factor conditions are unique to a supply chain and set it apart from would-be imitators.

- **Demand conditions**: Sophisticated and demanding local customers. Locally, demand is for high quality, specialized products. Sophisticated local demand allows a supply chain to innovate quickly and develop demand-driven products faster.

- **Related and Supporting Industries**: Local firms, organizations, and similar industries which are associated through the supply chain or other relationships. Close relations can encourage innovation, spur supply chain upgrading, stimulate collaboration, and more.

- **Context for Strategy and Rivalry**: The nature of competition between local rivals, whether in the form of firms, outputs, or outside market forces. Concentration of firms and intensity of rivalry pressures companies to innovate to separate themselves from their rivals.
Porter also recognizes two additional elements that influence competitive advantage:

- **Government**: Government policy can either stimulate or discourage supply chain formation, upgrading, and success.

- **Chance**: The furthest removed from the core elements of the diamond, chance refers to forces or events detached from the cluster itself but that still influence competitive advantage and supply chain success.

**Figure 3: Diamond Analysis, Minnesota Small Grains**

Because this report is not a true study of a Porter-defined cluster, nor does this report attempt to define the presence or strength of a small grains cluster, the elements of the diamond analysis must be adapted to meet the conditions of this report. Factor and demand conditions transfer effectively for understanding the potential of the local small grains supply chain, as does the ability to gauge which firms, organizations, and industries are more likely to encourage growth of the small grains ecosystem. Context for firm strategy and rivalry may not apply in the same context, as the small grains supply chain does not act like an industry comprised of firms competing against one another. Grains and other crops, however, can be discussed in this fashion and will receive attention later on in this report.

Figure 3 takes Porter’s four elements and two additional conditions and applies them to the small grains within scope of this report. The remaining sections of the report elaborate further on the diamond analysis and ultimately result in a map of key industry players and stakeholders engaged in the small grains markets relevant to this study.
B.1 Demand Conditions

Any stakeholder within the small grains supply chain relies upon demand conditions to make production decisions. The key research question behind this study is whether a market exists for food-grade oats, barley, rye, buckwheat, or wheat varieties.

B.1.1 Organic Market Growth

Moving from conventional grain markets to organic markets may prove challenging yet financially rewarding for producers. Total domestic organic food sales, as seen in Figure 4, have grown substantially over the past decade and outpace the growth of the overall food market by substantial margins (11% compared to 3% in overall market in 2015).36

The broad scope of organic food now takes up 5% of the total food market in the US, and even though produce and dairy comprise nearly half of organic food sales, grains are expected to take on larger growth patterns. According to the USDA and Euromonitor International, organic bread sales are expected to increase 39% between 2016 and 2021, along with 60% and 59% increases in savory snacks and confectionary, respectively.37 This demand increase for food-grade organic small grain production may prove critical for producers seeking to take the step into organics.

Long-term prospects in organic, food-grade small grains appear to be positive, as more Americans include organic products as a common staple of their everyday diet.38 Critical to any Minnesota small grains farmer is having a market to supply, but more importantly, current organic, food-grade small grain demand is outstripping available domestic supply. Today, less than 1% US farmland is certified organic by the USDA,39 and organic grains continue to be heavily imported from nations such as Romania and Turkey to support both food-grade and feed-grade markets.40 Further yet, several questions remain about the validity of these organic imports, suggesting that further investigation may result in additional protections for US organic farmers over time.41

Despite improving demand conditions and significant premiums associated with organic grains (Figure 5), there is a risk-reward decision process that comes along with transitioning to organic small grains. A 2015 report from California Certified Organic Farmers (CCOF) identified the transition period from conventional to organic practices as the primary barrier for producers entering the market. Any small grain producer wishing to produce organic grains must certify that soil is free of synthetic fertilizers and pesticides for three years, not
to mention that organic practice adoption may require more labor and paperwork, increase costs and initially decrease production per acre.\(^{42}\)

**Figure 5: United States Average Organic vs. Conventional Corn Price, 2007-2010**

To help American food markets meet demand with certified organic, food-grade grains, several private and public players have begun to offer—or consider—transitional certification programs. Private sector players, such as Kashi and Quality Assurance International (QAI), developed their own certified transitional standard for producers growing for their supply chain, providing a consumer-facing seal to reach a higher retail premium.\(^{43}\) While these programs provide an opportunity for transitioning organic producers to guarantee premiums, a publicly-supported transition certification process has not materialized. The USDA and the Organic Trade Association (OTA) briefly implemented a program for transitional certification, but questions about retail labeling and legal challenges from producers fearing a watering-down effect on organic products put a hold on a national program.

Organic small grain demand is present for food-grade producers, but the supply chain faces several challenges. This means producers do have an opportunity to consider a premium opportunity but must understand the challenges that come with transitioning to certified organic.

### B.1.2 Craft, Specialty, and Local Demands

Much like growing demand for organic products, consumer tastes for “craft” and “specialty” applications of small grains have also grown. The term “craft” generally refers to the explosive growth in demand for both “craft” quality beer and spirits, while “specialty” tends to align more closely with baked goods, flours, or integrations into other foods (e.g., salads).

Craft beer demand anecdotally and statistically leads these potential market drivers for small grains producers. While growth in craft beer demand is positive yet slowing down
nationwide, craft brewery numbers in Minnesota continue to grow annually at double digit rates.

Figure 6: Brewery Launches in Minnesota by Year, 2008-2017

Today, Minnesota is home to 150 breweries statewide, and as seen in 2017, craft brewing growth appears to be more focused in niche, localized markets. Of the 30 breweries that opened in Minnesota, the majority were located outside of the Twin Cities metro and included openings in 3 communities with populations of 1,000 or less. This localized, service-oriented brewery reflects national trends, as does the fact that demand for local craft beer inputs largely outstrips current supply levels. This means most two-row barley malted used for craft brewery production must be sourced from outside of Minnesota rather than through small grain producers in Minnesota or the United States.

These demand conditions are also beginning to transition over to the world of distilling. Though the 35 registered distilleries in operation in Minnesota today may seem like a small number, the majority of these distilleries have opened within the past seven years, reflecting a staggering national growth trend. Like craft brewing, many Minnesota distilleries take on a localized approach to defining a target market, as seen in the case of small-town distilleries in Osakis and Spring Grove. Further yet, two of the 35 distilleries also take on a unique “field-to-glass” model in which distillers are growing and processing their own grain. Though few sources cite where small grains are specifically being sourced, it is commonly understood that Minnesota’s distillers make strong efforts to find local ingredients to the extent possible. As more distilleries enter the scene, producers may find an additional market to produce rye, barley, and heritage wheats.

Meanwhile, the use of specialty grains for producing baked goods and cereals is also growing. Very little, if any, information is available from USDA-reported pricing on heritage wheat varieties such as emmer, spelt, or einkorn. Local demand data is also limited, but local players such as Baker’s Field have partnered with local heritage wheat growers to further advance the argument for locally grown and milled small grains. Consumers are seeking local, flavorful grains for breads in greater numbers, and some Minnesota bread makers are pushing for flavor testing to become more of a focus of grain production. Alongside this trend, more consumers are seeking grains or grain substitutes to address gluten sensitivity. Over 18 million Americans are said to experience digestive issues as a
result of gluten composition changes in modern wheat varieties, meaning a reversion to heritage wheat varieties may meet the needs of a growing population of gluten sensitive Americans—and Minnesotans.

**B.1.3 Value-Added Benefits for Producers**

Among a meeting of fellow producers, processors, food entrepreneurs, and researchers at a Small Grains Conference in Mankato, MN, Doug Hilgendorf shared the story of his farm’s transition to becoming an integrated processor and packer of small grain food products. Citing some of the demand conditions already spoken for—especially in the organic and specialty foods categories—Doug also spoke to another driving force for small grains growth. “The soil is working harder,” he told the crowd. In simple terms, Hilgendorf explained the need for farming practices that include cover crops as a tool for reducing soil erosion, water quality degradation, herbicide resistant weeds, new crop disease prevalence, and declines to populations of natural pollinators (e.g., bees). In his case, it led to an eventual transition to organic farming and on-site processing, but other producers in Minnesota may determine other ways to secure value-added benefits of small grain production.

As studies from Iowa State University and the University of Wisconsin-Madison demonstrate, small grains can boost environmental and profitability yields. The studies examined extended crop rotations made up of various combinations of conventional (e.g., corn) crops and small grains to test for efficiency. Extended crop rotations (i.e., 3-4 crops in a rotation) which included small grains performed most effectively in improving soil quality, reducing weed prevalence and need for herbicide usage, and improved the overall health and yield of the conventional crops (e.g., corn and soybeans) included within the rotation. Most importantly, the rotations which included small grains as a cover crop demonstrated lower gross returns and lower costs but similar—or higher—levels of profitability compared to conventional 2-year rotations. Each institution’s respective studies took place over an eight- to ten-year period and used specific methods for planting, tilling or plowing, and fertilizing that applied minimal chemicals and considered the land under management.

Similarly, the use of small grains may produce other value-added benefits for integrated livestock operations. Though this study focuses on food-grade small grains, multiple stakeholders interviewed suggested that opportunities may exist to integrate small grains into livestock feed, particularly as a hay using cereal rye or as a forage or silage crop for local dairy producers in southeastern Minnesota. Value-add for food-grade small grain production appears to be found most easily in a diversified 3- or 4-crop system, but further discussion may reveal for how small grains may better fit into a feed-grade system.

**B.2 Factor Conditions**

To meet a market demand, Minnesota’s small grains producers must be able to assess and respond to the factors that affect their ability to ultimately produce grain. Growing small grains today looks much different than it did in the days of original introductions of heritage wheat varieties in Minnesota in the 1870s. Many of these factor conditions fall outside of a producer’s control, but producers must be able to respond in the areas where control can be exercised—especially when deciding how to care for a crop.
B.1.1 Changing Climate and Changing Growth

When growing small grains, traditional wisdom suggests cooler climates are more effective, particularly for crops such as oats or barley. Market conditions are more likely to explain the decline in harvested acres for small grains in Minnesota, but changing climate also remains an important consideration.

As seen in Figures 7 and 8, weather hardiness is becoming a critical conversation for the viability of the small grains in scope for this research. Figure 7 shows current extreme minimum temperatures for various parts of Minnesota, which would contribute to overall hardiness for winter small grain crops. Figure 8, meanwhile, provides a comparison of plant hardiness zones between 1990 (left) and 2015 (right), showing how warmer climates have migrated further north into southern Minnesota.

**Figure 7: USDA Temperature Hardiness Zone Map (1976-2005)**

![USDA Temperature Hardiness Zone Map](image_url)
While these shifts may not pose a significant impact on small grain production alone, climate shifts experienced over time may stress native plant species and make it easier for non-native species, as well as their associated pathogens and insects, to move into the area. This change to local ecology is important to consider, as is the impact to growing prospects for various varieties of small grains.

**Figure 8: Transitions in American Plant Hardiness Zones, 1990-2015**

![Changing Plant Hardiness Zones](image)

Generally, however, small grains specialists simply point to adjusting to seasonal conditions to achieve optimal planting conditions. While significant discussion could be dedicated to management of several disease types that plague the small grains within scope, in-depth understanding of climate and soil conditions necessary for yield improvement may be most important for producers wishing to include small grains as part of a rotation strategy. Table 6 below provides general timelines for when small grains would be ideally planted and out of the ground, though growth purposes and ranges will vary by season and location.
### Table 6: Small Grains Growth Characteristics

<table>
<thead>
<tr>
<th>Grain Category</th>
<th>General Growth Range(s)</th>
<th>Ideal Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oats</strong></td>
<td>April 5 – September 10</td>
<td>• High test weight crop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cool, moist conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Avoidance of heat to increase speed of growth</td>
</tr>
<tr>
<td><strong>Buckwheat</strong></td>
<td>May 15 – September 1&lt;sup&gt;63&lt;/sup&gt;</td>
<td>• Mid-summer cover crop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Used as part of short-term recovery strategy</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Not frost or heat tolerant; cool, moist conditions</td>
</tr>
<tr>
<td><strong>Rye</strong></td>
<td>August 30 (CY) – Aug 30 (FY)</td>
<td>• Hardest cereal cover crop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Cool conditions and adapted for winter cover</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Planted in early fall to avoid harshest temperatures</td>
</tr>
<tr>
<td><strong>Barley</strong></td>
<td>Spring: April 5 – September 10</td>
<td>• Thrives best in cooler conditions</td>
</tr>
<tr>
<td></td>
<td>Winter: September 10 – August 15</td>
<td>• Winter varieties still under testing (UMN) to ensure yield and hardiness are sufficient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Different varieties (2-row, 6-row) may have different protein requirements</td>
</tr>
<tr>
<td><strong>Heritage wheats</strong></td>
<td>Winter: Aug. 5 – Sept. 5</td>
<td>• Planting before frost critical for winter varieties</td>
</tr>
<tr>
<td></td>
<td>Spring: April 5 – September 30</td>
<td>• Similar growth cycle and care as for modern wheat</td>
</tr>
</tbody>
</table>

### B.1.2 Storage and Processing Needs

For producers, the local small grains supply chain doesn’t end with the combine. Small grains must be stored and processed before moving down the next steps of the supply chain to food production or packing for purchase at the local grocery store or food cooperative. In Minnesota, storage and processing needs present challenges for small grains producers statewide, particularly in southern parts of the state.

Fortunately, storage requirements for each grain within scope largely fall in similar conditions. Each requires a specific period of cooling or warming, depending on the time of year, and these grains generally can be housed in ways similar to conventional cash crops of today’s Minnesota agricultural environment: corn and soybeans. Figure 9 includes a list of specific cooling requirements for some of the grains in scope.
Among the most important challenges for Minnesota producers wishing to engage in small grain production may be understanding how to store small-scale production and manage grain over time. Each grain will require separate storage facilities, as most end-users, processors, and aggregators place specific quality standards on grains for cleaning and eventual use in food-grade products. Depending on a producer’s position or ability to produce scale of small grains, bin storage may not be an option and bagging operations may be necessary, as is often the case for producers expanding a conventional corn operation. Most importantly, additional monitoring may be required over time as grains may be kept in storage from fall through early spring, depending on market conditions.

Processing of small grains, on the other hand, may be a little more uniform in nature. Infrastructure requirements for each grain are virtually similar, though the end-use of specific grains such as buckwheat may require different processes than the other grains included in scope. Malting, as opposed to milling, will also require use of different equipment but virtually uses the same processes known throughout the system.

The challenge for local small grains producers in Minnesota relates back to the scale and quality requirements set by processors throughout the state. Today’s processing infrastructure for small grains in Minnesota does not favor small producers, hence a emergence of some smaller, vertically-integrated producers and processors such as Sunrise Flour Mill or Whole Grain Milling. As further described in the Context for Strategy and Rivalry section below, the demand conditions for corn and soybeans have drastically scaled back the need for a local grain elevator to process oats, buckwheat, rye, or heritage wheat varieties, and large-scale grain end users such as General Mills have stopped purchasing several of Minnesota’s small grain varieties.

Demand conditions are changing in favor of small grains, but processing infrastructure struggles to maintain pace with the change of demand. In Minnesota and around the country, conversations among small grains advocates focus on the need for small-to-mid-
sized processing facilities for small grains, especially for organics. The difficulty for plant managers wishing to process the small grains in scope of this report may lie in the need to stop production, clean, and process specific grains. Though specific processes for rolling or grinding grains may be nearly identical in nature, each type of grain would need to be processed separately to achieve maximum value. Though there is significant interest and likely investment that will occur in these smaller, more nimble facilities, the current context for small grains processing is focused more on larger-scale production that isn’t conducive to the smaller-scale grains included in this report.

**B.3 Context for Strategy and Rivalry**

Small grain production in Minnesota falls within a spectrum of choices for producers to make. Many of the challenges facing small grains in Minnesota today follow the context of strategy and rivalry—not among firms, but among crops selected for production and eventual use in a variety of food- and feed-grade products. In Minnesota, local small grain supply chains must compete with two major forces: the profitability and scale of corn and soybeans, and the availability of close, large-scale substitutes to small grains from around the globe.

**B.3.1 Profitability, Scale, and Growth Challenges: Corn and Soybeans**

It is no secret that corn and soybean production dominates the Minnesota production landscape. In 2015, corn and soybeans accounted for 63% of Minnesota’s 25 million acres available for harvest, an amount that is significant by any account and contributes to Minnesota’s position as a leading producer of corn and soybeans in the United States. The Minnesota agricultural ecosystem relies on corn and soybean products primarily in a feed-grade capacity, though several food-grade applications may be present. As seen in Figure 10, corn and soybean production dominates the Minnesota landscape, particularly in the southern portion of the state.

The positioning of corn and soybeans above “king wheat” can be attributed to combination of significant research contributions reducing time to maturity and increasing yield in Minnesota’s climate, as well as changing economies of scale in American agriculture. Decades of research focused on disease and insect resistance, root strength and stability, maturity dates, yield, and efficient use of fertilizers and drain tiling have improved the ability to grow corn and soybeans in large scale and with higher profitability. Research is also focused on developing new markets for corn and soybeans, especially in the realm of renewable energy. Tax incentives and production mandates dating back to the 1980s have resulted in a boom in ethanol production, an area in which Minnesota ranks fifth nationwide.

Though ethanol production is generally experiencing some declines, a new trend of making bioproducts (e.g., household cleaners) from corn and soybeans is anticipated to create new demand conditions and further increase research and development investments. This increased drive for commercialized usage of corn and soybeans is likely to create further incentive for corn and soybean production as a cash crop.

Another notable consideration is the application of corn and soybeans as high-quality inputs for feed. As eloquently stated by University of Illinois animal science professor Hans Stein, “nobody goes away from corn and soybean meal unless they can save money.” Consistency and scale of soybean production, especially knowing the uniformity standards established by US soybean processor, makes it easier to formulate diets and, therefore,
create a product that American livestock producers can rely upon and improve over time. There is an increasing demand for transitional and organic feeds, but this rivalry cycle must be recognized as a powerful force that may limit immediate market growth for both food-grade and feed-grade small grains in Minnesota.

Despite a strong wave of research, development, and investment in the success of corn and soybean crops, conventional producers in Minnesota have faced four years of consistently tight profit margins or losses. Though small grains may not be considered a close substitute to corn and soybeans for food-grade purposes, producers are seeking alternative crops to avoid deteriorating operations and, eventually, bankruptcy.

**Figure 10: Land Cover by Category in Minnesota, 2009**

![Figure 10: Land Cover by Category in Minnesota, 2009](image)

B.3.2 Market Power: Global Grain Alternatives and Local Limits

When sourcing grains for both malting and processing, local industry giants such as General Mills and Rahr Malting notably do not source their small grains from Minnesota fields. Typically, Rahr sources its barley from Canadian and European sources, while General
Mills typically sources its oats from Canadian producers. Sourcing outside of the US can be attributed to these companies’ desire for economies of scale in both brewing and flour-based food products. Rahr tends to act as a provider of malted barley for both major beer producers in the US (e.g., Anheuser-Busch) as well as the largest brewers in the region, while General Mills and its direct competitors produce a variety of baked and consumer-packaged goods (CPGs) that use significant amounts of wheat, oat, and other small grains for sourcing.

When considering the needs of these manufacturers, reliability is a primary concern, much like with what is found in the world of corn and soybean feed. Creating a consistent, quality beer, bread, or cereal requires both uniformity and ability to produce grain on large-scale, meaning contracts for grain often come with standards that the average producer may not have the land or inputs to meet. To meet this demand, companies like Rahr and General Mills may not be able to source locally, let alone make it a priority. Profitability incentives do not always align closely the needs of local farming communities in Minnesota, so sourcing dynamics are likely to stay in place until scale and quality could align with larger-scale demands. This dynamic also comes into play with smaller food-grade end users, such as Seven Sundays, who seek to source small grains locally whenever it is feasible.

That is not to say that large-scale growth of small grains in Minnesota is not possible. Simply put, it is important to understand that industry dynamics—especially scaling and the idea of “feeding the world”—combined with the rise of corn and soybean production play a critical role in driving food-grade small grain sourcing outside of Minnesota.

B.4 Related and Supporting Industries

Related and supporting industries may use or directly support the growth of small grains, as applied using the Porter framework, which would include beer or baked goods industries. Related and supporting industries also include entities that would support local small grains supply chains outside of generating profit, such as nonprofit associations or government agencies. These institutions for collaboration (IFCs) enhance the competitiveness of small grains supply chains by providing research materials, convening stakeholders, and working collectively to advance the interests of all members in the supply chain—especially producers. Note, craft beer and distilling would be considered related and supporting industries, but as they were discussed extensively in Demand Conditions, emphasis in this section will be placed on cereal production and IFCs.

B.4.1 Cereal, Baked Goods, and Flour Production

Among Minnesota’s top industry clusters, the Food Processing and Manufacturing cluster employs 31,979 people as of 2016. Considered a “specialized” cluster among Minnesota’s largest industries, the Food Processing and Manufacturing cluster is ranked 8th in the nation by employment. Figure 11 below shows the growth of the cluster’s sub-categories, which include key end users of small grains such as baked goods, malt beverages, specialty foods and ingredients, and distilleries. Bars above and below the x-axis represent positive or negative job growth over an 18-year span, respectively, while solid red lines within the graphic represent growth expectations based upon national trends.
Digging deeper into these sub-clusters, the largest tracts of employment can be attributed to Specialty Foods production, along with Baked Goods and Dairy Products. Figure 12 illustrates these employment totals, along with rankings nationally. Those sub-clusters that rank among the top, most specialized industries in the country are highlighted in light green.

To understand where small grains fit into the supply chain most closely means digging further into the industries that comprise these clusters. Particularly, the Baked Goods sub-cluster is most likely to align closely with small grains production, as it contains flour production, breakfast cereal manufacturing, dry pasta manufacturing, and a variety of other snack food or bread-like food manufacturing (e.g., tortillas). Baked Goods have demonstrated significant growth, led within the sub-cluster by frozen pastries, breakfast cereal, and snack food manufacturing.
These numbers may not fully explain the demand conditions outlined for “local” or “specialty” versions of popular breakfast cereals or breads, but the level of specialization and job growth within this supporting industry would suggest that demand increases have changed employment outlooks, not to mention created a new pool of expertise for emerging cereal producers like Seven Sundays to tap into. The industry cluster methodology applied by Harvard Business School does not produce forward looking data, but it is clear that strong related and supporting industries are present in Minnesota to support local small grain supply chains—including emerging brewery and distillery opportunities.

**B.4.2 Institutions for Collaboration (IFC)**

To improve the case for growing small grains, several institutions for collaboration (IFCs)—entities that can advance the competitiveness of a given industry—operate in the Minnesota small grains ecosystem. Among the known leaders promoting objectives to increase small grain production are Green America’s Midwest Grains Initiative team, Practical Farmers of Iowa (PFI), and the Minnesota Sustainable Farming Association (SFA). The Midwest Grains Initiative has set a goal of reaching 5 million acres of small grain rotation in Minnesota, Wisconsin, Iowa, and Illinois, while PFI provides programs focused
on connecting new small grains farmers with growing resources, peer mentors, and cover crop cost-share programs. The Minnesota SFA, like PFI, places specific emphasis on soil management practices that include cover cropping, demonstrating the benefits of small grains for farmers who may be able to integrate these crops into livestock systems.

These three organizations stand out for their ability not only to provide resources for producers overcoming a critical knowledge gap—knowing how to grow small grains—but also as entities that convene producers in a meaningful way. The Midwest Grains Initiative takes a leading role in this effort, bringing together stakeholders across the spectrum of IFCs interested in advancing small grains, including PFI, while also including a variety of small grains producers throughout their 4-state coverage area. This can improve the viability of local small grains while also collecting valuable perspective on the challenges that face markets and producers alike. Other IFCs, like the University of Minnesota Extension office, provide local test farms, tours, and collaboration opportunities with plant researchers seeking to create new varieties of small grains to meet market demands.

Similar to these conveners and resource providers, the literature review revealed a new trend emerging nationwide: IFCs that unify and promote supply chains for food-grade small grains. Not unlike trade associations seen for other industries in Minnesota (e.g., medical devices), organizations like New York’s Greenmarket Regional Grains Project, Chicago’s Artisan Grains Collaborative, or the California Grain Campaign seek to advance the fortunes of producers and end users alike by promoting or creating new local markets for small grains. The Artisan Grains Collaborative (AGC) provides the most relevant case study, as many of its members—which include University of Illinois Extension—mirror similar entities that can be found in Minnesota and may present an opportunity for expansion into Minnesota and other Midwest states. Organizations like AGC may also provide a specific convening point for food-grade supply chains as opposed to other conveners (e.g., PFI or Midwest Grains Initiative) who may be agnostic to food- or feed-grade applications.

Fortunate for the growth of local small grains in Minnesota, previously mentioned IFCs as well as other state-level institutions—e.g., the Agricultural Utilization Research Institute (AURI) or Minnesota Department of Agriculture (MDA)—can greatly benefit from advocates and marketers of small grain producers. Stakeholders throughout the supply chain, ranging from aggregators (e.g., Albert Lea Seed House) to vertically-integrated producers (e.g., Whole Grain Milling) actively participate in the programs promoted by PFI, for example, to help producers navigate the complexities of small grains. This rich ecosystem of supporting entities provides necessary resources for local small grains producers to identify markets and ensure their growing practices meet quality standards.

B.5 Government and Chance

Combining the government and chance aspects of the diamond places necessary emphasis on the other four sectors, while also recognizing that government action and current events can play a critical role in shaping local small grains supply chains.

While significant attention could be devoted to long-term federal farm policy and its impacts on the shift from small grains to today’s conventional cash crops (i.e., corn and soybeans), Minnesota’s state policymakers produced funding in 1994 that resulted in what is now called the “Small Grain Initiative,” or SGI. This funding mechanism provides biennial
research support to the University of Minnesota’s College of Food, Agricultural, and Natural Resource Sciences (CFANS) department to initiate or accelerate problem-solving or opportunity research in support of Minnesota’s wheat and barley industry.\textsuperscript{84} This is a critical support link between other convening or market-promoting IFCs, producers, and academic institutions in the small grains ecosystem, especially knowing the SGI is focused primarily on “significant, comprehensive proposals.”\textsuperscript{85}

In the case of Minnesota small grains, government and chance tend to blend closely together. Current global pricing challenges for American producers of corn and soybeans,\textsuperscript{86} combined with growing demand for organic and “know your farmer” products in the marketplace have created a social “tipping point” for producers to consider small grains more seriously. Though it may be difficult to fully measure this phenomenon, anecdotal evidence gathered from stakeholder interviews suggest a shift toward small grains is underway. This shift is not a new concept; in fact, it may be a common factor in the landscape when markets shift lower.\textsuperscript{87} However, there appears to be more staying power in this “chance” event, as other demand conditions are aligned to maximize the effect of tariffs.

\textbf{C. Mapping Stakeholders in the Small Grain Supply Chain}

As the challenges and opportunities facing local small grain supply chains in Minnesota become clearer, a need for stakeholder mapping also becomes clear. While it may seem impossible to map every organization involved in the supply chain when tracking grain production into food-grade ingredients, it is important to start with a mapping effort to understand who is engaged. With an initial methodology, stakeholders can be identified and further study can continue and improve the state of the ecosystem.

\textbf{C.1 A Map of Local Small Grain Supply Chain Stakeholders}

In Section VIII of this report (pages 35, an initial map of local small grain supply chain stakeholders is included for the state of Minnesota. Not all stakeholders identified fall within state boundaries, but each stakeholder identified—especially for processing and purchase of grains—may play an important role in local dynamics depending on the region of Minnesota where a particular grain is grown.

The map in Section IX is coded as follows:

- **Millers, malters, processors, and buyers**: This group, denoted with blue markers, includes a variety of supply chain stakeholders who are most likely to purchase grain directly from a producer. This includes locations where grain can be milled or malted for food and beverage end users, or places where grain may be aggregated or purchased directly for eventual redistribution to other end users or purchasers globally. Several entities are encompassed within this classification, and each entity is tied to the grains within scope in some capacity.

- **Food end users (e.g., food entrepreneurs)**: This group, denoted with brown markers, includes any known stakeholder in the supply chain producing food products using the small grains in scope. Like other groups, this list may be limited in nature and require continuous grooming over time, as few, if any, sources encompass the full
scale of organizations sourcing small grains. This group also encompasses any known vertically integrated food end users, such as Whole Grain Milling.

- **Beverage end users (e.g., distilleries):** This group, denoted with gold markers, includes any known stakeholder in the supply chain producing beverage products using the small grains in scope. This group is largely sourced from available lists produced by IFCs in the craft brewing and distilling space and is likely to be more accurate and updated than the other groups included within the map.

- **Institutions for Collaboration (IFCs):** This group, denoted with lime-green markers, includes any institutions intending to support the small grains industry in Minnesota through a variety of shared services or convening opportunities. This list includes the IFCs mentioned previously, as well as others who may provide support to the industry and connect Minnesota’s local small grains supply chain to outside market forces.

Note that the map is simply a starting point; additional digging and maintenance should continue and be promoted, as discussed in recommendations, to advance further discussions with producers about where to go and how to bring grains to new markets. Ultimately, the map is only as accurate as the tools and lists used to produce it, relying upon both self-reporting and updated information available from IFCs and educational institutions engaged in the work of improving local supply chains. Further discussion on trends within the maps can be found in Section 5.

As a follow-up to this report, the map has been shared with Renewing the Countryside (RTC) for further development and flagging of further stakeholder interviews. The stakeholder map was produced using Google Maps GIS features as a means of helping RTC embed into an online format or share with other conveners in the food-grade small grains ecosystem.

### C.2. A Note on Organic and Conventional Grains Producers

Locating the processors and malters, food entrepreneurs, craft breweries and distilleries, and IFCs covers one portion of the local small grains supply chain—the “demand” side of the equation. There is also a need to connect with local producers willing to enter the supply chain and produce small grains from a variety of organic or conventional means.

Today, the Minnesota Department of Agriculture produces a webpage that lists a directory of organic producers from throughout the state, including certification dates and crops certified as organic. This list is directly sourced from USDA’s list of certified organic producers, which is regularly updated based upon changes in certification over time.

Though this report does not include a map of organic or conventional grains producers like the stakeholder map in Section VIII, data is available to begin including organic and conventional grain producers in Minnesota in future Minnesota small grains stakeholder maps. Fewer challenges exist to identify organic or transitioning producers, but through the work of IFCs such as Renewing the Countryside, Practical Farmers of Iowa, or the Sustainable Farming Association of Minnesota, potential for future collaboration exists to bring forward additional lists of producers to help food entrepreneurs, processors, and other entities seeking to increase small grain production to understand who is currently or seeking to produce small grains in the future. Future iterations of the map and list from Section VII would ideally include organic producers and lists of any conventional producers of food-grade small grains in a particular part of the state.
V. Challenges, Opportunities, and Recommendations

A. Trends in Local Small Grain Supply

After analyzing trends using Porter’s diamond framework and aligning available information with stakeholder interviews, a few key trends emerged from the research.

Most stakeholders in the supply chain see opportunity for small grains as a third or fourth crop rotation, including producers.88 This approach results from converging demand conditions and chance factors that may reduce the position of corn and soybean production as a solely viable option. However, it is unlikely that small grains will unseat corn and soybeans as the primary crop rotations of Minnesota farmers, and as a result, small grains are more likely to take on a rotational structure that serves to improve corn and soybean yields over time. This may be a slower model of growth for the grains within scope than displacing corn or soybeans entirely, but it would go toward meeting goals set by groups like the Midwest Grains Initiative.

Increasing presence of collaborative-style approaches found around the country, including Minnesota, will continue to drive market opportunities for small grain producers. Increasing demand for organic small grains, as well as growing markets for craft beer and spirits, mean producers will likely be on the search for contracts and resources for growing crops that may be unfamiliar to them. The current IFCs in the Minnesota small grains landscape, as well as potential new structures similar to the Artisan Grains Collaborative, will play a critical role in facilitating small grains production while also enhancing the connections between producer and end user.

Ease of growing and access to markets are a key determinant of small grains production declines around the state, as is weather cycles for specific grain types. Challenges in finding local processing facilities will continue to plague small grain production until new, small-to-mid-size options can be brought to market. Current small grain processing facilities are present in Minnesota and regional hubs out-of-state (e.g., Grand Forks), but distance to market may be an inhibitor for future small grains producers. Depending on the grain, limited to no infrastructure may be available within a two- to three-hour span (e.g., buckwheat). Producers must also be mindful of the need for cool, moist weather for most small grains in scope and manage growing seasons accordingly.

Small grains generally cost less to grow but also are less likely to produce higher revenue streams. Available academic studies from around the region demonstrate the ultimate value of three- to four-crop rotations that include small grains, especially the reduced costs that come with more limited use of fertilizers and insecticides. However, producers will need to balance lower cost of small grains with lower revenues in the interim period, especially if undergoing the three-year transition to organic production.

B. Emerging Opportunities for Small Grains in Minnesota

Several trends place a positive outlook on small grains in Minnesota, but a few additional opportunities are emerging within the ecosystem.
Based upon current and continuing demand conditions, differentiation through “specialty,” organic, and craft beer and spirit markets provide best market opportunities for food-grade small grains producers. The growth potential for both craft beer and distilling remain high, especially considering the wide gap between demand and local sourcing for small grains. This opportunity extends to the baked goods discussion in this research paper, whether including cereal production or snack foods. Placing an emphasis on “specialty” grains, especially heritage wheats, may provide beneficial to end users seeking to differentiate their product as locally grown or better for dietary needs.

New FODMAP studies to review grain gluten content and may reverse dietary aversion to gluten products. Anecdotal evidence throughout the literature review suggested that heritage wheats, beyond existing gluten-free options like oats, may be a solution for individuals facing dietary challenges as a result of gluten intolerance. New FODMAP studies are being conducted to better understand the impacts of modern wheat varieties on human diet, and if results prove beneficial for heritage wheats, additional market demand may drive production of the small grains within scope.

Increasing anecdotes of soil composition challenges, as well as global pricing issues for corn and soybeans, may drive further demand for producers to consider small grains. As IFCs continue to advocate alongside experienced producers to use small grains as a cover crop, more producers in Minnesota are likely to introduce small grains into their local supply chains. While the full impact of corn and soybean tariffs on producers remains unknown, time will provide further context for market impact and how this substitute for small grains may either decline or simply shift to new buyers.

C. Challenges Facing Small Grains in Minnesota

Despite a wealth of evidence and expression from stakeholders that local small grains supply chains are likely to experience growth, challenges remain. Several challenges have been noted throughout the research:

Scalability of sustainable small grains business models must continue to be addressed. Currently, viable production is only possible through large-scale contract or in small batches, as processing infrastructure has not yet advanced to match the current situation for small grains. Until processing infrastructure is more readily available on a local basis throughout the state, producers will still face challenges when trying to find ready, available markets for grains, especially if unable to meet quality standards of a food-grade buyer.

Increasing corporatization of agriculture remains a challenge for small producers seeking to keep up, especially if not already transitioning to organic or sustainable farming practices. As further research and development prioritizes corn and soybean production—or, more specifically, in yield and disease resistance—current agricultural practices that focus on intensive fertilization and disease management will continue and drive further complication of the industry. Small producers, particularly those who stay with small grains, may find challenges in overcoming rising input costs to compete.

Seed availability must follow market demand conditions. Local and regional seed producers, including university researchers, need a steady number of producers willing to contribute to seed variety trials that can improve the production of small grains. To meet demand or
advance demand conditions, additional seed producers are needed, especially for organics and feed-grade small grains.

D. Recommendations for Future Study and Action

To address these trends, opportunities, and challenges, several recommendations are being made. Some of these may be directed to Renewing the Countryside and advisory board members engaged in this research project, but most of these recommendations focus generally on IFCs engaged in improving market conditions for small grains. Recommendations include:

**Broaden current collaborative efforts to include larger array of stakeholders within the supply chain.** Several organizations are engaging producers directly to improve the production capacity of small grains, but creating further connection between producers and end users will increase likelihood of contract relationships and willingness to try crops that can be brought to market.

Knowing significant research and development is conducted at the University of Minnesota and other regional institutions, and new collaborations to advocate for studies that include “specialty” evaluation measures, such as taste. Current demand contexts focus heavily on “craft” or “specialty” versions of familiar small grain products, but few academic studies of small grains have focused specifically on more “subjective” markers, such as taste or sensation of fullness. AGI has been working with the University of Illinois to develop a platform for testing and evaluating grains. These efforts for more consumption-focused are most likely to be driven by IFCs in partnership universities and research laboratories but ultimately, a shift to studies that include these markers are more likely to align crops with specific markets and, potentially, create new food-grade applications.

**Continue to advance and evaluate cover crop cost-share programs, as well as transitional programs for new organic producers.** Cost-share programs, such as what is being offered by PFI, continue to proliferate and are now being extended to additional Midwestern states to increase small grain production as a cover crop. Pushing for additional cover crop usage, as well as promoting former USDA support mechanisms for transitioning organic farmers, is likely to increase the number of producers willing to include small grains as part of their operation. These frameworks are also likely to increase producer interaction with IFCs that can provide resources for growing small grains in effective ways.

**Add a local small grains collaborative that focuses on market-growth (e.g., Artisan Grains Collaborative) and can connect conveners with producers within the supply chain.** While it is typically not advised that an ecosystem add additional IFCs for the sake of adding, organizations like the Artisan Grain Collaborative may be an effective mechanism for aligning local market demands for “specialty” and “craft” food and beverage products with production capacity. Most importantly, organizations like these can connect stakeholders throughout the supply chain and may prove effective in uniting end users that typically don’t interact (e.g., baked goods and beer or spirits producers).
VI. Conclusion

Local small grains supply chains in Minnesota are present, yet remain underdeveloped in order to capture the full set of available market opportunities. Most of these areas of development are addressed in the final recommendations. However, the work of identifying and mapping stakeholders at all stages of the supply chain, not to mention analyzing industry dynamics, is a continuous venture that will have no end. So long as Minnesotans grow small grains, there will remain a need to provide support to the ecosystem producers, processors, end-users, researchers, and consumers.

Future research opportunities to support the state’s small grain ecosystem must also focus on the dynamics of the individual grains in scope. Similar processing infrastructure can and must exist to support producers of oats, buckwheat, barley, rye, wheat, and emerging small grain varieties, as these grains each carry similar milling or malting properties. However, each grain possesses specific food-grade properties that can be positioned in different ways for food-grade markets.

Additionally, future research should also include further emphasis on feed-grade opportunities for small grains. Several interviewees mentioned the capacity to include small-grains as part of third- or fourth-crop rotations either in integrated livestock operations, or simply growing small grains as a part of differentiated ration for cattle or hogs. This research did not fully explore feed-grade options as part of the scope conditions, but there are clear feed applications that can be found for local small grains in Minnesota.

Lastly, a key indicator of success for small grains in Minnesota will depend on the future development of small-to-mid-sized processing facilities. Interviewees suggest that interested investors are already considering new facilities throughout the state. Until local, nimble processing facilities come available, however, local producers of small grains may have to go a significant distance to mill or malt their grains. This may be the most critical barrier to entry for producers wishing to enter the small grains market and is an area that will require significant attention in future research.

Despite the current challenges facing local small grain supply chains, the future remains bright. If not for the favorable market demand conditions in place, Minnesota small grains producers can take hope from this: each stakeholder interviewed mentioned a positive outlook for the supply chain. “It may require harder work to search for markets,” but that still means an opportunity exist.
VII. Acknowledgements

**Advisory Board Participants:**
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- **Seven Sundays:** Brady Barnstable*

**Stakeholders Interviewed:**

- **Tom Ehrhardt,** Albert Lea Seed House
- **Steve Peterson,** formerly General Mills
- **Doug Hilgendorf,** Whole Grain Milling
- **Christopher Abbott,** Sprowt Labs
- **Theresa Keaveny,** Sustainable Farming Association of Minnesota
- **Kent Solberg,** Sustainable Farming Association of Minnesota
- **Lee DeHaan,** The Land Institute
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- **Shannon Schlecht,** Agricultural Utilization Research Institute
VIII. Initial Map of Local Small Grains Stakeholders
IX. Resources

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