

2019 | By: Erik Muckey, Research Assistant



Kernza® in Southern Minnesota: Assessing Local Viability of Intermediate Wheatgrass

Southwest Regional Sustainable
Development Partnership

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I. Executive Summary

Kernza®, an intermediate wheatgrass breed trademarked by The Land Institute, has demonstrated promise and potential market opportunities for producers in southern Minnesota. The benefits of the crop are numerous, ranging from improved soil protection, to potential nitrate reduction in groundwater sources, to providing a tasty grain source for inclusion in beer and a variety of breads, cereals, and other baked goods. Since beginning research on the crop in the 1980s, The Land Institute, the University of Minnesota's Forever Green Initiative, and other partnering research institutions have been able to discover substantial new knowledge about the crop, as well as improve yields, increase disease resistance, and identify opportunities for commercializing the grain.

Simply demonstrating benefits and potential market opportunities, however, does not lead to a healthy market structure for intermediate wheatgrass in southern Minnesota. Commercialization of the crop requires a supply chain fitted with the knowledge and tools to be successful, from production through processing and milling to delivering the grain to market. Commercialization also must address ongoing challenges facing intermediate wheatgrass as a crop, ranging from yield concerns to creating clear value propositions for the range of producers growing the crop in southern Minnesota.

With numerous opportunities and as well as challenges facing the commercialization of intermediate wheatgrass in southern Minnesota, key stakeholders in southern Minnesota sought to best understand what actions are needed to support producers and processors in the region, as well as community members and research institutions providing direct assistance. This research study provides a point-in-time analysis of the commercialization process for intermediate wheatgrass in southern Minnesota, outlining recommendations for producers, processors and millers, and collaborating institutions in the region and laying out a roadmap for decision-making.

While this report does not employ a specific framework for supply chain feasibility, the report relies heavily upon stakeholder interviews and fellow researchers to provide a clear, accurate picture of intermediate wheatgrass adoption. Using both individual interviews and a facilitated session with producers and processors in southern Minnesota, this report combines "on-the-ground" insights with available qualitative and quantitative research to provide a guide to all stakeholders in the commercialization system.

Keywords: feasibility analysis, intermediate wheatgrass, local ecosystems, early adoption

II. Introduction

In a state with a history of producing small grains for over a century,¹ there are few trends in grain production that are not taken up by Minnesota crop producers. Intermediate wheatgrass—widely recognized by The Land Institute’s trade name, Kernza®—is no exception, and several producers in southern Minnesota have either tested this emerging grain or seek to grow it at some point in the not-so-distant future.

What separates Kernza®, an emerging grain, from a fully-commercialized crop, such as the corn and soybeans that cover the southern Minnesota landscape? In short, an interconnected system of infrastructure that allows for continuous planting, growth, harvesting, processing, milling, and marketing of the grain. There also remains agronomic challenges in growing the crop at scale. To advance a crop from early adoption to commercialization requires an eye toward developing infrastructure at all points in the supply chain and meeting the needs of stakeholders engaged in the production of grain. A “point-in-time” analysis can demonstrate needs and the current environment for Kernza®—but action must be taken now.

While the ultimate goal of intermediate wheatgrass researchers has been to simultaneously develop a viable crop for large-scale production and create a market for the grain, this research focuses this goal on understanding local needs in southern Minnesota. The southern region of the University of Minnesota Regional Sustainable Development Partnership (RSDP) demonstrates prime characteristics for growing Kernza® but is experiencing gaps in infrastructure to advance beyond an early adoption stage.

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

- **Outline the commercialization process and necessary conditions to be met.** Intermediate wheatgrass—and its current leading brand, Kernza®—isn’t the first crop to meet a commercial need and reach market maturity. Understanding what factors lead to effective commercialization and matching those factors to current realities can provide an effective guide for any stakeholder engaged in the supply chain.
- **Identify key stakeholders, map involvement in southern Minnesota, and define the potential value propositions for producers and processors.** Though intermediate wheatgrass is in early stages of adoption, several stakeholders are involved in its development in southern Minnesota—and beyond. By outlining who is involved, current producers, processors, millers, and end-users can identify peers and resources necessary to start or expand production. Further, stakeholders may be able to better shape current value propositions for Kernza® or find new value.
- **Clearly state the trends, challenges, and opportunities facing intermediate wheatgrass commercialization in southern Minnesota, and provide decision-making frameworks for key stakeholders involved.** Combining the previously mentioned commercialization framework with insights gained from qualitative research, this report provides a point-in-time analysis for researchers and producers alike. As a result of this research, stakeholders engaged with the commercialization of intermediate wheatgrass could make informed decisions for future development.

III. Intermediate Wheatgrass in Minnesota: A Primer

A. What is Kernza®?

Intermediate wheatgrass is a sod-forming perennial grass included among a family of plants known for their seed heads: “ears” that imitate common wheat.² The key difference between intermediate wheatgrass and common wheat, as noted, is common wheat is an *annual* grain. Native to Europe and Western Asia,³ intermediate wheatgrass has been domesticated under trial in the United States through The Land Institute and several land-grant institutions—including the University of Minnesota—as a part of a movement toward perennial agriculture practices. Intermediate wheatgrass’ history as a crop in the United States stems from its original breeding purpose—use as a forage crop—and today, it is recommended for dual-use in forage to mitigate current risks with grain production.⁴

The benefits of intermediate wheatgrass stem from its multi-functional use. Deep roots maintain soil structure, sequester carbon, and limit nitrogen runoff,⁵ while simultaneously footing the bill as an effective cover crop and reducing topsoil loss. As a perennial grain, there is a reduced need for tilling and plowing year over year, and grain yields do not experience significant decline for up to 3 years.⁶ In terms of end use, currently available forms of intermediate wheatgrass can produce “impressive” amounts of biomass,⁷ and a “nutty,”⁸ low-gluten grain that has been used for traditional wheat-based food products, ranging from waffles to beer to potential inclusion in consumer-packaged goods. In short, ongoing research is demonstrating that intermediate wheatgrass could be incorporated into a variety of production systems, spanning food- and feed-grade purposes, grazing and forage, wellhead protection and setback areas, buffer strips, and rotational crops.



Figure 1: Kernza® Root System
(Source: The Land Institute)

What, then, is Kernza®? Simply put: it is a trademark name for a specific variety of intermediate wheatgrass that has undergone significant breeding, testing, and production to-date. In the attempt to produce and process intermediate wheatgrass at a pre-commercialization stage, The Land Institute trademarked its intermediate wheatgrass variety as “Kernza” in 2009, setting the stage for its rise as the leading private research institution in the United States focused on intermediate wheatgrass production. While several other research institutions around the country have begun to study intermediate wheatgrass more intently as interest in the crop grows, Kernza® has become synonymous with intermediate wheatgrass in many producer, processor, and end-user circles nationwide.

Throughout this report, Kernza® and intermediate wheatgrass may be used interchangeably when discussing agronomic conditions, research progress, and potential for the crop in southern

Minnesota. It is important to note, however, that Kernza® and intermediate wheatgrass are not one in the same, as other seed varieties for intermediate wheatgrass may emerge over time. At this point, however, Kernza® is the dominant seed type and, in most contexts, is considered synonymous with intermediate wheatgrass.

While intermediate wheatgrass has existed for centuries, Kernza® found greater awareness since its trademarking in 2009.⁹ Over that decade, several test plots have been planted in Minnesota, while also finding inclusion in Minnesota's restaurant scene (Birchwood Café) as well as in one of its largest consumer-packaged goods companies in General Mills. It is not a coincidence that trademarked seed variety has been followed by several new opportunities for commercialization, but the sudden rise of Kernza® should not lend to expectations that it is an immediately viable crop for producers in southern Minnesota.

Challenges remain for Kernza®'s development, namely through limited distribution channels, lack of current seed availability, and a variety of agronomic traits that remain in testing. The juxtaposition between these grand opportunities and difficult challenges is what drives the work of researchers and collaborating institutions supporting producers, processors, millers, and end users of Kernza®. It also serves as the driving purpose behind this report—a need to unveil the path forward for Kernza® in southern Minnesota.

B. Purpose and Scope of Research

Today, multiple public entities and private producers are engaged in growing Kernza® in southern Minnesota. The reasons for growing Kernza® range from plot testing to improving water quality to inclusion in intercropping or forage systems, but all producers face similar challenges: identifying seed availability, moving the crop from seeding to processing, and heightened risk associated with lack of insurance and continuous market availability. Limited content is available to-date that specifically addresses the needs of southern Minnesota Kernza® producers, processors, millers, and end users, let alone for all of greater Minnesota.

This report, as mentioned in the Introduction, seeks to address this gap in content through three actions:

- Outline necessary conditions for commercialization and aligning the framework to the current state of Kernza® production in southern Minnesota;
- Map stakeholders in the Kernza® ecosystem of southern Minnesota and define likely value propositions to meet the needs of producers, processors, millers, and end-users; and
- Identify the trends, challenges, and opportunities in southern Minnesota and create recommendations for stakeholders in the region, emphasizing future research.

Though large-scale commercialization efforts are in progress, this research study emphasizes local efforts to produce and market Kernza® grain. In alignment with the mission of the University of Minnesota Regional Sustainable Development Partnership, this research study focuses on what actions can be taken by community members served by the RSDP. That is not to say that commercialization options outside of the southern Minnesota region will not be addressed, but the scope of this research focuses on what can be done in the region of interest.

C. Literature Review

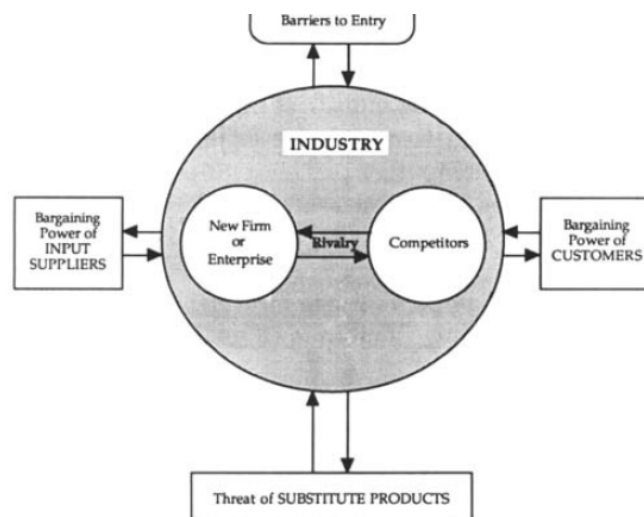
Like what has been produced for a previous overview of small grains in southeast Minnesota,¹⁰ this report is designed to provide a characteristic view of an “industry” undergoing commercialization. While an emphasis is placed on key stakeholder groups in southern Minnesota (e.g. producers), keeping an eye on commercialization assumes that all stakeholder groups involved in the production and use of Kernza® means taking on research methods that create an industry-wide picture. Though the impact and assumptions surrounding perennial agriculture create unique opportunities and challenges for commercialization, applying the learnings from previous grain commercialization may provide tools and lessons for Kernza® commercialization.

Like what is seen in other grain studies, the methodology for this research does not benefit from a wealth of literature focused on grain supply chains around the globe. Other grain supply chain studies focus on sustainability of growing practices and impact on consumer choices,¹¹ study specific types of grain such as wheat,¹² or take on an approach that is more focused on a nationwide or globalized scale.¹³ Additionally, this report faces the challenge of limited content available on Kernza® or intermediate wheatgrass generally. This is among the first research pieces to place focus on a local region’s ability to produce, process, convert, and market Kernza®, adding to recent studies completed by students at the University of Minnesota’s Carlson School of Management¹⁴ and a partnership of research collaborators led by Green Lands Blue Waters.¹⁵

To achieve the research purposes outlined above, available literature guides us down a similar path to previous Minnesota-focused grain studies: applying a stakeholder interview process used by Canadian officials to assess their nationwide grains supply chain,¹⁶ and applying competitive analysis frameworks found in Michael Porter’s assessments of industry strength.¹⁷

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 shippers¹⁸—is far different from this work, the heavy emphasis on bilateral interviews with a variety of stakeholders in the field is applied for this report. While it is not the only interview technique that would be effective for this research, it does illuminate why interviews provide effective information. Emerging supply chains may lack reliable quantitative information, especially knowing differences in agronomic conditions

Figure 2: Adapted Version of Porter’s Five Forces
(Source: Wilson, Wade, and Leones, 1990)



from region to region. Interviews may provide a knowledge link where it simply isn't possible to find consistent information.

Meanwhile, Porter's Five Forces and Competitive Analysis frameworks may not be the first thought that comes to mind when discussing commercialization of emerging grains. And yet, Porter's frameworks have been frequently adapted in crop commercialization and agribusiness research^{19,20,21} as a tool for understanding what makes a crop—and a supporting industry—successful. In particular, the work of Wilson, Wade, and Leones serves as a guide for applying Porter's Five Forces in the context of emerging industrial crops, using the example of a then-emerging Lesquerella plant. A Five Forces analysis can prove useful in terms of understanding the attractiveness of an industry from a particular point of view. In this case, Porter's competitive framework may be more relevant, as Five Forces tends not to include policy or cultural lenses.

While these two focus areas of literature guide the methodology of this report, one additional scope of thought also guides the analysis: understanding consumer value. For reports such as these, the idea of creating value generally tends to focus on what is best for crop producers. That is certainly the case here. However, current agribusiness strategy literature emphasizes that consumer value perception is a key tenet for producer strategy. In other words, what is good for a consumer—i.e. the benefits of a particular crop outweigh all other options²²—is good for the producer. This idea is critical for understanding the potential for Kernza®'s food-grade and feed-grade benefits, but also why Kernza® may present unique ecological impact that is relevant for both consumers and producers. In other words, when consumer value is aligned with producer value, a crop may be more likely to reach commercialization.

D. Methodology

Like previous small grains research, this report takes the mixed approach suggested by the literature: Porter diamond analysis to outline commercialization factors, and an interview protocol that identifies the needs of stakeholders in southern Minnesota. Augmenting the approach used by Wilson, Wade, and Leones with an additional policy lens—the diamond analysis—gives a clear view of the factor and demand conditions at play for Kernza®, as well as the necessary collaborations, suppliers, and rivalry conditions that drive commercialization success.

Interviews were conducted with thought leaders, researchers, and current producers of Kernza® throughout Minnesota and beyond. These interviews provided relevant background information to inform the diamond analysis, while also guiding questions for a different interview approach—one involving a forum of producers, processors, and millers interested in Kernza® in southern Minnesota.

A forum was held as a means to gather feedback on the state of Kernza®, held in Fairmont, Minnesota on December 7, 2018. The agenda, included in Appendix A, included a discussion of how Kernza® moves from seed purchase to market distribution, as well as overviews of particular cases from southern Minnesota where Kernza® has been planted. These overviews laid a foundation for attendees to ask questions about agronomic and market conditions, as well as outline specific research priorities. In a sense, the forum was designed not only to gather feedback, but give producers, processors, and millers in the

room a voice to express needs and shape future research. Forum results are included within the diamond analysis, as well as recommendations at the end of the report and the beginnings of a southern Minnesota Kernza® stakeholder map.

To complete the approach to the research question, a set of value propositions are considered—conventional, organic, forage and grazing, and wellhead protection. Combining available information, informed assumptions about valuation, and economic costing approaches developed by the University of Minnesota and other research institutions, this report explores current value to consumers—and how it translates to producer value.

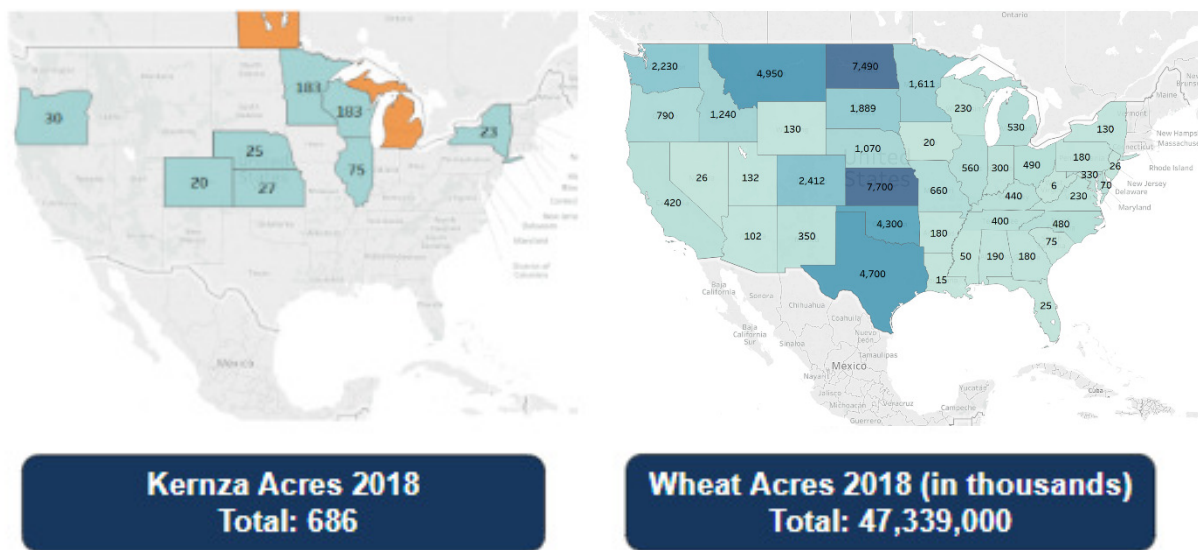
Taken together, this approach gives a point-in-time analysis of the Kernza® ecosystem in southern Minnesota. This methodology is limited by challenges in securing quantitative data but also by the dynamic nature of change in Kernza®’s commercial development. As such, this methodology is useful in that it meets research goals and sets a precedent for future study, but the report will naturally “expire” and should be acted upon by key stakeholders with a sense of relative urgency.

IV. The State of Intermediate Wheatgrass in Southern Minnesota

A. Kernza® in Minnesota

Minnesota is not new to small grains, let alone standing among leading states around the country in terms of acreage planted for several small grain varieties.²³ Kernza® is no exception, as Minnesota shares the mantle with Wisconsin as the top location for acreage planted in 2018. Figure 3 below displays current Kernza® acreage, while also showing current wheat acreage—one of Kernza®’s closest agronomic relatives. 686 acres of Kernza® were planted in the United States in 2018, with 183 acres planted in Minnesota.

Figure 3: Comparison of Kernza® and Conventional Wheat Acreage in United States, 2018
(Source: Carlson School of Management Supply Chain Analysis)



Kernza® is unlikely to surpass wheat acreage in a foreseeable future, but Figure 1 frames the potential for future growth patterns as commercialization becomes possible.²⁴ In Minnesota, most Kernza® plots can be found in the southern and southeastern parts of the state, spanning a pair of RSDP regions—inspiring this research.

Beyond Kernza® producers, Minnesota also plays host to a leading Kernza® processor (RL Magnusson Growers) as well as a leading consumer-package goods (CPG) corporation interested in including Kernza® in its products (General Mills).²⁵ The latter has chosen to select a preferred processor for its Kernza® sourcing (Healthy Food Ingredients) while also providing substantial funding to the University of Minnesota to continue its Kernza® research. Of additional interest, University of Minnesota alumni Lee DeHaan serves as the Lead Kernza® Domestication Scientist at The Land Institute. Minnesota’s ties to Kernza® are strong in several aspects that contribute to a high potential crop ecosystem.

Production of Kernza®, as discussed in the introduction, possesses many benefits while encountering challenges both in terms of agronomic characteristics as well as key supply chain factors (e.g. seed availability). As a result, most research found on Kernza® to-date has focused on planting, harvesting, and processing best practices, as well as improvements that support supply chain development (e.g. breeding a “dehulled” Kernza®).

Known agronomic characteristics for production are listed in Table 1, though it is important to note that research continues to derive a clearer set of best practices for Kernza® production. Efforts to create recommendations for production best practices are currently underway through the Forever Green Initiative at the University of Minnesota.²⁶

Table 1: Production Best Practices and Agronomic Characteristics, Kernza®
(Source: Carlson School of Management Supply Chain Study)

Focus Area	Characteristics
Planting	<ul style="list-style-type: none"> September planting is optimal Four-week minimum germination period before frost Modification to existing equipment is necessary for planting at the proper depth and spacing Establishment difficult without direct researcher assistance
Harvest	<ul style="list-style-type: none"> August-September Identifying optimal time is difficult; if harvested too late the seed shatters, too early and seed weight is low
Yield	<ul style="list-style-type: none"> Yield for Cycle Five Kernza is ~250-1000 pounds per acre Low yields from marginal land, higher on prime land Yields peak in years two and three, drop >50% in year four Seed weight for each cycle increasing, currently ~40% of wheat
Management	<ul style="list-style-type: none"> Higher labor and equipment costs year one, lower cost years two to three Weed pressure can make organic production challenging, esp. year three Producer demand for seed outstrips seed supply Information on agricultural best practices remain in development

Capturing and sharing information on processing best practices is equally as important as production guidance. Today, processing capacity in Minnesota is largely limited either to larger-scale grass-seed processors, like RL Magnusson Growers, or to locally-sourced processors such as Cal Spronk.²⁷ Sourcing a processor is one part of the equation that

needs to be addressed in the ecosystem, but challenges with the processing itself are also a key point of concern.

Today, Kernza® processing faces three key challenges:²⁸

- **Intensive nature of processing** requires cleaning, dehulling, and conditioning to meet optimal storage conditions (13% moisture).
- **Small kernel size** requires specialized equipment not necessary for traditional substitutes (i.e. conventional wheat) and may not reach profitable yield levels.
- **Low density** causes more loss in machines such as color sorters that may also contribute to lower end yield.

The highest priority of these challenges in agronomic research are in-progress efforts to breed a dehulled version of Kernza®²⁹ while also continuing long-term efforts to increase kernel size—potential size has doubled since 2001.³⁰ This research will prove critical over time, as seed size also contributes directly to challenges with traditional milling for flour and various mixes (e.g. bread). Minnesota’s community of small-grade millers and food and beverage entrepreneur community have contributed greatly to the development of Kernza® in its current stage, but as stated frequently by Minnesota-based stakeholders, “we need agribusiness” if Kernza® is to achieve commercial success.³¹

B. Diamond Analysis

To understand the steps to move forward towards commercialization, previous studies have focused on developing an effective Kernza® supply chain in Minnesota.³² This approach offers valuable perspective as it addresses the key concerns above—a holistic model that drives processing, milling, and commercial scale. In this instance, however, the focus is not solely on the supply chain and must take a broader stroke—one focused on the forces that contribute to a thriving, successful industry.

Enter: Porter’s theory of competitiveness. Porter’s theory asserts that using the diamond analysis of a particular cluster or industry can reveal how different elements interact to form what would be considered a successful cluster—or in this case, crop ecosystem.³³ Porter’s diamond analysis framework is comprised of four primary elements:

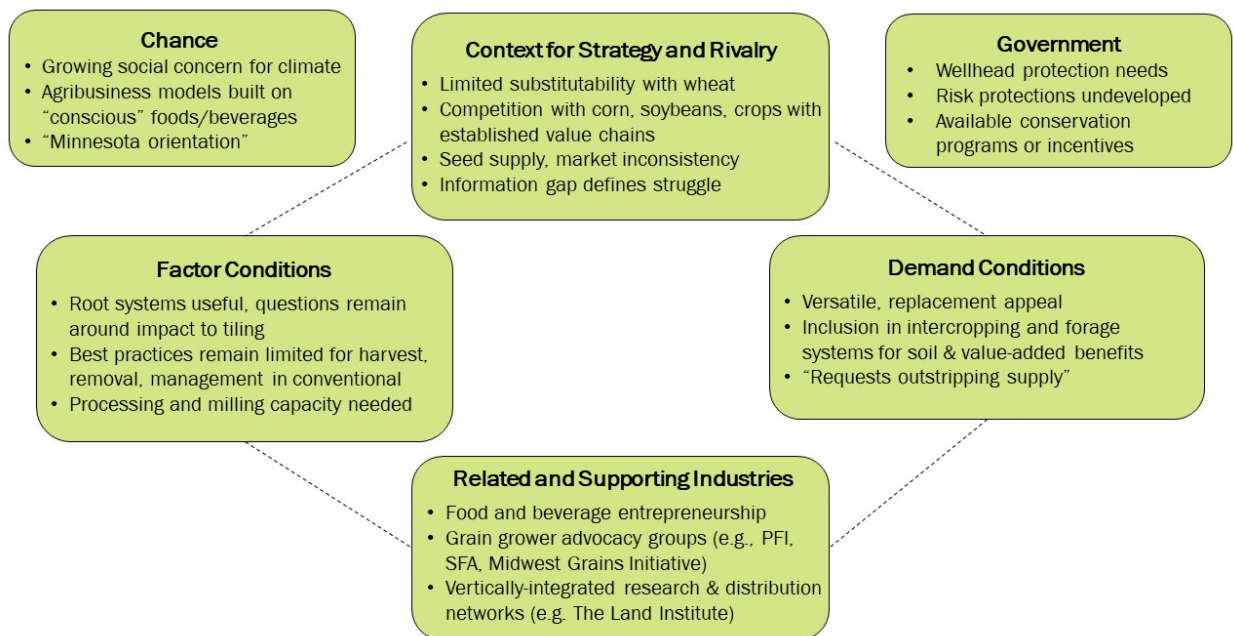
- **Factor conditions:** Locally available inputs with specialized quality or quantity including human, physical, and knowledge capital, and infrastructure. Factor conditions are unique to a supply chain and set it apart from would-be imitators.
- **Demand conditions:** Sophisticated and demanding local 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, drive supply chain upgrades, and stimulate collaboration.
- **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, both of which extend beyond the more widely-known Five Forces and account for collaborative influences beyond the “market”³⁴:

- **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 4 outlines the diamond analysis conducted for Kernza® in southern Minnesota, with inclusion of factors that impact the entirety of Minnesota.

Figure 4: Diamond Analysis, Kernza® in Southern Minnesota



Factor and demand conditions serve to gauge Kernza®’s commercialization potential effectively, as does the inclusion of related and supporting industries and government and nonprofit collaborators. “Context for firm strategy and rivalry” does not directly translate to a crop ecosystem, as the Kernza® ecosystem not act like an industry comprised of firms competing against one another. Instead, context for strategy and rivalry more closely aligns with Porter’s “Power of Substitutes” principle in a Five Forces analysis, giving a better picture of how Kernza® overcomes the value of available substitutes and becomes the “crop of choice” for a producer, processor, miller or malter, and end user.

The following subsections explain more clearly the details behind each aspect of the diamond analysis.

B.1 Demand Conditions

While it is clear that seed availability and a lack of a clear, trusted distributor is creating challenges for Kernza® markets, demand conditions are favorable to the crop and serve as a driving force for continued testing, development, and interest all along the value chain. The strength of Kernza®'s demand conditions can be attributed to the food- and feed-grade benefits discovered through research-to-date, as well as its ecological benefits as a perennial grain with incredibly deep root systems.

Though there are challenges facing Kernza® at nearly every point in production and the supply chain, its demand conditions (Figure 5) can explain Kernza®'s potential value in commercialization.

Figure 5: Demand Conditions for Kernza®

- **Versatile use of Kernza® makes it appealing for several food- and feed-grade uses, especially as a replacement for higher gluten products.** Despite limited supply, Kernza® has been successfully used in artisan food products by Birchwood Café and Baker's Field in Minneapolis, as well as in a pair of beers produced by Patagonia Provisions and Bang Brewing.³⁵ Its lower gluten content presents challenges for use as a replacement for flour in bread, but beer appears to be a key market for its grain. Its current state also produces significant biomass, something valuable for feed applications.
- **Intercropping and forage applications make it an appealing crop for its demonstrated soil and value-added benefits.** Kernza®'s perennial nature proves a natural fit for soil cover over a pattern of multiple years, and its deep root systems provide a potential solution for reducing nitrate leaching and carbon loss. This plays into Kernza®'s original purpose—forage application—with ongoing research focused on increasing grain size for food- and feed-grade application. This means Kernza® may first and foremost provide a rotational or forage solution while also capitalizing on grain potential, creating a potentially higher-value agricultural operation.
- **Demand for Kernza® in artisan foods and beers outstrips available supply.** Anecdotally, more requests are being made for Kernza® flour at locations such as Baker's Field in Minneapolis, and more brewers in Minnesota—especially near wellhead protection area—are expressing interest in using the grain. This could be attributed to several likely reasons for market appeal—taste, demand for “socially conscious” products—but ultimately, consumption has outpaced supply of Kernza® in the market. Much of this phenomenon results from a lack of supply rather than growth in demand, yet it is clear through investments made by General Mills and beer demonstrations from Bang! Brewing and Fair State Brewing Cooperative that further demand capacity is possible.

B.2 Factor Conditions

Factor conditions refer more closely to the inputs or constraints necessary to help an industry grow. Though enough knowledge has been distributed and carried out to help grow, process, and convert initial batches of Kernza® for use, factor conditions must be further refined in order for commercialization to be possible.

Growing and processing guides remain the most critical factor condition to consider at this time, followed closely by processing and milling infrastructure needs in southern Minnesota. Another key factor condition to consider is Kernza®'s root systems fit into the current agricultural landscape in southern Minnesota—in particular, its deep root systems. Figure 6 outlines the factor conditions for Kernza® in Porter's diamond analysis framework.

Figure 6: Factor Conditions for Kernza®

- **Best practices for growth and management, particularly in conventional systems, remain in development—for now.** Through initiatives sponsored by the University of Minnesota, a set of recommendations for growth and management of Kernza® is in draft and prepared for distribution. Continued distribution of content like these grower recommendations will make Kernza® production more accessible in southern Minnesota, yet challenges remain with regard to conventional systems. No approved herbicides are in use for conventional Kernza® growth,³⁶ for example, as nearly food-grade Kernza® production has occurred as part of organic operations.
- **Processing and milling infrastructure are critical needs in the supply chain for southern Minnesota.** While there are multiple individuals and organizations capable of cleaning Kernza® in southern Minnesota, dehulling remains a critical barrier for the expansion of the Kernza® supply chain. Just as important, milling capacity must be taken into account, as both equipment needs are unique to seed size and supply must be sufficient to justify the capacity to mill. One known miller in the region has milled similar products, but additional milling markets must be identified to match potential production scale.
- **Kernza® root systems provide substantial benefit for buffer strips and wellhead protection, but questions remain about usage on tiled land.** Among the top discussion points at a producer-, processor-, and miller-focused forum in Fairmont, MN was not only the potential benefits of Kernza® root systems but also potential shortfalls. In particular, concern was raised over Kernza® impacts to drain tiling installed in corn and soybean fields and how adding Kernza® to the rotation may damage tiling. In southern Minnesota, this is a critical research question that merits attention for future production.

B.3 Context for Strategy and Rivalry

Growing Kernza® outside of research plots must take into account not just scale of planting additional acres, but the “global” set of choices that all stakeholders in the ecosystem must make. In other words, commercialization is dependent on how well Kernza® competes with immediate substitutes—i.e. wheat and cover crops—as well as any other crops that take up most of southern Minnesota’s acreage. Rivalry for cropland is strong, despite conditions that may soften the advantage for crops widely grown in the region (e.g. corn and soybeans). Figure 7 outlines the context for strategy and rivalry in the case of Kernza®.

Figure 7: Context for Strategy and Rivalry, Kernza®

- **Kernza®’s close relation to wheat and perennial nature make it a potential wheat substitute, but gluten content poses a challenge in end use.** “King wheat” does not dominate acreage to the same extent corn and soybeans do in southern Minnesota, but its properties are not easily replaced by Kernza®. Chief among these food-grade properties are its gluten content, which limits Kernza®’s ability to be used in rising breads. Kernza® can be integrated by smaller amounts, but rarely does it stand alone as a substitute for wheat in food products.
- **Corn and soybeans dominate southern Minnesota acreage, as do several other crops with more established value chains.** Kernza® isn’t only competing with its closest agronomic relatives. It must also compete with other crop cycles for land use, especially corn and soybean production in southwest Minnesota. In order to be viable for commercial scale, the value propositions for Kernza® must be sufficient to be included among corn, soybeans, and other commercialized crops with established supply chains (e.g. oats).
- **Producers are unlikely to choose Kernza® over other crops, in current state, with inconsistency in seed availability and market access—i.e. profitability and lack of insurance.** Limited to no foundation seed will be made available to producers until later in 2019. At the same time, no clear distribution partner has emerged as a buyer and marketer of harvested and cleaned Kernza®. As such, seed availability and market access suggest little confidence in the current supply chain.
- **Information gaps define the current state of the Kernza® ecosystem, though program opportunities exist to change this gap.** Attendees of the Fairmont forum noted gaps in communication from The Land Institute on current growing status and availability of seed, let alone best practices for growing Kernza®. This will remain a challenge until local actors—especially for Minnesota’s research institutions—identify means to connect with all players in the supply chain and provide continuous, accurate information to increase producer, processor, and miller efficacy.

B.4 Related and Supporting Industries

The words “related and supporting industries” apply to more than just the suppliers and customers of Kernza® producers. The term also applies to research and advocacy organizations—called “Institutions for Collaboration,” or IFCs—that support the needs of industry players. In this case, the key stakeholders of interest include food and beverage end users, as well as the research organizations that drive Kernza® development.

In the case of Kernza®, related and supporting industries (Figure 8) include Minnesota’s unique ecosystem of food and beverage companies at both artisan and commercial-scale, as well as a variety of research and nonprofit partners advancing grain commercialization and policy environments.

Figure 8: Related and Supporting Industries, Kernza®

- **A wealth of emerging and established food and beverage companies in Minnesota suggests there are several opportunities to scale Kernza® locally through artisan and CPG contexts.** Several food-grade uses of Kernza® have been developed in Minnesota. This, on its own, is helpful to local Kernza® supply chains, but more important yet is Minnesota’s large and innovative food and beverage cluster. This encompasses smaller-growth artisan options (e.g. craft brewing, specialty restaurants) as well as established CPG players more capable of achieving wide-scale (e.g. flour-based products).
- **Grain grower advocacy groups, such as Practical Farmers of Iowa, may be helpful collaborators to support scaling and distribution networks as they develop.** Small grain production is receiving greater attention and funding in the region thanks to collaborators convening stakeholders and advancing grower interests. New grants secured by Practical Farmers of Iowa (PFI) will expand its small grain production support programs to five additional states, including Minnesota, while groups such as Renewing the Countryside are partnering with food-grade grain collaboratives to advance supply chain upgrades for small grains. Though Kernza® will need specialized attention to advance to the next stage of commercialization, its rising market potential can benefit from the advancement of other small grains.
- **Commercialization and distribution efforts have returned to vertically-integrated sources, like The Land Institute, to better coordinate scaling efforts in early supply chain development.** Kernza®’s ability to reach new markets is dependent on the network of related industries—distribution, processing, and milling, as prime examples—that can move grain through the supply chain. Knowing the current challenges facing seed availability and information sharing, as well as recent failures within the supply chain to provide a viable distribution channel, research institutions are consolidating their ability to manage growth via communication and distribution channels. The Land Institute and the University of Minnesota’s Forever Green Initiative both have hired or will be hiring commercialization specialists to guide further development of the space.

B.5 Government and Chance

The two non-core factors of a diamond analysis, government and chance, describe aspects of a commercialization strategy that may not be directly felt. Policy environments and events that are out of an industry player's control may not seem like things to consider, but for crop production to increase in scale, several considerations must be made in terms of government support and uncontrollable trends in the market.

Figure 9 outlines the most critical areas of influence for policy and public sector involvement in the Kernza® ecosystem. Today, Kernza®'s value may be best served through wellhead protection and setback areas that provide added value for southern Minnesota communities. At the same time, policy challenges must be addressed, particularly for risk protections and grower incentives.

Figure 9: Government Impacts, Kernza®

- **Wellhead protection needs in southern Minnesota, particularly because of high nitrogen application in corn production, drive public sector production of Kernza®.** In south central Minnesota, multiple examples exist in which Kernza® is planted on publicly-owned land—whether held by a county rural water district or a municipality—for the purposes of reducing nitrate leakage into water systems. While the plots are not yet old enough to demonstrate what is known in research trials, the sudden proliferation of communities expressing interest in using Kernza® as a tool for water quality uses shows promise—both for intended impact and its potential as a value-added revenue source for rural communities.
- **Limited risk protection for Kernza® growers remains a critical deterrent to scalability.** New opportunities are emerging to test Kernza® as part of risk management trials,³⁷ but the process of establishing insurance protections for a crop requires sufficient scale for data trials over a period of years. As such, lack of risk protections will dampen growth for some time and will require current collaborating institutions to consider their own offerings to grower networks willing to adopt Kernza®.
- **Availability of and eligibility for conservation programs and other growing incentives must remain a key fixture of ecosystem development.** Like the wellhead protection examples that have appeared in south central Minnesota, Minnesota state and local policy leaders may be able to generate further value propositions for Kernza® through conservation programs, setback areas, and grower groups. In February 2017, the Minnesota NRCS office approved the use of Kernza® in contour buffer strips, filter strips, and cross wind traps to protect waterways from agricultural runoff.³⁸ This appeals very much to the use of Kernza® as a perennial cover crop and its impactful root systems, but this theme can also be applied to Kernza®'s overwhelming usage in organic systems in south central Minnesota. Kernza® may be a valuable tool not only as part of a transitional organic system but also in ongoing policy discussions focused on reducing barriers to organic transition.

Chance may appear fickle, and for good reason: it doesn't have a home anywhere else! Forces of chance may be purely opportunistic or create challenges that are hard to overcome. As such, it is important to keep in mind that these factors are not lesser than the other forces in the diamond analysis, but they are more difficult to control than demand or factor conditions, for example. In short, chance factors (Figure 10) are forces that go well beyond the scope of Kernza®.

Figure 10: Chance Factors, Kernza®

- **Looming forces socially and politically to address climate change may drive further Kernza® development as a conservation necessity.** While it should not be assumed that Kernza® is a climate change solution, there is a growing amount of literature and research interest being placed in its contribution to improving ecological health—especially as a perennial grain. As nations, especially the United States, continue to consider and identify actions to take to stem back climate change in all sectors, the ultimate impacts of Kernza® and perennial agriculture may prove beneficial for the crop's development. Regardless of what point in the commercialization process is advanced by this phenomenon, a world that is growing bolder in addressing climate effects will continue to benefit Kernza®.
- **As Patagonia and General Mills test and implement more socially-conscious food and beverage brands, more may follow the example with Kernza®.** Consumer demand in food spaces can be incredibly fickle; multiple factors, many of which may be difficult to control, drive market demand and may make it difficult for producers to rely on a singular value proposition for a crop. However, market demand for organic baked goods show continuous, upward trends, as does demand for locally-produced goods as part of the push for “know your food source” programs come to play. This could be related to growing societal recognition that more needs to be done to improve the environment, but it also ties into a thematic shift toward “craft” or “quality” food products.
- **Minnesota's unique “orientation” toward Kernza®—in terms of geography, resources, and infrastructure—make it an ideal location for future investment and scale.** Chance factors may present the appearance that “stars are aligning,” and for this particular factor, Minnesota's ties to some of the biggest players in Kernza®—from research to food products—positions it for unique local opportunities that may not be present in other states. The most prominent consideration is the investment made by General Mills into research through the Forever Green Initiative, but the close proximity of producers to processors, millers, end-users, and researchers makes for the beginnings of a strong Kernza® industry cluster here in Minnesota.

The diamond analysis can provide an incredible amount of information in terms of commercialization trends and potential. What is clear: demand conditions, both private and public, are the key driver behind Kernza®'s development, alongside unique chance factors

that position southern Minnesota favorably for the crop's development. However, challenges remain, particularly in terms of inputs and infrastructure necessary to scale, and until obstacles are cleared, Kernza®'s potential for scale will remain just that—potential. The question is: what is the best path to sustain the path of development?

C. Value Proposition for Kernza®

There is no clear answer for the “best” path to commercialization for Kernza® in southern Minnesota, but for good reason: there are multiple value propositions that can serve the interests of producers and processors, as well as the communities supporting these stakeholders. These specific opportunities include organic and conventional grain production, forage and grazing systems, wellhead protection and setback areas, and biomass applications.

Creating value for consumers, and therefore value for private and public entities alike, should serve as the primary consideration for each of these four applications. To understand consumer value is to understand the “why”—the benefits that encourage producers to choose Kernza® over other options to meet their needs. The challenge, however, is operating with inconsistent pricing data, let alone an underdeveloped sense of cost for both organic and conventional systems as best practices continue to emerge. What is known about the value of Kernza® to consumers and stakeholders in southern Minnesota?

- **The value-added nature of Kernza® in wellhead protection and setback areas, as well as in forage and grazing applications, are a key starting point for local feasibility.** In southern Minnesota, a small number of Kernza® producers aren't private entities. They are communities and rural water districts seeking Kernza®'s benefits as a tool working against nitrate leeching. Though the results on nitrate reduction are not yet determined, what has been successful is the means by which it has united community stakeholders—i.e. local harvesting and processing—while also generating creative means of financing land purchase and securing seed. Likewise, forage and grazing applications show promise in research conducted at the University of Wisconsin-Madison and University of Minnesota-Morris, though results remain preliminary. Because of the ability to harvest and sell the grain on top of business case for reducing nitrates and feeding livestock, Kernza®'s value in southern Minnesota may begin here.
- **Value to consumers, to-date, has brought widely varied pricing in both conventional and organic contexts.** Much of the Kernza® sale in Minnesota has been arranged on a case-by-case basis, knowing its limited quantity and purchasing usage.³⁹ Between 2017 and the time of this writing, price ranges for cleaned and dehulled conventional grain stood between \$2.75-\$4.00/lb, covering an array of market players stepping into the supply chain for local needs. Flour pricing covered approximately a \$0.75-\$1.00 premium above the seed price, which may prove out in time as the value of the grain is established. Because of the early adoption stage of the grain, many stakeholders at different points in the supply chain lost money for their participation in the ecosystem. At the same time, stakeholders engaged with Kernza® expressed their continued support of grain development and were willing to move forward with

additional production knowing that promise for the supply chain exists.

- **The data on pricing needs a further refined supply chain in order to advance.** The message is clear to-date: while some economic modeling exists to give producers a sense of farm cost/revenue scenarios, there is not enough data yet to prove out a sense of Kernza®'s ultimate profitability. This may prove challenging to current players engaged in Kernza®'s development, but there remain several opportunities in the supply chain to improve seed reliability and increase grain yields for a sustainable pricing mechanism. Important, also, is a better understanding of the specific tools needed to support conventional grain production, such as which herbicides may be needed to remove a mature stand of Kernza®.
- **Biomass is a potential area for additional value-add, though it is not a critical priority of research.** Little is said in research about biomass as a potential revenue source, though it is remarked how much biomass is produced by Kernza®. Though research priorities are focused on Kernza®'s grain production capacity and may reduce biomass over time, this may also prove to be a crucial marketing and pricing consideration for future use of the crop. Further value-adds may create a powerful case for a crop that has multiple lifecycles.

D. Mapping Kernza® Stakeholders in Southern Minnesota

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.

An initial map of Kernza® stakeholders in southern Minnesota can be found in Appendix B. Using Google Map's GIS functionality, the stakeholder map can be shared and used in a variety of Internet applications that make it accessible to the southern Minnesota Kernza® ecosystem.

The map in Appendix B is coded as follows:

- **Producers:** This group, denoted with purple markers, includes any known or potential producers of Kernza® in southern Minnesota. This range includes known public and private entities, spanning all value propositions for the crop.
- **Processors:** This group, denoted with blue markers, includes current or potential processing options for Kernza® in southern Minnesota. Though others exist outside of the geography (e.g., Healthy Food Ingredients), focus on local options is paramount.
- **Millers and Malters:** This group, denoted with red markers, stand as a critical, separate set of stakeholders aside from processors. Because processing in Kernza®'s current state requires cleaning and dehulling before moving down the chain to the next stage of conversion, millers and malters require different equipment and distribution channels than processors. Note: no known millers and

malters exist in the current state of the supply chain, and this group reflects potential players only.

- **Food end users (e.g., food entrepreneurs):** This group, denoted with brown markers, includes any known or potential stakeholder in the supply chain that may produce food products using Kernza®. 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 or potential 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.

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 creating a local ecosystem. This map is a starting point and should continue to be maintained by collaborators working with stakeholders in southern Minnesota and throughout the state.

V. Challenges, Opportunities, and Recommendations

A. Trends in Southern Minnesota

To meet the ultimate purpose of this report, an understanding of trends in Kernza® commercialization in southern Minnesota were drawn from interviews with stakeholders through a forum in Fairmont, MN.

Producers present in Fairmont expressed significant interest in trying Kernza® or growing it at a larger scale to test its viability, though healthy skepticism of its potential also exists. It was no secret to attendees what possibilities existed because of Kernza®, especially as a perennial crop with grain production capability. What was also clear, however, was that the experience to-date was mixed. Producers wanted to grow more Kernza®, but challenges in communication, yield, seed and market availability, and still developing research outcomes make it an incredibly challenging crop to adopt. As a result, interest has not yet been dampened but will require further attention to the mentioned challenges in order to maintain engagement with Kernza®.

Small-scale processing capacity exists, but scalability is largely dependent on the ability to secure appropriate equipment (i.e. dehuller) and/or expand capacity in a financially feasible manner. As learned through the forum, many local producers of Kernza® in southern Minnesota relied upon one processor—Cal Spronk—to clean their harvested grain. The presence of processors like Spronk is a meaningful step forward for producers to secure new seed,⁴⁰ but equipment needs and capacity planning remain a significant challenge to overcome. Kernza®, like some other grains, requires dehulling and debearding, but few, if any, stakeholders know how to dehull or debeard a grain of Kernza®'s size, let alone find the equipment necessary to do so. The Fairmont forum produced a connection that meant getting a potential dehulling solution in Spronk's hands, an action that inspired hope—even if questions remain regarding processing capacity to support all interested producers.

Gaps in communication with specialists in Kernza® development and commercialization and stakeholders in southern Minnesota poses the greatest threat to its adoption. Audible frustration existed during the meeting regarding the lack of information and communication from The Land Institute regarding seed availability. Many producers in the room had completed the latest seed interest forms, but no communication had been shared on progress toward receiving said seed. Similarly, many attendees expressed a need for more regular communication on research updates, whether for yield, for insurance purposes, for processing and milling tools, or simply for opportunities to connect with other producers. Commercialization success in Minnesota will thrive only if communication issues present in today's supply chain are addressed and replaced by regular, consistent, and local updates.

Some do not view Kernza®'s commercialization efforts differently than other crops, though its perennial nature does present unique challenges. Healthy Food Ingredients' Chris Wiegert expressed a sentiment that is not heard frequently in the Kernza® ecosystem: commercialization is a process that every crop must face, at some point, and Kernza® is no exception.⁴¹ At the same time, Kernza®'s perennial nature may drive commercialization specialists and researchers to believe that its qualities—and therefore, the process to wide-scale adoption—are entirely unique. Regardless of viewpoint, applying early-adoption language to the current stage of Kernza®'s development is imperative for maintaining reasonable expectations in this nascent stage. Commercializing Kernza® in southern Minnesota must apply lessons learned from other crops grown in the region—especially considering its potential scale.

B. Opportunities for Intermediate Wheatgrass Production in Southern Minnesota

Southern Minnesota possesses unique qualities for producing Kernza®, especially as it has been used most frequently as an option in forage and wellhead protection uses. Several other factors contribute to an optimistic future for Kernza® in southern Minnesota.

Considering the high levels of corn, soybean, and livestock production in the region, Kernza® may prove to be a valuable forage crop, as well as a value-added tool for communities and landowners seeking to reduce nitrates in water systems. Value propositions for Kernza® in southern Minnesota are numerous, and the unique properties of the crop—especially its ability to thrive with lowered moisture availability⁴²—make it useful for the needs of producers in the region. More importantly, Kernza® is among the first cover

crops to substantially increase its value for cover (i.e. its perennial nature) while creating value-added benefits through the grain and biomass.

Processing capacity does exist in southern Minnesota, given appropriate equipment, as does potential for milling and brewing sources for small batch testing. As stated previously, a small number of processors like Cal Spronk are present in southern Minnesota and have played a key role in the successful planting and harvesting that has occurred to-date. Though less has been done to test success in milling and brewing in Minnesota, there are unique millers—such as Whole Grain Milling in Welcome, MN—and brewers in the region that appear willing and able to test Kernza® in food products.

Increasing anecdotes of soil composition challenges may drive more producers to express interest in Kernza® as an intercropping or rotational option. Simply stated, “the ground is becoming harder to work”⁴³ in southern Minnesota as a result of multiple factors, such as limited cover crop usage. As the soil becomes more compacted and more difficult to turn, producers may turn to Kernza® as an option for improving soil health and improving corn and soybean yields over time.

As seed becomes available, interest is present for a growing cooperative in the region to support infrastructure for scale. Attendees to the Fairmont forum expressed their desire to combine efforts, knowledge, and capital to increase scale of production and reduce risk via shared processing, milling, and distribution capacity. While it is unexpected that the first Kernza® growers cooperative in southern Minnesota will form in 2019, this type of energy is necessary—and healthy—for a burgeoning crop to achieve commercialization. This is recognized by The Land Institute, as demonstrated by a study commissioned with the UW Center for Cooperatives in 2018.⁴⁴ Similar industry-focused efforts drove the grass-seed production that now occurs in northern Minnesota, and knowing the ties RL Magnusson Growers has to both the thriving grass-seed business and to Kernza®’s early processing, southern Minnesota Kernza® growers may also benefit from a bus tour to visit Magnusson.

Newfound commercialization efforts are coming in early 2019, both in Minnesota and from The Land Institute. It is little secret among individuals and entities involved in the Kernza® ecosystem that changes are coming to key institutions, especially The Land Institute. With new hiring for commercialization specialists at The Land Institute and the University of Minnesota’s Forever Green Initiative, progress that has been made has a chance to take a new step forward. Capitalizing on the new energy and dedicated support of incoming staff would give life to the recommendations outlined in this report.

C. Challenges for Producers, Processors, and Partners

The challenges facing Kernza® commercialization in southern Minnesota can be separated by stakeholder group: producer, processor, and partners (i.e. IFCs). Because Kernza® remains in an early adoption stage, several challenges exist and must be overcome in order for Kernza® to reach a higher likelihood of commercial success.

In terms of producers:

- **Seed availability must be effectively managed and communicated to maintain interest and trust in product.** Information on seed availability was of vital importance to the producers present in Fairmont, and it was among the top causes of

frustration with the current ecosystem. Knowing the likely benefits and eventual larger market possible, producers want to move toward adopting Kernza® but need the seed—or more importantly, the communication about seed availability—to plan. That has not existed over the past year, though potential to resolve this issue may become a top priority in 2019, especially as Kernza® begins its move through varietal release channels at the Minnesota Crop Improvement Association (MCIA).

- **Lacking risk protections will prevent further scale until developed.** Simply put, producers must not only be able to create for their operations by growing Kernza®, but they must also be able to effectively manage the risks associated with production. While there is potential to grow Kernza® in smaller scale both to support risk management efforts and as a result of limited risk management tools, achieving the scale outlined by the Carlson School of Management Supply Chain team and by General Mills' investment in the Forever Green Initiative will take, at minimum, 3-5 years. Many other aspects of the Kernza® ecosystem can be addressed in that timeframe, but for producers, insurance will take time to develop.
- **As new best practices emerge, continuous updates and mentorship networks must follow.** Through available grant funding secured by the Forever Green Initiative in January 2019, growing cohorts will be established with current growers and a limited number of new producers interested in growing Kernza®. This grower network will further illuminate the practices needed to successfully grow, manage, harvest, and market Kernza®, but this work will need to be continued either formally or informally to drive Kernza® adoption in southern Minnesota. Producers attending the Fairmont forum expressed interest in organizing, something that demonstrates promise for the grower network model currently used.

In terms of processing (and milling):

- **Best practices must emerge to go along with available equipment—in particular, dehulling.** The missing link in processing capacity in southern Minnesota appears simple enough: get a dehuller and learn how to apply it to Kernza®. While steps were taken out of the Fairmont meeting to test a potential, small-scale dehulling solution, similar content created for producers must emerge for processors—best practices. In this instance, the support of the Minnesota Department of Agriculture AGRI Value-Added Grant Program or research partnerships with the University of Minnesota College of Science and Engineering may create solutions for this problem—both in terms of equipment and best practices. With a better understanding of the challenges involved with not only cleaning, but dehulling Kernza®, current processing players may stand a better chance to serve producers and, likewise, help producers secure seed more quickly.
- **Previous distribution partnerships have failed to hold and must be redeveloped in some capacity to inspire hope in market access.** As mentioned earlier, key research partners like The Land Institute have taken action to exert more control over the entirety of the supply chain to manage the risks of growth. While this is beneficial in the short-term, this cannot be a long-term strategy, and efforts to identify new

distribution partners in the region—whether start-up or existing—is something that must follow work to support producers and processors in southern Minnesota.

- **Processing and milling options must follow growth patterns, and seed availability hampers movement forward.** Simply put: a limited amount of seed will limit the ability for both processors and millers in the region to test at a reasonable capacity that allows for potential profitability. Fortunately, Kernza® is a perennial grain with multiple harvests to take advantage of, but it may prove difficult for millers, in particular, to test Kernza® without a reasonable amount of volume.

In terms of collaborating partners:

- **Communication challenges have impaired ability for stakeholders at all points in the value chain to connect, share ideas, and inspire action.** Creating a market for producers, processors, millers and malters, and end-users (e.g. food and beverage companies) requires the ability to gather updated information and take action. While Kernza® continues to demonstrate promise in food-grade and feed-grade contexts, it is clear that communication challenges—particularly between research institutions and on-the-ground reports from producers—will dampen commercialization efforts until addressed. Much of this challenge can be addressed in the ways research institutions (e.g. The Land Institute) choose to communicate updates with stakeholders that have signed up to grow Kernza® or wish to know more about what is happening in the field. In any case, collaborating institutions on national scale (i.e. The Land Institute) and local scale (e.g. I-90 Restorative Farmers) would benefit by making information more accessible to interested parties.
- **A lack of commercialization staffing both in state and beyond hampered efforts in 2018 to expand seed availability and provide new updates to producers.** The communication challenges mentioned above likely stemmed from limited staffing capacity at The Land Institute and statewide research institutions focused on Kernza®'s development. Fortunately, this immediate need has been and will be addressed for 2019, as commercialization staffing will be joining The Land Institute and Forever Green Initiative. Naturally, the commercialization roles will seek to address several challenges in the supply chain, but the presence of new staffing capacity should serve all stakeholders well in southern Minnesota.
- **Current food and beverage end users in Minnesota—particularly, artisan brands—may require additional financial support to sustain involvement in Kernza® ecosystem.** Knowing that much of the food experimentation that has occurred with Kernza® in Minnesota has come through less scalable artisan contexts, scalability—and profitability—may be a concern for further exploration if current pricing remains consistent. In order to support continued exploration of Kernza®'s food-grade promise, further support in distribution may be needed, along with additional outside funding in the form of grants or subsidies.

D. Recommendations for Future Study and Action

Based upon available information from the interview and forum data collected, as well as information from the diamond analysis and value proposition exercises, several research and knowledge gaps were identified that have been shared with key IFCs engaged with this study. These gaps should provide clear, guiding questions to help IFCs understand needs in southern Minnesota and take action to address them. Key themes to consider for future study and action include:

- **Conduct further evaluation of wellhead protection results, both for narrative and quantitative purposes.** The wellhead protection plots planted near Edgerton, Pipestone, and Chatfield, as well as a proposed wellhead protection plot in Rock County, would provide stakeholders engaged in the region with ample information on agronomic qualities. More importantly, evaluation would provide lessons in how public and private entities have engaged with Kernza®—creating added public value and increased profitability for producers in the region.
- **Further integrate qualities of southern Minnesota needs into Kernza® research questions, with emphasis on tiling impacts.** This research may be best completed by Minnesota-based institutions. As part of the Fairmont forum, attendees were asked to outline concerns or questions that could drive future research, and the vast amount of responses suggest Minnesota institutions could remain busy for some time. Tiling impact is a key question for southern Minnesota producers, as is updated best practices for not only producers, but also processors and millers.
- **Provide resources to interested Kernza® growers, processors, and millers in southern Minnesota to tour successful processing and milling facilities, such as RL Magnusson Growers or Healthy Food Ingredients.** This recommendation stems directly from requests made by attendees in Fairmont, but it is also a recognition of the Porter competitiveness framework. To develop a sustainable, competitive Kernza® industry in southern Minnesota, stakeholders must be able to collaborate and also understand the dynamics that drive a successful industry. Organizing a bus tour to visit RL Magnusson Growers or Healthy Food Ingredients would offer a view of how Kernza® can be processed, while also giving stakeholders a chance to see how grass-seed producers near Roseau, MN developed a competitive industry.
- **Maintain stakeholder information from study (i.e. grower lists and stakeholder maps) to provide consistent communication of updates, seed availability, and any responses to feedback provided.** This information may be best put to use by the Forever Green Initiative as part of statewide commercialization efforts, but it is also valuable for local organizers (i.e. Rural Advantage and I-90 Restorative Farmers) to possess this information and communicate with likely producers, processors, millers, and malters on a consistent basis. Communication efforts, outlined in key challenges, are a joint responsibility, and the resources produced from this report can provide an immediate starting point for all organizations involved.

- **Begin to pool resources for necessary inputs (e.g. processing capacity) in each region, using stakeholder mapping approach, to support higher scale of production.** The tools produced with this report—especially the research questions identified—aren't just useful for communication purposes. In the case of seed availability, identifying other pieces of the Kernza® puzzle in southern Minnesota may increase the likelihood that seed will become available. Using the stakeholder map, in particular, may guide local decisions and pooling of resources to create processing and milling capacity beyond what is currently available today. This can also support connection to previously mentioned value-added grants or research partnerships.

VI. Conclusion

Intermediate wheatgrass possesses significant potential to literally and figuratively change the landscape of southern Minnesota. As a perennial grass-like crop, soil benefits are numerous and may provide valuable to Minnesota communities seeking to address nitrate leeching in groundwater. As a grain, the value-added benefit of forage use, biomass, and food-grade usage makes it a crop worthy of attention for southern Minnesota producers.

Today, intermediate wheatgrass, known in many circles by its trademark name Kernza®, is grown at relatively small scale and still faces significant challenges to achieving commercialized scale. Many of these challenges are agronomic in nature and must be given ample research time to address. Other challenges facing local Kernza® commercialization are issues involving the supply chain: lacking processor equipment and capacity, inconsistent seed availability, missing links in distribution and marketing, and communication challenges that span researcher to producer. Reports like this are few, and generating content available to producers must be created with early adoption in mind.

Local feasibility for Kernza® as a grain also cannot depend solely upon large-scale interests. It is no secret that General Mills' intent to include Kernza® in its products falls in line with its sustainable emission goals for 2050, and its investment in the Forever Green Initiative will greatly benefit producers beyond any contracting to grow Kernza®. However, it is important to separate this success for Kernza® from the need to develop local infrastructure and markets. Elements of a successful Kernza® industry exist in southern Minnesota but must be continuously supported in order for the crop meet the needs of all stakeholders.

Based upon the analysis completed, there is reason to believe that Kernza® commercialization is viable in southern Minnesota. Several producers in the region are interested in growing the crop, while some early-stage processing and milling capacity exists. More importantly, the will of a collective group is present—spanning several experiences, uses for the crop, and points in the supply chain. Given the recommendations presented here, there is room for local players to grow not only Kernza®, but a sustainable industry to support it.

VII. Acknowledgements

Advisory Board Participants:

These individuals provided guidance to the research methodology, format, and selection of stakeholders for interview at various points throughout the supply chain. Advisory board participants denoted with an asterisk (*) also were included in stakeholder interviews during the research process.

- **University of Minnesota Extension Regional Sustainable Development Partnership:** Anne Dybsetter, Connie Carlson, Okey Ukaga
- **Rural Advantage:** Linda Meschke
- **I-90 Restorative Farmers:** Dean Goette
- **Green Lands Blue Waters:** Aaron Reser*

Stakeholders and Collaborators Interviewed:

- **Swan Ray**, M.S. Supply Chain and Operations Management (2018), Carlson School of Management
- **Chris Wiegert**, Chief Supply Chain Officer, Healthy Food Ingredients
- **Laura DeBeer**, Regional Water Resources Specialist, Pipestone Soil and Water Conservation District
- **Bradley Heins**, Associate Professor of Organic Dairy Production, University of Minnesota-Morris
- **Carmen Fernholz**, Kernza® Producer, Madison, MN
- **Jake Jungers**, Assistant Professor of Perennial Ecology, University of Minnesota-Twin Cities
- **Bill Lazarus**: Professor and Extension Economist, University of Minnesota-Twin Cities
- **Jeremie Favre**: Agronomy PhD student, University of Wisconsin-Madison

Attendees to Fairmont Intermediate Wheatgrass Forum:

- Linda Meschke, Fairmont, MN
- Dean Goette, Hope, MN
- Carmen Fernholz, Madison, MN
- Doug Hilgendorf, Welcome, MN
- Scott Haase, Blue Earth, MN
- Wes Tennis, Hayward, MN
- Archie Kluender, Wells, MN
- Cal Spronk, Edgerton, MN
- David Benson, Bigelow, MN

Appendix A: Agenda, SW Minnesota Kernza® Forum

I-90 RESTORATIVE FARMERS AND SOUTHERN RSDP

KERNZA® DISCUSSION: OPPORTUNITIES, CHALLENGES, AND VIABILITY IN SW MINNESOTA

Location: Knights of Columbus Building | Fairmont, MN

Date: Dec. 7, 2018

Time: 10am – 2pm CST

10:00 – 10:15

INTRODUCTIONS

10:15 – 11:15

WHAT IS THE CURRENT STAGE OF DEVELOPMENT FOR KERNZA®?

Erik Muckey, Center for Urban and Regional Affairs

- Introduction to Kernza®: Uses and Benefits
- Current Crop Viability / Yields
- Best Practices for Growth and Harvest
- Necessary Processing Capacity and Practices
- Current Markets for Kernza®
- Challenges and Opportunities for Scale

11:15 – 11:45

CURRENT EXPERIENCES: SW MINNESOTA AND BEYOND

Facilitated by Erik Muckey and Linda Meschke, Rural Advantage

- Watershed Districts
- Organic Systems
- Forage
- Conventional

11:45 – 12:15

LUNCH SERVED; DISCUSSION CONTINUES

12:15 – 1:45

WHAT DOES A KERNZA® VALUE CHAIN LOOK LIKE IN SW MINNESOTA?

Facilitated by Erik Muckey and Linda Meschke

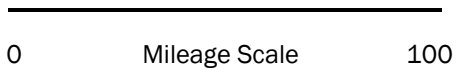
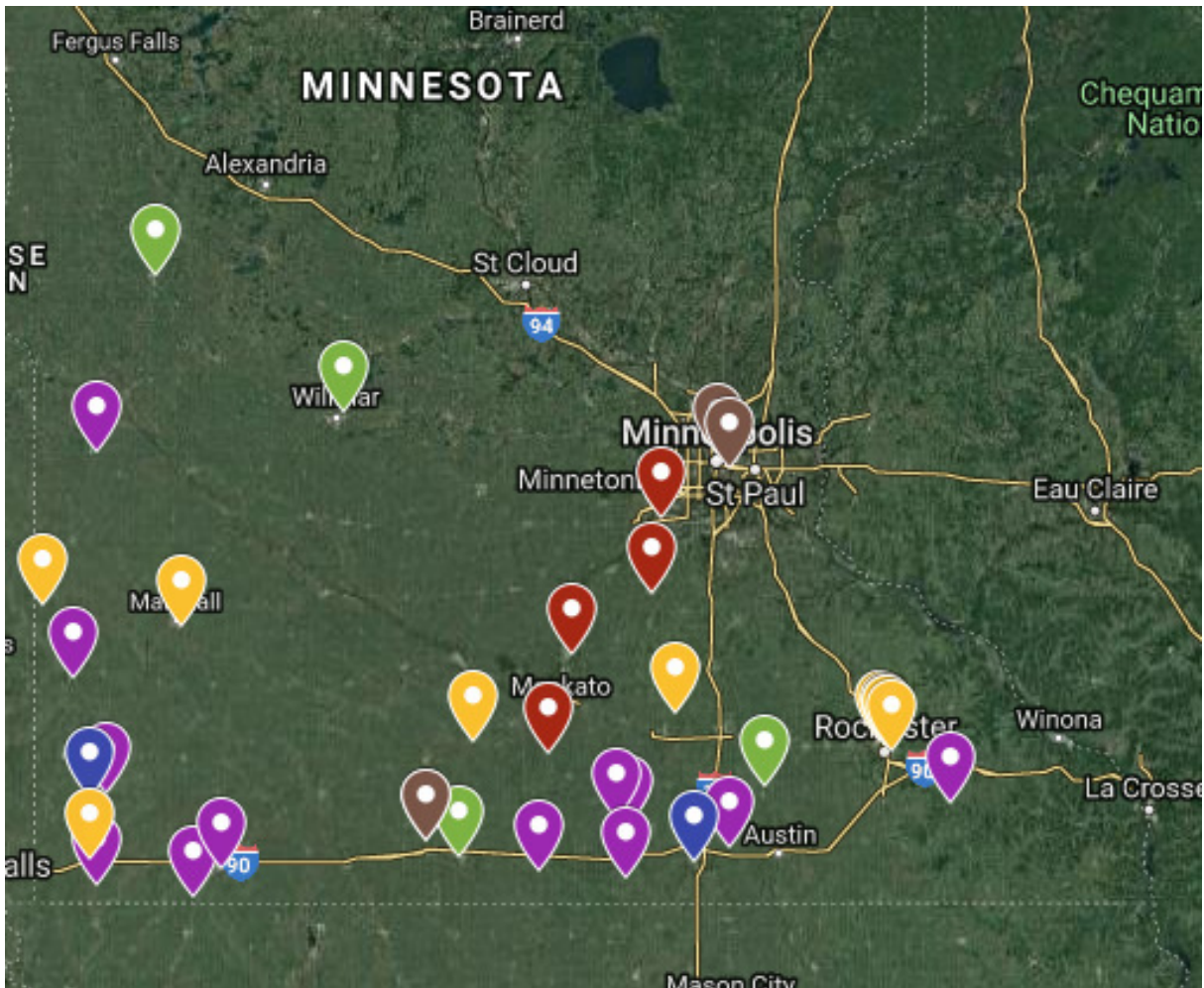
Bring your questions and ideas! We'll start with four questions:







- Where might Kernza® meet producer needs?
- What would be the biggest challenges for Kernza® in SW Minnesota?
- What information would be most helpful for Kernza® producers?
- What circumstances would lead producers to grow Kernza® or an intermediate wheatgrass in general?

1:45 – 2:00

WRAP-UP AND NEXT STEPS

Appendix B: Map of South Central Minnesota Intermediate Wheatgrass Ecosystem



KEY					
	Producers		Food End Users		Beverage End Users
	Processors		IFCs		Millers/Malters

Appendix C: Endnotes

¹ Muckey, E. "Small Grains in Minnesota: Assessing the Feasibility of Local Supply Chains." *Center for Urban and Regional Affairs*, Humphrey School of Public Affairs at the University of Minnesota. September 2018.

² "*Thinopyrum intermedium*". [Natural Resources Conservation Service](#) PLANTS Database. [USDA](#). Retrieved 9 December 2015.

³ Ibid.

⁴ "Approaches to Managing Intermediate Wheatgrass for Dual-Use Forage and Kernza® Perennial Grain Production." Draft version, 5 November 2018. Produced in partnership between Green Lands Blue Waters, the University of Minnesota Dept. of Agronomy and Plant Genetics, the University of Wisconsin-Madison Agronomy Dept., the Forever Green Initiative, The Land Institute, and farmer partners.

⁵ Young, R., Hestick, G., Ray, S., Roberston, K., and Schlick, A. "Developing a Supply Chain Strategy for Kernza®." *Supply Chain Solutions*, a partnership between MS in Supply Chain Management at Carlson School of Management and The McKnight Foundation. 6 Aug 2018.

⁶ Quote from The Land Institute, included in note 4 (Carlson Supply Chain study).

⁷ Quote from Linda Meschke, forum facilitated by Erik Muckey in Fairmont, MN, 7 Dec 2018.

⁸ Painter, K.L. "General Mills, Cascadian Farm back development of Kernza wheatgrass." *Minneapolis Star Tribune*, 8 March 2017.

⁹ Supra, note 5.

¹⁰ Supra, note 1.

¹¹ Galli, F., et. al. "Sustainability assessment of food supply chains: an application to local and global bread in Italy." *Agricultural and Food Economics*, 2015, 3:21.

¹² Kennett, et. al. "Supply Chain Management in Cereal Grains: A Case Study from the U.S. Milling Wheat Industry." *Canadian Journal of Agricultural Economics*, 2008, 46:4, 549-558.

¹³ "Grain Supply Chain Study, Final Report." Quorum Corporation, in partnership with the Canadian Government. September 2014.

¹⁴ Supra, note 4.

¹⁵ Supra, note 5.

¹⁶ Ibid.

¹⁷ Porter, M. E. *On Competition*. Updated and Expanded Ed. Boston: Harvard Business School Publishing, 2008.

¹⁸ Supra, note 11.

¹⁹ Wilson, P., Wade, J., Leones J. "The Economics of Commercializing New Industrial Crops." *Agribusiness*, 1995, 11:1, 45-55.

²⁰ Hudson, M.A. "Toward a Framework for Examining Agribusiness Competitiveness." *Agribusiness*, 1990, 6:3, 181-189.

²¹ Kennedy, et. al. "Perspectives on Evaluating Competitiveness in Agribusiness Industries." *Agribusiness*, 1997, 13:4, 385-392.

²² Ibid.

²³ United States Department of Agriculture, included in note 1 (Muckey).

²⁴ Supra, note 4.

²⁵ Supra, note 7.

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- ²⁶ Supra, note 4.
- ²⁷ Forum facilitated by Erik Muckey, Fairmont, MN, 7 Dec 2018.
- ²⁸ Supra, note 4.
- ²⁹ Jungers, J., interviewed by Erik Muckey at Saint Paul, 2 Nov 2018.
- ³⁰ Ostrander, M. "The Grain That Tastes Like Wheat, but Grows Like a Prairie Grass." *The Nation*, 11 October 2017.
- ³¹ Quote from Steve Horton, Baker's Field, included in note 29 (Ostrander).
- ³² Supra, note 5.
- ³³ Supra, note 4.
- ³⁴ Supra, note 16.
- ³⁵ Supra, note 29.
- ³⁶ Supra, note 4.
- ³⁷ Supra, note 28.
- ³⁸ Reser, A., email communication sent 25 Jan 2018.
- ³⁹ Reser, A., email communication sent 19 Dec 2018.
- ⁴⁰ Supra, note 6.
- ⁴¹ Wiegert, C. Interviewed by Erik Muckey at Brookings, SD, 16 Nov 2018.
- ⁴² Supra, note 4.
- ⁴³ Quote from Doug Hilgendorf, included in note 1 (Muckey).
- ⁴⁴ Supra, note 38.