

Going Local: Developing Sustainable Small Grain Economies in Southeast Michigan

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Abstract

Current conventional food production has created genetically homogeneous crops that encourage environmentally harmful practices. The large-scale production of commodity crops like wheat has led to mass production of subpar quality food, and discourages consumer involvement and knowledge. Encouraging the growth of local small grain economies and partnerships between farmers and businesses can produce food that is not only flavorful and nutritious, but that has fewer harmful environmental impacts. Moving away from homogeneous commodity crops can also enhance the resiliency of food systems with uncertain future climate conditions. This project analyzed local grain economies around the United States to identify the partnerships and coordination required for success, and the barriers that exist to their expansion, in order to apply this information in Southeast Michigan. The project facilitated a partnership between Zingerman's Bakehouse and a local organic seed company (Nature and Nurture) to initiate future expansion of local small grain markets and create a model that can be applied to other parts of the United States. Grain trials were designed to be implemented by Nature and Nurture in the coming growing seasons to identify diverse wheat varieties that can grow in this area, and to provide Zingerman's with more local grain options. Zingerman's will perform baking and tasting trials with this wheat to determine which type is most desirable for their business and customers, and to inform their choice of grain to support continued production in the future. Consumer surveys and practitioner interviews were conducted to inform this project, and allowed us to better understand consumer demand and preferences, which drives small grain economy expansion. We also identified grant opportunities for Nature and Nurture to apply for in the future, since we found resources to be a limiting factor for local farms diversifying into small grain production. In addition to understanding trends in consumer demand, creating relationships between farmers and the markets for their goods, and identifying gaps in local grain economies, will help mitigate risks for those involved in expanding small grain production. Modeling this process will be useful for more of these grower-buyer relationships to form in the future and will aid the continued expansion of local sustainable small grain economies.

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Background

Commodification of agricultural crops has a complicated history, tracing the surplus growth of grain in America to European settlers. These settlers grew more grain than they intended to eat, in contrast to Native American subsistence farming practices, with the intention of selling excess crops in markets. Increased grain production allowed for the growth of grain markets, and the advent of the railroad allowed for larger quantities of grain to be sold across the country, requiring new, more efficient grain transportation methods. This included transporting large quantities of grain in rail cars where grain from many producers was combined. Combining grain required that it be dissociated from the producer, and widely applied grain quality standards were created so grain with similar quality and characteristics could be combined and treated as one product¹. Grain in this scenario is considered a commodity, which refers to agricultural products in their original form, like wheat, where the methods of production have not provided any distinguishing characteristics to the product. Since there is nothing that sets commodities apart from one another, they are only able to compete based on price², and due to input costs and market prices, profits are often low. This growth and transformation of grain markets and the increased scale of production it allowed for contributed to the eventual homogenization of grain commodities, where consistency and similarity were valued more than flavor, nutrition or other unique characteristics.

During and after the industrial revolution, the movement of people into urban centers and a growing population increased the demand for food, further encouraged the emphasis on food production quantity, and contributed to the continued detachment between food and its growing practices and conditions. Farming methods meant to increase crop production efficiency by increasing yields while reducing labor inputs, required uniform crops that had predictable behavior, which encouraged the mass production of only a few types of crops with similar characteristics. While these aspects of efficiency and consistency have provided streamlined food production and distribution processes, the environmental consequences are vast, and the declining quality in food is apparent. One component of food quality that has decreased is the genetic diversity of crops, as crop varieties that can withstand mechanical harvesting, long distance shipping, pests, disease and other environmental stressors are selected³. While much of the original genetic diversity in crops has been bred out of the most common commodities consumed, many varieties of these crops still exist, and they are functionally diverse⁴. Landrace crop varieties have retained much of their original diversity, but they often do not match the current requirements of the agriculture production system in the United States⁵. While this genetic selection has provided increased yields of select commodities, it comes at the cost of environmental health and food diversity, and is not the only option for production. Some of the environmental impacts include an overall reduction in ecosystem services, which encompasses reduced biodiversity, declining presence of natural pest predators, pollinator species and their activity⁶.

¹Cronon, W. (2009)

² Commodity Marketing. (n.d.)

³ Reiss, E. R., & Drinkwater, L. E. (2018)

⁴ Sharp, G. (2011).

⁵ Esquinas-Alcázar, J. (2005)

⁶ Landis, D. A. (2017)

Selection of the most desirable genetic traits in plants has occurred since the advent of agriculture and plant domestication. During this time, however, trait selection was only a side effect of the timing and techniques used for crop planting and harvesting. Characteristics of plants that ripened at the time of harvest, were the correct height, and were easily edible, were naturally selected for and retained. As different species were grown around the world, they adapted to the conditions they encountered and mixed with the genetics of local wild species, giving rise to what we now know as landrace (also called heirloom or heritage) varieties. This allowed for the development of different varieties of the same crop, each adapted to a specific region, giving landrace crop varieties a great deal of genetic variation and adaptive potential⁷. Genetic diversity is beneficial because it provides a variety of defenses plants can use to combat inevitable pest and disease outbreaks, and provides insurance that some individuals or varieties can withstand adverse conditions, reducing the chance of total crop losses⁸. This is especially important as our current climate is changing and future conditions are uncertain. There are many historic examples of plant disease outbreaks devastating communities that relied too heavily on one crop variety out of the hundreds or thousands that exist⁹, like the potato blight in Ireland¹⁰. While the technology to control diseases and pests has increased in the United States, crop losses to pests continue to increase even with increased use of pesticides¹¹, and alternative management practices should be explored for food system resilience. Expanding crop production beyond current commodities allows for the inclusion of more heritage types with increased genetic diversity and adaptive potential, and could be a viable management alternative.

⁷ Esquinas-Alcázar, J. (2005)

⁸ Reiss, E. R., & Drinkwater, L. E. (2018)

⁹ Esquinas-Alcázar, J. (2005)

¹⁰ Reiss, E. R., & Drinkwater, L. E. (2018)

¹¹ Gliessman, S. R. (2014)

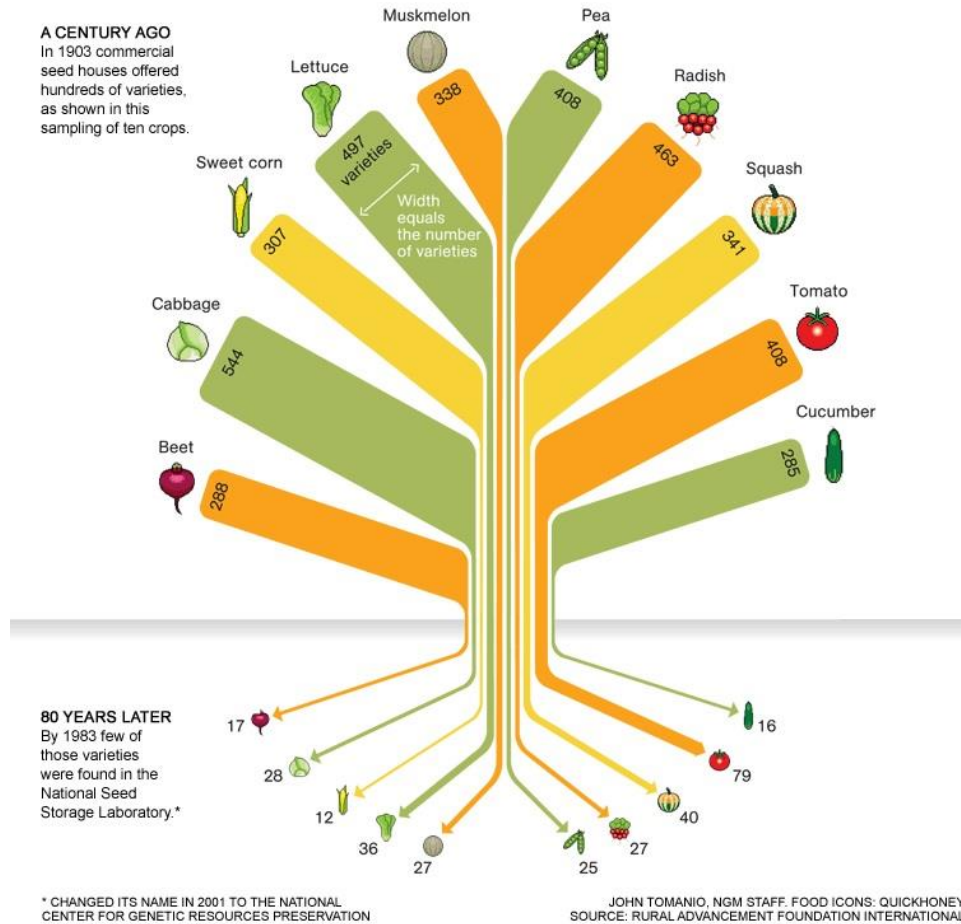


Figure 1. A representation of the loss of plant genetic diversity between 1903 and 1983, based on the seeds saved and offered by the National Center for Genetic Resources Preservation

As crops became more homogenous, mechanized farming techniques, and widespread fertilizer and pesticide use became both more accessible and necessary, in order to sustain yield with reduced plant diversity, leading to expansion of monocultures. Monocultures are defined as growing a single crop in one area, often repeating the same crop several years in a row. Monocultures allow for production efficiency because farmers can become specialists in one or a few crop varieties, and purchase less equipment. In addition, knowledge of nutrient and pest management, as well as other management practices can be streamlined for a small number of crops. Producing large amounts of one crop can also be beneficial for farmers because they are required to follow fewer commodity markets, and can receive beneficial volume discounts. The effects of monocultures are visible in the United States through the economy and infrastructure that has developed to support the few dominant crops grown in an area. While the convenience of monocultures is apparent and have been convincing for many, the negative environmental impacts have long lasting and global effects that outweigh their

perceived benefits¹². These impacts include negative effects on soil, water, and air quality, as well as on biodiversity¹³.

Monocultures ignore the beneficial relationships that can be found between different plant types, like nitrogen fixing legumes, or integrated pest management techniques that utilize natural plant or insect pests that serve as biocontrols. Declining soil health, unpredictable weather patterns, and variable fuel prices negate the benefits of monocultures; they no longer achieve the maximum agriculture potential of an area and can leave farmers vulnerable¹⁴. They also contribute to pollinator decline, as they are unable to support pollinator populations, and encourage blanket insecticide use in fields. Some of the most common monoculture crops like corn and wheat also do not produce pollen or nectar for pollinators to use¹⁵.

In contrast to the conventional farming practices that have been normalized and internalized in the United States, diversified agroecosystems offer an alternative. This type of agriculture can be equally as profitable and high yielding as monoculture farming¹⁶, and provide a myriad of benefits including erosion reduction and organic matter production. They also offer a potential economic safety net for farmers in the event of disease or pest outbreaks, or extreme weather that could result in the total failure of one crop variety. While no two diversified agroecosystems are alike, they share similar qualities that make them a better alternative for food production in the future. These include; minimizing negative effects on the environment, such as greenhouse gas emissions and contributions to climate change, preserving and restoring soil fertility, using water in a way that allows for aquifer recharge, using resources primarily in a closed loop, and conserving biodiversity. Adding on farm diversity can be achieved in many ways, but one of the easiest is to grow several cultivars (plant varieties produced in cultivation by selective breeding) of the same crop type, like wheat, together in the same field. Many cultivars behave similarly to each other and can easily be incorporated into current mechanical farm management styles, while adding beneficial diversity and promoting ecosystem services. In addition, the yield increase found by incorporating multiple cultivars is comparable monocultures of the best performing cultivar¹⁷. In the larger context of food systems, diversity goals can be achieved by replacing industrial food supply chains with food networks made up of small to medium scale agroecosystems that are relatively self-contained; decreasing the distance food travels before it is eaten and increasing crop diversity to encourage adaptation to local conditions¹⁸.

Fortunately, there has been increasing interest in local food economies that incorporate diverse grain types and support sustainable farming practices, and a rising demand for healthy, delicious and sustainable food. In response to consumer's revealed preferences, restaurants and bakeries have renewed interest in using local ingredients, which has been apparent with the farm to table trend¹⁹, and adding ancient or heritage grains to menus has been met with similar

¹² Power, J. F., & Follett, R. F. (1987)

¹³ Landis, D. A. (2017)

¹⁴ Power, J. F., & Follett, R. F. (1987)

¹⁵ Kluser, S., & Peduzzi, P. (2007)

¹⁶ Reiss, E. R., & Drinkwater, L. E. (2018)

¹⁷ Reiss, E. R., & Drinkwater, L. E. (2018)

¹⁸ Gliessman, S. R. (2014)

¹⁹ King, R. P., Hand, M. S., & Gómez, M. I. (Eds.). (2014).

consumer support. Demand for these grains is outpacing supply, and since consumers are willing to pay a premium for these products, up to 25% more for organic heirloom wheat²⁰, farming crops with environmental benefits could become more profitable²¹. Consumers are drawn to a variety of grain attributes found in alternative grain sources, including improved flavor, environmental and health benefits, and a desire to support local economies²². The current grain supply chain does not serve these needs because it has little capacity to process diverse, locally produced small grains. Addressing the gaps in network connections could satisfy these consumer demands, and also address environmental concerns caused by production agriculture.

There are many examples of organizations around the country serving as leaders in this movement, and as models for creating local grain economies that fill the gaps in the existing supply chain. The support they receive is another signal that consumers are also interested in these issues, and willing to pay a premium for sustainably grown, locally sourced products. In particular, [Wide Awake Bakery](#) in Trumansburg, NY partners with local organic growers who produce traditional wheat and corn, as well as more unique wheat varieties like emmer, einkorn, and spelt. These grains are sent to a local mill, which produces flour with unique baking properties and flavor profiles for the bakery. Local mills partnering with local farms and bakeries are also becoming more popular, reverting back to the grain economy structure that once existed in the United States. Wide Awake Bakery partners directly with [Farmer Ground Flour](#), based in Trumansburg, NY as well. This mill aims to provide their community with fresh, organic, local, stoneground flour and seeks to lead the growth of the small grain economy by bringing together the ancient trio of farmer, miller and baker. Another example, in Athens, OH, is the [Shagbark Seed and Mill](#), which provides dry beans, and freshly milled spelt and buckwheat flour to their community, partnering with restaurants, schools, bakeries and home kitchens, helping to create markets for their farm partners. These kinds of mills fill a crucial gap in local grain economies, which allows for food independence and autonomy, giving control and decision-making power back to the farmer and consumer. The end goal of these smaller networks of farmers, processors, and bakers is stronger communities, healthier soils, cleaner water, and better food. Other promising contributors to this movement include the [Bread Lab](#) at Washington State University, where researchers identify what characteristics and types of small grains are best for farmers, as well as end users like bakers, brewers and malters. Their goal is to breed and develop publicly available varieties of grains to increase access to affordable and nutritious food.

While these are only a few examples of the different organizations that are addressing the failings of the food system, specifically in grain markets, there are many more, which indicates the interest and support for continued expansion of local grain economies. Expanding local grain economies addresses flaws in the food system by allowing for more diverse grain types grown, reducing the distance food must travel to be processed and sold, encouraging more sustainable growing practices, and has the potential to provide more flavorful and nutritious food.

²⁰ Specialty Food Association (2016)

²¹ Ramanujan, K. (2018)

²² Sant, L. (n.d.)

Current state of Great Lakes grain economy

While the idea of local grain economies is increasingly popular around the country, there is a lack of cohesion among organizations working towards this goal, and the pace of development differs regionally. Consumer and business interest encourage the creation and growth of these economies, and we believe there is the necessary interest in the Great Lakes region to grow a local grain economy here. However, there are gaps in the network of participants, and a lack of infrastructure that is hindering its creation. For this business model to function properly, farmers, plant breeders, researchers, millers and bakers all need to coordinate their efforts and work in tandem with similar end goals²³. Without cohesion from each level of participation, there is too much risk involved for any single part of this network to operate independently, and with little chance of success.

Michigan is positioned to be a leader in the local food movement, since it is a diverse agriculture state capable of growing over 300 different types of commodities²⁴. Soft white and red winter wheat (*Triticum aestivum*) are the primary grain varieties grown, and while Michigan is not one of the largest wheat producing states, average yields are high enough to make wheat production profitable and small grain economies feasible. At one point in history, Michigan led the nation in wheat production, and it is capable of producing many other grains, like oats and barley, which are second and third in grain acreage planted, behind wheat²⁵.

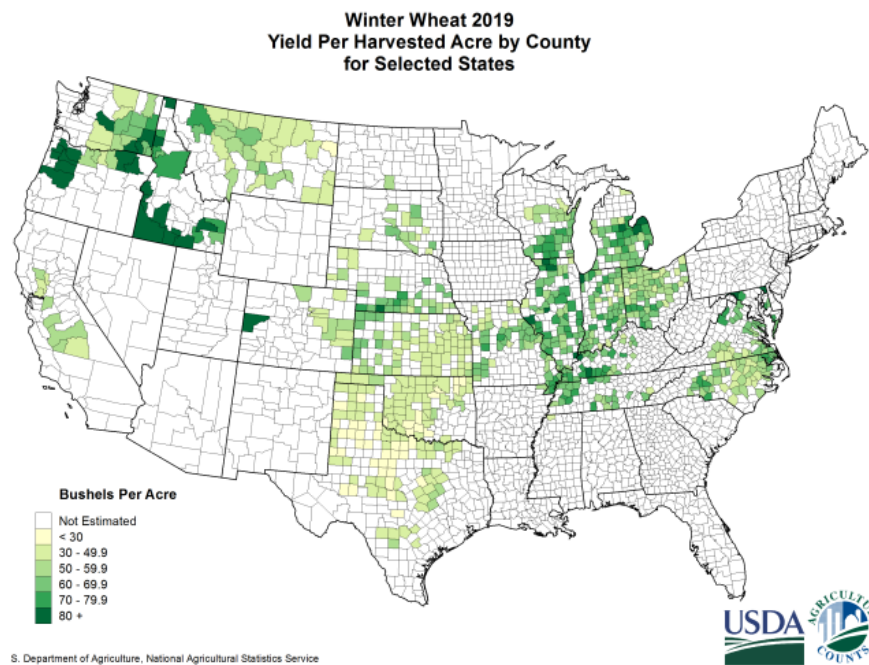


Figure 2: 2019 winter wheat yields at the county scale across the United States, showing Michigan as a competitive wheat producing state

²³ Specialty Food Association(2016)

²⁴ Michigan Department of Rural Development. (n.d.)

²⁵ Michigan State University Extension. (2013)

While more research is needed before Kernza becomes widely used, General Mills has partnered with the Land Institute to make products with Kernza, in order to promote climate beneficial foods, which will hopefully encourage further testing to create a viable perennial grain²⁸.

In addition to research in Michigan, a seed company in northern Indiana, [Sherck Seeds](#), is trialing and growing unique and heirloom grains, including varieties of barley, wheat, teff, Sorghum, Quinoa, and Rice, with mixed but surprising success. Conditions in northern Indiana are similar to those in southern Michigan, so the information gleaned in these trials is valuable when growing similar varieties in this area. While not exhaustive, these examples indicate the variety of crops capable of growing in Michigan, the expertise and knowledge that exists here, and the overall interest in these unique crop varieties.

Client Introductions

The clients for our project are Nature and Nurture Seeds and Zingerman's Bakehouse. Nature and Nurture is a 122-acre organic farm-based seed company located in Ann Arbor, MI offering heirloom vegetable, flower and herb seeds. The owners, Mike Levine and Erica Kempter, founded Nature and Nurture in 2001, and in addition to growing and selling seeds, they provide organic garden consultation, design, installation and maintenance, operate a fruit nursery and orchard, and grow and sell shiitake mushrooms. Some of the goals they have with their business include increasing organic seed growing in the Great Lakes region, bringing back food biodiversity, and preserving place-based foods. They are passionate about fostering public domain plant breeding by providing open-pollinated heirloom seeds that allow for seed saving, and they are an Open Source Seed Initiative partner.

Founded in 1982, Zingerman's is a family of ten businesses located in Ann Arbor, MI, each operating independently, but as one larger organization rooted in the community. These businesses include a delicatessen, a bakehouse, catering, a coffee company, a candy manufactory, and event spaces. They place an emphasis on education, flavor, tradition and the integrity of the ingredients they use. Among their guiding principles they emphasize improving life in the community through contributions of time, money, food, energy and information. Zingerman's 2020 sustainability vision includes prioritizing ingredients that use ecologically sound growing practices, minimizing food waste, and reducing food miles, as well as prioritizing transparent relationships with producers.

Project Goals

With the growing interest in local grain economies around the country, research and engagement is required for continued expansion and connectivity of these markets. The goal of this project is threefold. The first step is to assess the state of the local grain economy in Southern Michigan, gauge consumer interest in local, sustainably grown grain, and determine which production practices and product attributes are most important to consumers. The next step is to determine which alternative grain best meets these needs, is feasible and profitable to grow in Southeast Michigan, and has desirable baking qualities for Zingerman's. The end goal of this project is to use the information gathered to foster a relationship between Zingerman's

²⁸ General Mills (n.d.)

and Nature and Nurture, where Nature and Nurture supplies the desired grain type for Zingerman's, with future expansion of grain growth through local farm partnerships scaled to match demand.

Client Specific Project Goals

Nature and Nurture has several agricultural fields that are managed as permanent hay fields. They are not currently lucrative, and Nature and Nurture would like to transform these fields into profitable grain production in the future. In 2017 a University of Michigan SNRE master's project team created a farm design and management plan which outlined current farm conditions and future goals, and this project is a continuation of some of those goals. This farm design helped guide our decisions with in depth information on soil type, landform hydrology and climate on the farm. While the initial plan did not include grain fields, Nature and Nurture is interested in expanding their production and growing crops that fall in line with their goals and values, and this project is in line with that goal. Since they are a for profit business, minimizing risk by growing grains that have a high chance of success and profitability is also a priority, and trialing grains on a small scale before large scale production will provide information on growing expectations, and minimize crop losses. Ensuring a market exists for certain grain types before production is also a key component of profitability. Forming a relationship with Zingerman's before growing grains is important in order to ensure the grain grown will be purchased and used, and that it meets Zingerman's expectations. Nature and Nurture is committed to sustainable organic farming practices, and any activities that occur on their farm must meet their environmental standards of conservation and restoration.

Zingerman's is interested in increasing the amount of ingredients they source locally and in improving upon the sustainability and quality of the ingredients they use. They are interested in using novel grain in their baked goods that meet their 2020 sustainability vision, as well as in the profitability of the grains they use. As a food-based industry Zingerman's is also largely concerned with the flavor of the flour they use and the overall quality of their baked goods. Because they are a for profit business that serve consumers, they are interested in understanding which aspects of grain production and bread quality characteristics are most important to their customers. Understanding these preferences will not only allow Zingerman's to produce the most desirable product for their customers, but will also guide them in how to choose the ingredients and producers they work with, and how to best market their products to convey sourcing information to consumers.

Deliverables

This project consists of five main components. The first is an analysis of the current state of local grain economies in the United States. The goal of the grain economy analysis was to evaluate current small grain economies around the United States to determine how they have successfully developed, and what barriers exist to their expansion. The information gained from this analysis was used to create a model that can be followed for continued small grain economy growth throughout the country. The second is a survey of consumer preferences and interests in grain attributes and production methods conducted with Zingerman's customers. The survey provided information to guide the selection of the grain type for the grain trial, and

will be used to inform the managers at Zingerman's Bakehouse about their grain sourcing decisions in the future. It also provided key insights into the underlying motivations of their customers, information about the demand of local grains in bakery markets, and the consumer support to be expected. The third is interviews of practitioners who are participating in local grain economies throughout the United States to gather specific information about their experiences and apply it to Southeast Michigan. The goal of the interviews was to gather specific information from practitioners involved in small grain economies tailored to our project and questions. Local small grain economies are continuously evolving, and most are in their infancy, making them difficult to research through literature. Asking questions specific to our project to those intimately involved with growing heirloom grains, processing grains into flour, or baking with heirloom grain flour provides information that is most useful. Learning from those who are involved and farther ahead in the process also provides information on best practices and mistakes to avoid, and allows for efficiency in learning from others who have already laid the groundwork.

The fourth deliverable is a site design for Nature and Nurture, including grain trial designs and specifications to be implemented in the future. The goal of the grain trials is to identify grain varieties that grow best in the specific conditions on Nature and Nurture's farm, and to mitigate risk for our clients. The trials will be helpful in determining the environmental factors that influence grain growth and identifying the most effective management practices for each grain. The grain trials will test seed varieties on small scales to determine area suitability before investing in growing them in larger areas and purchasing larger quantities of seed. Climate, soil type and topography are all local factors that can influence the suitability of a specific seed variety to an area, in addition to management practices. Our farm clients Nature and Nurture use organic production methods, and grain trials provide useful information on the methods that are most effective for growing grains typical of conventional systems with non-conventional practices. In particular, controlling weeds and pests in organically managed systems requires more planning, since there are less "quick fixes" available to organic farmers than there are to conventional farmers. Trialing small plots of many varieties allows for some experimentation in organic pest and weed control practices, and can provide useful information in scaling up production²⁹. The fifth component includes information on grants that may provide funding and resources that can be put towards grain trial implementation, and materials that can be used for grant submissions.

Methods

1. Grain Economy Analysis

The information for this analysis was gathered through literature reviews using google scholar and the University of Michigan library resources, using search terms like "small grain economy", "sustainable" and "local" small grain production. Interviews of practitioners participating in these market networks as farmers, millers or bakers were also used to provide information on specific business models, to supplement information that was not available

²⁹ Organic Seed Alliance (2018)

through literature reviews. Information gathered from the consumer survey conducted was also used to inform the grain economy analysis.

2. Survey

The primary objective of the consumer survey was to investigate the market potential for the production, utilization, and sale of local grain in Southeast Michigan. There were many aspects considered for the structure of the survey, namely the composition of the questions, formatting of those questions, the method for delivery, and garnering responses. We used an electronic survey platform to condense the timeline of survey creation, distribution, and analysis, to reduce the potential issues surrounding response collection, and to eliminate the requirement of digitizing survey responses.

To determine the survey format, we considered the number of unique products that would need to be created and determined a comparison of attributes would be most efficient. We utilized the Consulting for Statistics, Computing and Analytical Research (CSCAR) resource on campus and professors in SEAS to discuss the best method for capturing consumer preference, and considering their input we opted for a 'modified' conjoint analysis survey structure. We were pointed to 'wiki-surveys' and the AllOurIdeas platform which is an online survey technology that allows users to create endless pairwise comparisons of attributes or qualities.³⁰ This allowed us to easily create a survey with a simple list of our attributes of interest and to distribute the link electronically via email.

The survey prompt and questions included key components. For instance, we intentionally used words or phrases that highlighted the transactional aspect of grains, i.e., something that would frame the hypothetical decision for respondents as an exchange for money. We wanted the respondents to think about spending their money because it moves the consideration beyond simply valuing a good. Furthermore, this framing is important, since it is the difference between theoretically preferring a product, and actually purchasing it. The other main component that we included in our survey prompt was the instruction to consider the two options as ranked. By asking which of the two options respondents valued more, we hoped to prevent "can't decide" votes on the survey. The prompt that we developed and used was: "What would be your primary consideration when deciding which loaf of bread to purchase?" The final attribute list covers aspects of the product that include: price, taste, sourcing, production method, and locality. The survey was distributed to Zingerman's email listserv to target a large number of consumers and to effectively guarantee that we had a representative population for the target Zingerman's consumer. We opted for the results to be hidden from participants to avoid biasing their preference decisions during the process

3. Interviews

We used semi-structured, open ended questions in the interviews, and a list of these questions can be found in appendix A. An International Review Board application for our interview methods was approved as "exempt self-determination", and the interview methods were approved. While the base questions for each interview were the same, there was some deviation from the script based on the specifics of the interviewee and their expertise. In addition, each interview differs from the others and the script questions based on the individual conversations and contributions from the interviewee. The individuals who were interviewed

³⁰ Salganik, M. J., & Levy, K. E. (2015)

were identified as knowledgeable practitioners by the project advisors and clients, and include John Sherck of Sherck Seeds, Steffan Senders of Wide Awake Bakery, Dillon Green of Shagbark Seed and Mill, and Greg Russo of Farmer Ground Flour. Each individual was contacted via email, and interviews were conducted over the phone and recorded. Shagbark Seed and Mill was unable to interview over the phone but did answer questions via email. The transcripts of each interview can be found in appendix B-E.

4. Grain Trial

The overall design and specific methods of the grain trial were determined through literature reviews of best management practices and from examples of successful trials. In addition, meetings with advisors and farm clients were utilized to ensure all trial considerations were addressed, and client goals were met. The trials are designed in a way that considers the capacity of the farm relating to time, funds and equipment, so that they can be completed successfully with little financial risk for Nature and Nurture. Once the specifics of the trial were determined, it was designed in context of the farm location, and the preliminary inventory of existing assets was completed through multiple tours and client meetings. The clients were also interviewed twice to explain the goal and method of the design project and management plan, as well as the expectation of our clients.

The specific grains used in the trial were determined through literature searches on grain attributes and baking qualities, the experience and advice of the practitioners interviewed, the preferred grain attributes indicated in the consumer survey, and input from our clients. The different grains we considered included Kernza, emmer, spelt, einkorn, amaranth, durum, Khorasan, oats, buckwheat, triticale, different varieties of wheat, barley, rice, and rye. Zingerman's was primarily interested in hullless barley, different wheat varieties including Skagit 1109, buckwheat, rice and amaranth. We considered each grain's growing preferences and their suitability for growing in Michigan, the grain baking properties and flavor, nutritional characteristics, and their ease of harvesting, processing and milling.

We initially intended to consider the environmental impacts of growing each of these grains, and to pick a variety that would have the least impact, but later realized the type of grain was not as important as the growing practices used. The survey also indicated that the environmental impact of bread production was not as important to consumers as things like taste, nutrition and locally sourced grain. The only grain that may have a reduced environmental impact through unique potential for improving soil quality is Kernza. Kernza is a perennial wheatgrass that could improve soil health and organic matter through plant traits such as its extensive root system, and the fact that perennials allow for reduced or no tillage³¹. After speaking with practitioners and researchers who have firsthand experience working with Kernza, we decided to eliminate it from our list of possible grains for trial. Greg Russo from Farmer Ground Flour discussed the challenges in milling Kernza grain, and John Sherck of Sherck Seeds shared the difficulties he has experienced getting it, and other perennial grains, to grow a second year. We also were informed about the challenges of dehulling grain from Greg, and decided not to choose any grains that would have to be dehulled. We learned from Stefan Sanders at Wide Awake Bakery that baking with amaranth is not a good idea, and John Sherck

³¹ Michigan State University (2018)

echoed that sentiment, commenting on the lack of information available for growing amaranth in Michigan. He suggested we focus on the low hanging fruit; that it would be easiest to start with a grain that is already established in Michigan, with known cultivation methods.

In considering grain baking quality, Stefan from Wide Awake Bakery described the basics of bread baking, and explained that different types of grain cause varying amounts of gas production and retention in bread, which results in different bread outcomes. The results of the consumer survey indicate that taste, flavor, and texture were some of the most important qualities when purchasing bread, so we wanted to be sure the grain we chose could produce a high-quality product. The nutrition and health of the bread product were also important to consumers, which led us to initially consider grains with different gluten contents. The gluten strength in dough in part determines the gas production and retention, which helps create ideal bread texture. Grains that do not contain much, or any, gluten, must be suspended in a gluten network, and rely on the use of grains with strong gluten, like wheat. Our goal was to identify grains that could take the place of conventional wheat in bread, so testing grains that still required the use of traditional wheat did not meet our goal. There may be potential benefits to using grains with lower gluten contents, as many people with gluten sensitivity report no reaction to products with low gluten contents, but there is little evidence to back this up. John Sherck also explained that there has been speculation over whether landrace wheats are more tolerable to those with gluten sensitivity, or whether it is related to production practices and chemical usage. Taking this information and the consumer survey feedback into consideration, we decided not to focus on low gluten or gluten-free grains.

The grain recommendations we received from the practitioners we interviewed included einkorn, spelt, teff, and rye. We were hesitant to focus solely on rye, however, because 100% rye bread has a texture that is often not preferred by United States consumers. Zingerman's does use rye in their bread, though, and providing a more diverse, local source of rye was of interest to our clients, so we continued to consider it. In asking if there was any grain that may replace wheat in the future, we were met with a resounding no. Greg and Stefan both made it very clear that wheat is special for the gluten properties it has, and it is likely not going to be replaced by any other grain. In the words of Stefan, "Trends come, trends go, wheat rocks the world", and as Greg said, "Wheat is always going to be special and amazing because gluten is special and amazing".

After hearing these responses and considering the desires of Zingerman's and its customers, we opted to use alternative wheat varieties for the trial. While wheat as a commodity is not perceived as an "alternative" grain source, using locally sourced, more diverse wheat varieties produced with environmentally conscious methods did meet the goals of this project. In pursuing this idea, we spoke with Dr. Jones from the Bread Lab at Washington State University. The Bread Lab breeds high quality food crops, and has created a high yielding, disease resistant, high baking quality hard red winter wheat called Skagit 1109. This wheat variety was designed to be grown in the pacific northwest, but was developed through bulk breeding, which allows for natural selection to change its composition and adapt to best fit its environment. We were intrigued by this variety, and the Bread Lab was generous enough to offer Nature and Nurture small amounts of this grain, 9 other hard red winter wheat varieties, and several rye varieties to use in the grain trials we designed. Zingerman's currently sources most of its hard

red winter wheat from Grand Traverse Culinary Oils, and uses a more conventionally bred variety. These new wheat varieties include more genetic diversity, which will benefit the success and yield of the crop, and ensure that the variety has the capacity to adapt to a changing future climate. The trials will determine which cultivars can be managed similarly and grown together, which is an easy way to increase diversity in a field. In addition, many cultivars are so similar they have no impact on the baking properties and end quality of bread³², so they can be processed easily as one crop. Transitioning their wheat source to more local farms, which could easily happen with the use of Skagit 1109 and other cultivars, would also allow Zingerman's to continue their transition to local grain sources and cut down on transportation costs and emissions. This would also align with the consumers' interests by providing a local source of wheat that will continue to create nutritious, delicious bread.

5. Grant Opportunities

Relevant grant opportunities were researched using key-terms like "sustainable farming", as well as existing knowledge of the opportunities available. The requirements for each grant were evaluated and the applicability of each grant for this project was determined. A budget was created using knowledge of materials needed, and known prices based on current farm practices, or expected price. The expected price was determined by averaging the price of equipment or materials from several reputable retailers. The budget can be found in appendix G.

Results

1. Grain Economy Analysis

The current grain economy operates on a large, consolidated scale with about five main companies producing mass quantities of refined and predictable flour for the United States. This product is what society associates with normal flour, and while the production methods offer convenience, the flour lacks flavor and nutrition³³. Large scale milling practices utilize roller milling, in contrast to older stone milling techniques, which efficiently produces low cost and shelf stable flour, but removes the wheat bran and germ, which contain much of the flavor and nutrients in the grain³⁴. The leftover endosperm, which is what makes up white flour, is primarily starch and contains little fiber, vitamins or minerals³⁵. Industrial whole grain flours do not offer much more than white flour, as they are milled the same way with the bran added back in after processing. This results in the familiar heavy and bland whole grain products disliked by many, in contrast to the light and flavorful bread produced with stone-ground whole-wheat flour³⁶. Since wheat is produced on such large scales, consumers are no longer involved in or aware of grain production and processing practices, and consumer standards and expectations of flour quality are lower than they could be.

An alternative to industrial grain economies are local or regional economies, which can be defined as staple crops (grains or beans for example) that travel from farmer to consumer within a 250-mile radius. These systems require fewer moving parts, including at minimum a

³² Reiss, E. R., & Drinkwater, L. E. (2018)

³³ Quanbeck, K. (2012)

³⁴ Beckhusen, T. J. (2018)

³⁵ Quanbeck, K. (2012)

³⁶ Quanbeck, K. (2012)

farmer, a flour mill and a bread baker³⁷. There are several main barriers to the expansion of local grain economies, with the largest being the highly concentrated and entrenched industrial grain system³⁸, and a lack of access to appropriate infrastructure and equipment to harvest, process and store grain³⁹. The flow of grain through steps in production, and the equipment used, cater to economies of scale, and there is no place for small farms producing alternative forms of grain⁴⁰. In order to harvest grains that do not meet current conventional wheat metrics and economy scales, farmers must use equipment from the early 1900's or retrofit other equipment to fit their needs⁴¹. The proper processing facilities can also be difficult to locate and access for small farms, since their distance requires increased transportation costs, and many have minimum grain quantities that small farms struggle to meet⁴². Equipment availability and expense is not just a limiting factor for farmers, either. In talking with Greg Russo from Farmer Ground Flour, he explained that they do not dehull any of the grain they receive, it is completed by a different farmer who has the appropriate equipment and business scale to justify the investment and expense. The equipment is expensive, and as a smaller mill, the responsibility of dehulling grains could be a limiting factor to their business operations and success.

Lack of infrastructure, or only having infrastructure geared towards commodity crops, has a role in determining where local small grain economies are developing. Much of the local grain revolution is occurring on the East coast, because they historically lacked grain production in comparison to the wheat belt (OK, NE, KS, CO, TX, ND, SD, MT). It is difficult to transition away from large scale grain production in areas that produce small grains like Michigan, because much of the infrastructure is designed for industrial production, and the local partnerships between farmers and bakers don't exist. However, Michigan is no longer one of the most dominant wheat growing states, which could put it in a better position to foster local grain economies than other more dominant grain producing states. Figure 4 shows a compilation of local farms, mills and malt houses, which are the backbone of local small grain economies⁴³. While the information contained in this image is not complete, it demonstrates that there is a lack of resources in Michigan and lack of knowledge about the resources that do exist in Michigan.

³⁷ Krumme, M. (2019)

³⁸ Quanbeck, K. (2012)

³⁹ O'Connell, J. (2019)

⁴⁰ Quanbeck, K. (2012)

⁴¹ O'Connell, J. (2019)

⁴² Quanbeck, K. (2012)

⁴³ Local Grains Council. (n.d.)

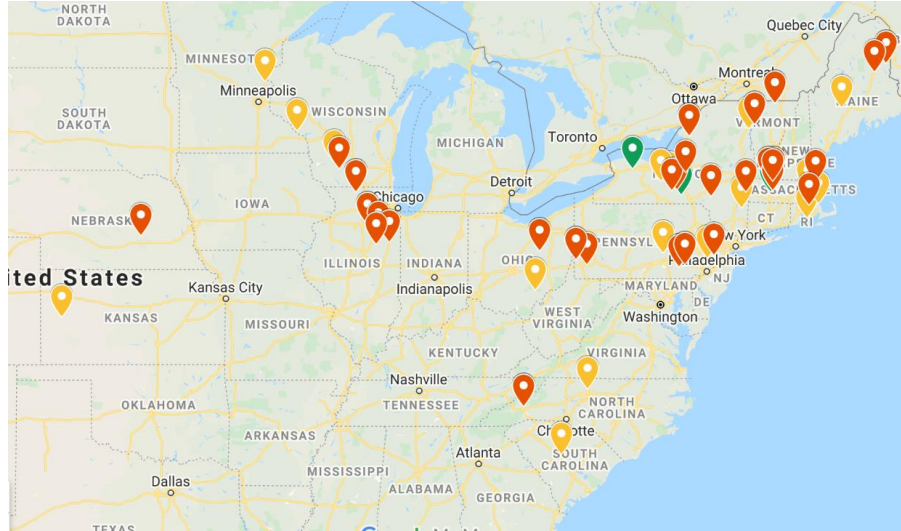


Figure 4: A compilation of local farms, mills and malt houses involved in the small grain economy, emphasizing the lack of accessibility in Michigan⁴⁴

Another barrier to local grain economies is the cost, including the price of grain production to the farmer, the price of flour to the baker, and the price of bread to the consumer. The cost of producing heritage grains is greater than traditional wheat in part because specialized equipment is required, and the industry is not geared towards small farms. This makes it challenging for small farms using more costly production methods to compete with large scale farms that receive government subsidies to endure market fluctuations or unexpected weather. This allows them to undercut small farmers and charge the low prices consumers have grown to expect⁴⁵, making the price of heirloom bread products seem unreasonably high.

Growing unique or uncommon grains can also be more expensive because they often have lower yields than traditional grains if they have not been selectively bred for maximized yield, and there is a lack of growing experience and knowledge that limits yield potential. Research has shown, however, that increasing in field diversity with the use of multiple cultivars can benefit yields, and equal those of conventional wheat⁴⁶. Greg (Farmer Ground Flour) has observed a learning curve for growing a new kind of grain, especially a food grade grain. He believes that since much of the grain grown in the country goes to feed livestock, the grain quality has been less of a concern and farmers are not used to growing to food grade standards. As a mill, finding farmers who can grow unique grains to appropriate milling standards has been challenging. One of the reasons, he believes, is because most of the food grade wheat grown in the country is grown in the wheat belt. Growing food grade grain in places like the East Coast where wheat has not historically been produced requires farmers to grow grain to new quality parameters and standards. The bakeries buying these grains also have

⁴⁴ Local Grains Council. (n.d.)

⁴⁵ Bland, A. (2013)

⁴⁶ Reiss, E. R., & Drinkwater, L. E. (2018)

different aesthetic and quality standards than what is found in typical white flour, making the production process “an entirely different animal”.

In addition to the learning curve in grain production, many bakers are milling these grains on their own using small stone mills, and are experiencing a learning curve working with dough made from more unique flours. Stefan Sanders from Wide Awake Bakery emphasized the lack of information available on stone milling, and stated that there will be little available until this generation of millers and bakers matures, and that “everybody is just doing it by the seat of their pants”. These grains don’t behave the same as industrial flour, and make baking with them more of an art than a science⁴⁷. When working with unique grains, bakers need to rely on the feel of the dough, following traditional formulas and adjusting them as needed for each different type of grain⁴⁸. Stefan mentioned that different amounts of gluten in flour makes them behave unpredictably, requiring adjustments in hydration, but that good bakers can feel the differences and make the necessary adjustments on the fly. He also described in detail the differences in fermentation time, gas production and gas retention between conventional wheat and other grains including whole grains. The extra time needed to learn how the flour behaves, and the risk associated with producing a novel product, as well as the increased cost of the flour, has increased the price of bread products made with these grains⁴⁹. It is not uncommon for bread made with local grains to cost \$8.00 or more for a loaf, which is a significant barrier to consumers. High prices could isolate consumers, and make it difficult for everyone to participate in the growth of sustainable grain economies, even though the goal is to bring a great tasting staple food product to the market for everyone to enjoy⁵⁰.

2. Survey

The AllOurIdeas platform generates a ranked preference list based on the responses generated in the survey. We received over 6,000 individual votes on the survey within a few days of distribution. The summary of the results from the survey can be seen in Figure 5.

⁴⁷ Quanbeck, K. (2012)

⁴⁸ Krumme, M. (2019)

⁴⁹ Quanbeck, K. (2012)

⁵⁰ Unrein, J. (2018)

Attributes	Wins	Losses	Can't Decide Votes	Score
Superior Taste	467	134	32	77.61
Has Full Flavor	417	154	33	72.95
Is Nutritious	397	174	29	69.46
That it is healthy	390	194	39	66.72
Supports the Local Economy	369	200	44	64.80
Texture	353	219	45	61.67
Sourced from Michigan Grain	321	263	48	54.95
Unique Flavor	332	273	38	54.86
That its Production Supports Native Pollinators	301	256	77	54.03
Is Locally Sourced	318	274	46	53.70
Consistency	295	281	36	51.21
Sourced from Grain Grown in the Great Lakes Region	287	288	47	49.91
That its Production Supports Healthy Soils	244	305	73	44.46
Visually Appealing	243	306	22	44.28
Is non-GMO	242	352	34	40.77
Appearance	232	344	39	40.31
Cost	234	373	44	38.59
Expense	226	366	57	38.22
Organic	212	382	45	35.74
Sourced from Grain Grown in Washtenaw County	203	370	60	35.48
That it is Soil Regenerative	163	352	65	31.72
Novelty	106	492	41	17.83

Figure 5: Summary Chart of ranked preferences in our consumer survey

From these results, it is apparent that customers of Zingerman's Bakehouse value taste and nutritional content above all else. A duplicate attribute for each category was included, and for both health and taste, both the duplicates were in the top four attributes ranked by customers. From these results we can also see that word choice is important when designing these surveys. For example, the options of "...Supports Healthy Soils" and "That it is Soil Regenerative" were not near each other in the ranked list, even though these phrases have a highly similar meaning. The more 'technical' phrasing was ranked second to last and the more colloquial phrasing stayed in the middle of the ranked list. The full survey results outlining how each attribute performed against all others can be found in appendix F.

3. Interview

The information gathered from interviews was applicable to many parts of this report and is included in the appropriate sections as supplemental material, and it also informed our grain choice for trials. Transcripts of each interview can be found in appendix B-E.

4. Grain Trials

The grain trial was designed as successive trials over a three-year period to gather enough data to determine which wheat varieties grow best in southern Michigan and have the best baking and flavor qualities. The goal of the first year of the trial is to gather preliminary data on the different varieties to inform future trials, and to gather data that can be used in analysis after the three years of trials has concluded. The second and third years of the trial will eliminate grains that do not perform well, and expand the scale to better mimic production conditions. As more grain is grown and available, more data will be gathered about its growing properties and quality.

The trials were designed as replicated trials, meaning each variety is grown once in a block, with three blocks total⁵¹. Replicated trials account for field variation that may impact crop growth, like differences in soil type, slope, drainage and weather patterns, which can impact yield and disease resistance. While they are more laborious, they provide more accurate data that can be used in statistical analyses in the future, and will better inform future trial and whole field decisions. Future trials will simulate conditions more similar to whole field grain production, and will focus on the most promising wheat varieties determined in the first trial. Multiple year trials will also accurately determine which varieties can withstand the climate conditions present and management practices used on our client's farm.

The first-year trial will include three blocks of all ten varieties to be tested and a check variety of hard red wheat, similar to what Zingerman's currently uses. A common variety of hard red winter wheat used in organic production is Warthog, and the University of Wisconsin Madison is in the process of trialing other varieties for organic production. Depending on the availability of the seed, a different variety could be used. The location for the initial grain trials is the fenced area northeast of the house. Space is limited in this area, so trials for each variety will consist of one two by six-foot-long row, replicated randomly 3 times in each of the trial blocks. Keeping distance between rows will help reduce the impact of competition, and the replication will generate a more representative sample. Although small plots are less representative of field scale production, they will provide adequate information to inform future trials. Equipment limitations also favor small scale trials initially, and are conducive to the equipment available to Nature and Nurture at this time.

In order to simulate realistic planting conditions, the seed will be planted with a walk behind seeder and harvested by hand. The planting depth should be 1 inch, or deep enough to reach moisture in extremely dry soils. The recommended planting rate is 1.8-2.2 million seeds per acre if planted within the two-week window after the Hessian fly-free date (September 18). The closer the planting date is to the fly free date, the lower the planting rate can be. As time increases into October the planting rate should increase. Figure 6 helps equate planting rate to seeds/foot⁵².

⁵¹ Organic Seed Alliance (2018)

⁵² Nagelkirk, M., & Pennington, D. (2019)

Target seeding rate (millions per acre)	Seeds per ft of row ¹	Seedlings per ft of row ²
1.4	20.1	18.5 (92%)
1.6	23.0	20.7 (90%)
1.8	25.8	22.7 (88%)
2.0	28.7	24.7 (86%)
2.2	31.6	26.5 (84%)

Figure 6: A summary of expected seeds and seedlings growth given a certain seeding rate. **1** Target seeding rate/43,560 X 0.625 = seeds per ft of row (7.5" spacing). Seeds per sq ft = target seeding rate/43,560. **2** An estimated emergence rate is given in brackets as percent. (The rate tends to decline as seed rates increase.)⁵³

Evaluation of the varieties will include grain yield (Kg/ha), above-ground biomass (Kg/ha), height at maturity, flowering and maturation dates, estimates of disease resistance, and general observations on performance. Yield and biomass will be measured by harvesting and threshing each row, drying the biomass at 60 degrees Celsius for 48 hours and measuring the dry weight of grain and straw separately for each variety plot⁵⁴. Weights for each variety can be averaged over the three plots, and compared amongst each other and the check variety. Once weighed, the grain can be milled into flour and used in baking trials. Disease resistance will be measured on a scale of 1-5 (best to worst) for each variety, determined visually. The same few people will measure each plot in order to ensure consistency in measurements and ratings. General observations include the plant's visual health, how the plant changed over weeks and months, how it handled changes in temperature, and how prone it is to lodging.

Harvesting by hand can be done by cutting the stalks just above the ground with pruners, a scythe or a sickle. The stalks should be dried⁵⁵ before threshing, which is the act of separating the grain from the seed heads, and can be done in a variety of ways. Rubbing between hands, flailing with a wooden bat, banging seed heads in a metal trash can, or treading with your feet are all viable methods. Once this has been completed the grain must be separated from the chaff, or winnowed. Winnowing can be done by pouring the grain from one container to another in front of a fan, which will blow the lighter chaff away⁵⁶. Since the initial trials will be completed by hand, additional labor is required for harvesting and processing the grains. Zingerman's has offered to assist with this, and more labor can be acquired through farm volunteers and interns, funded with grant money when necessary.

⁵³ Nagelkirk, M., & Pennington, D. (2019)

⁵⁴ Miller, P. R. et al. (2011).

⁵⁵ Barth, B. (2018)

⁵⁶ Duncan, J. (2011)

Zingerman's will conduct milling, baking and tasting trials of the varieties that yield at least one to two pounds of flour, which is enough to bake several loaves of bread. The initial trials should yield about one pound of flour, given grain performance, which is enough to bake one loaf of bread, or at minimum smaller flatbreads that can still assess the baking quality and taste of the grain⁵⁷. Zingerman's uses a Mock Mill, which is almost 100% efficient so there will be little grain lost in the milling process. The initial test of baking quality will be based on feel and perceived gluten content determined from proofing and baking.

Site context



Figure 7: Site location

Nature and Nurture Seeds is located at 7100 Marshall Rd, Dexter, MI 48130. The north side adjacent to the farm is hundreds of acres of privately owned conservation mesic oak woodland. On the eastern side is Scio Township property and property owned by various companies is on the west. A single-family home is located on the southern side, across from the Marshall Road.

⁵⁷ Barth, B. (2018)

Design area



Figure 8: Existing site assets

- 1 Mesic oak woodland
- 2 Hayfield
- 3 Maple swamp
- 4 Industrial hemp
- 5 Site for parent's house
- 6 Buildable land

The core area adjacent to the house



Figure 9: Existing site assets around housing area

1 House 2 Parking 3 Shiitake mushroom woodlots 4 Pond 5 Neighborhoods 6 Nursery
7 Hoop house 8 Barn 9 Camping ground 10 Intercropping field

Sunshine and wind analysis



Figure 10: Climate condition⁵⁸

The longest daylight day is 21 June. The sunrise at 05:58, sunset at 21:16. The daylight duration is 15 hours and 12 minutes. The shortest daylight happens on 21 December. The sunrise at 08:01, sunset at 17:06. The daylight duration is 9 hours and 5 minutes.

The seasonal winds are varied in summer and winter. Our clients mentioned windbreaks as a buffer could effectively reduce the impact on the worker's experience from harsh wind in winter.

⁵⁸ Aslakson, J. et al. (2017)

Shade analysis



Figure 11: Shade condition in July- 7 AM, 12 AM, and 7 PM



Figure 12: Shade condition in January- 9 AM, 12 AM, and 4 PM

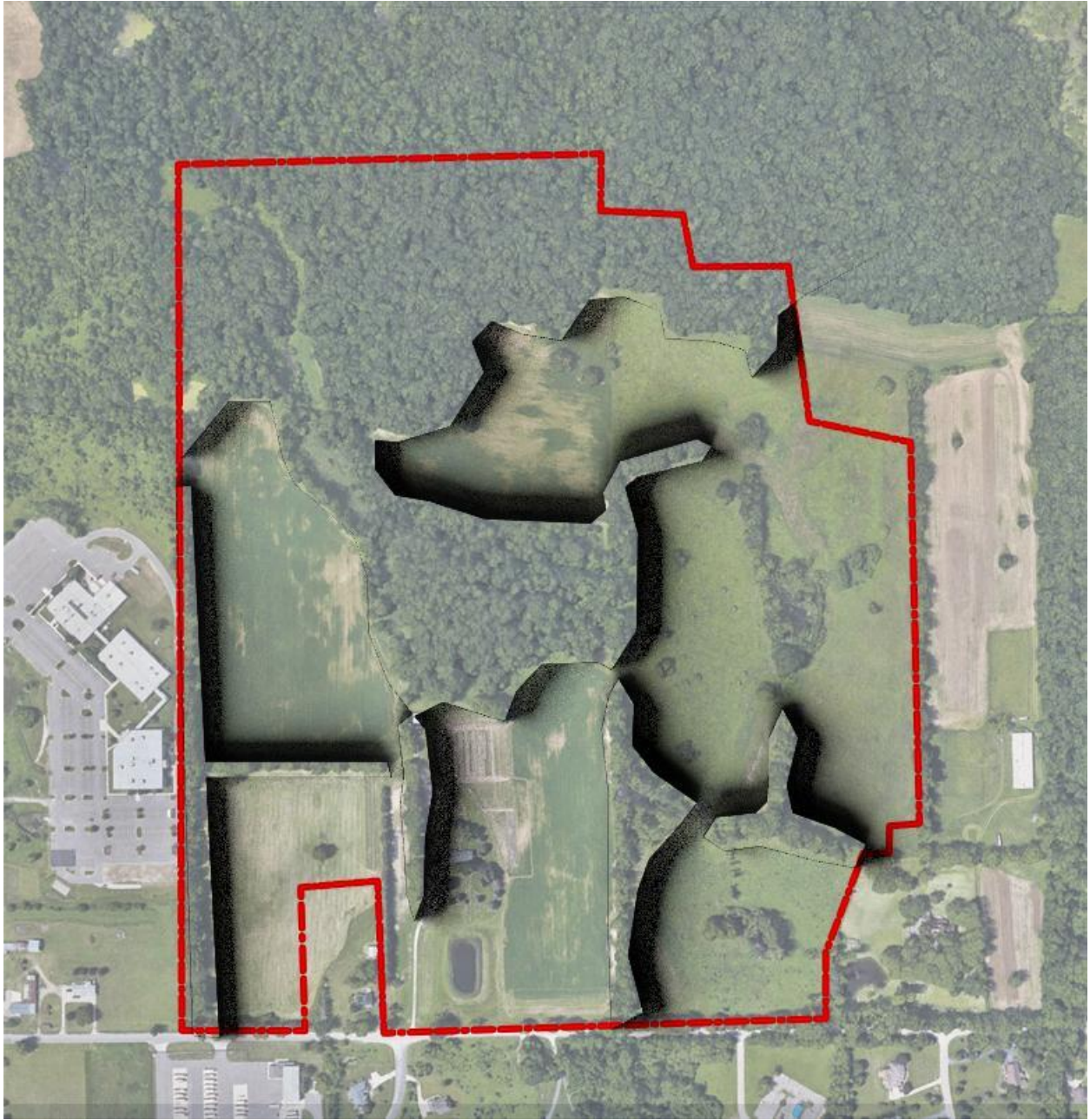


Figure 13: Part shade area in January

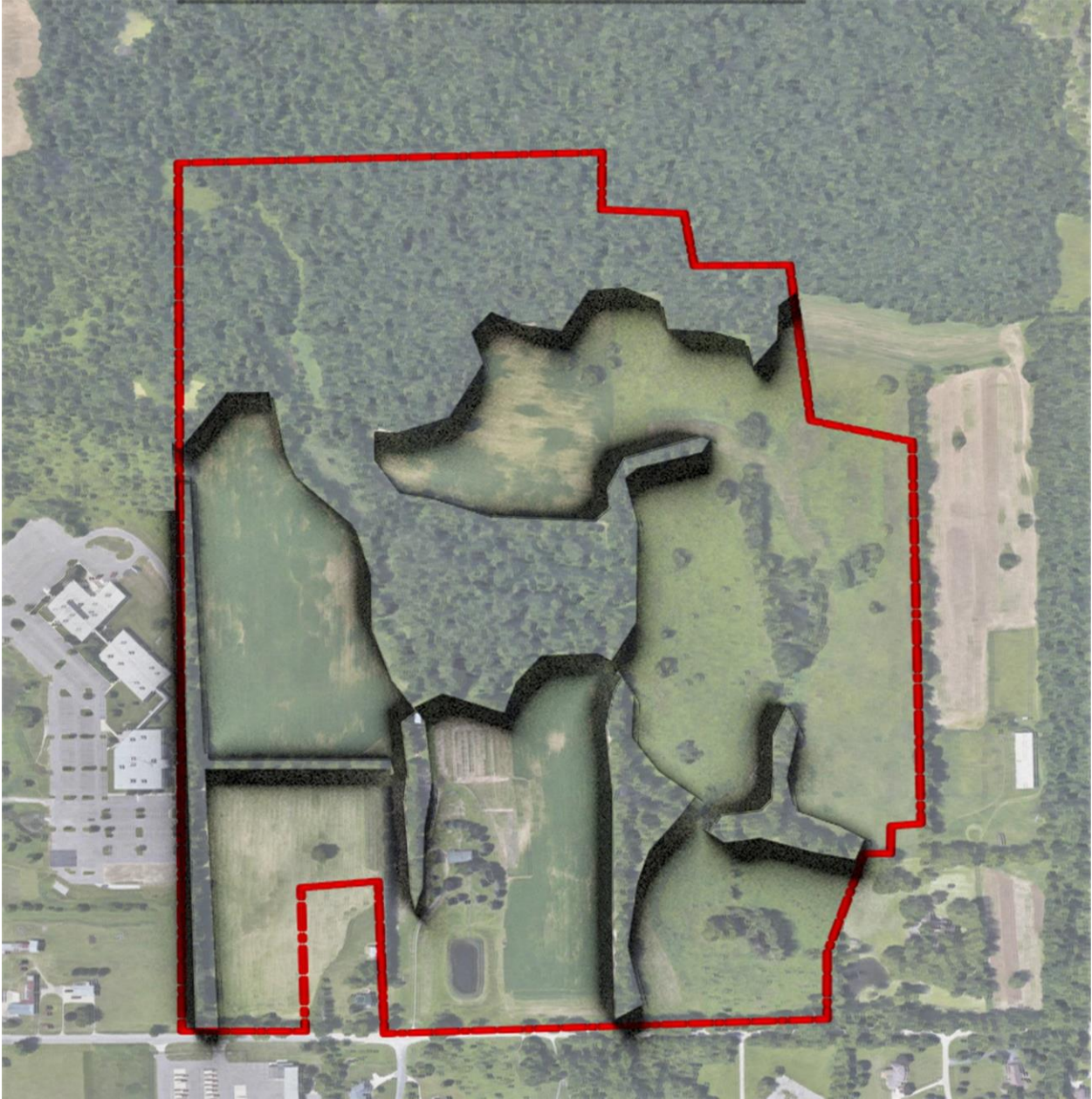


Figure 14: Part shade area in July

The design area is well illuminated, as determined by a sunshine-shadow analysis, but there may be a small amount of land on the edge of the dense forest that is underexposed to winter sun. Some areas are vulnerable to sun exposure in the summer, which should be shaded from the windbreak or buffer to prevent excessive exposure.

Hydrology analysis



Figure 15: Elevation and hydrology⁵⁹

The elevation changing in the design area is relatively complex, and is susceptible to surface runoff and water stagnation in the rainy season. Considering that soil compaction in farmland may reduce infiltration and produce a large amount of surface runoff, two design

⁵⁹ Aslakson, J., Li, Y., Lordon, M., & Peters, A. (2017)

methods and principles will be adopted in the design: first, reduce surface runoff by using planting design and stormwater management, and second, ensure drainage in the farmland.

Interview with clients



Figure 16: First visit Sep 13, 2019

We held interviews with our clients twice. These meetings stated our scope and design guideline as follows:

1. Pointing out 1-1/2 acres of land for establishing the grain trial, which need to be maintained and irrigated feasibly and simply.
2. Planning windbreak to improve the environment in the design plot
3. Considering the future development direction of combining grazing, permaculture, nursery and landscape classes.
4. Connecting the parents' house in the east of the design area for easy access and better living circumstances.

Site plan overview



Figure 17: Site plan overview with key features labeled

This site plan illustrates the final deliverable of the design. Responding to the existing site condition, and client interviews, our major design features include proposed windbreak, woodland habitat improvement, pathway to connect existing circulation, several boardwalks connection to existing road, and a housing area landscape with expanded and formalized entrance design.

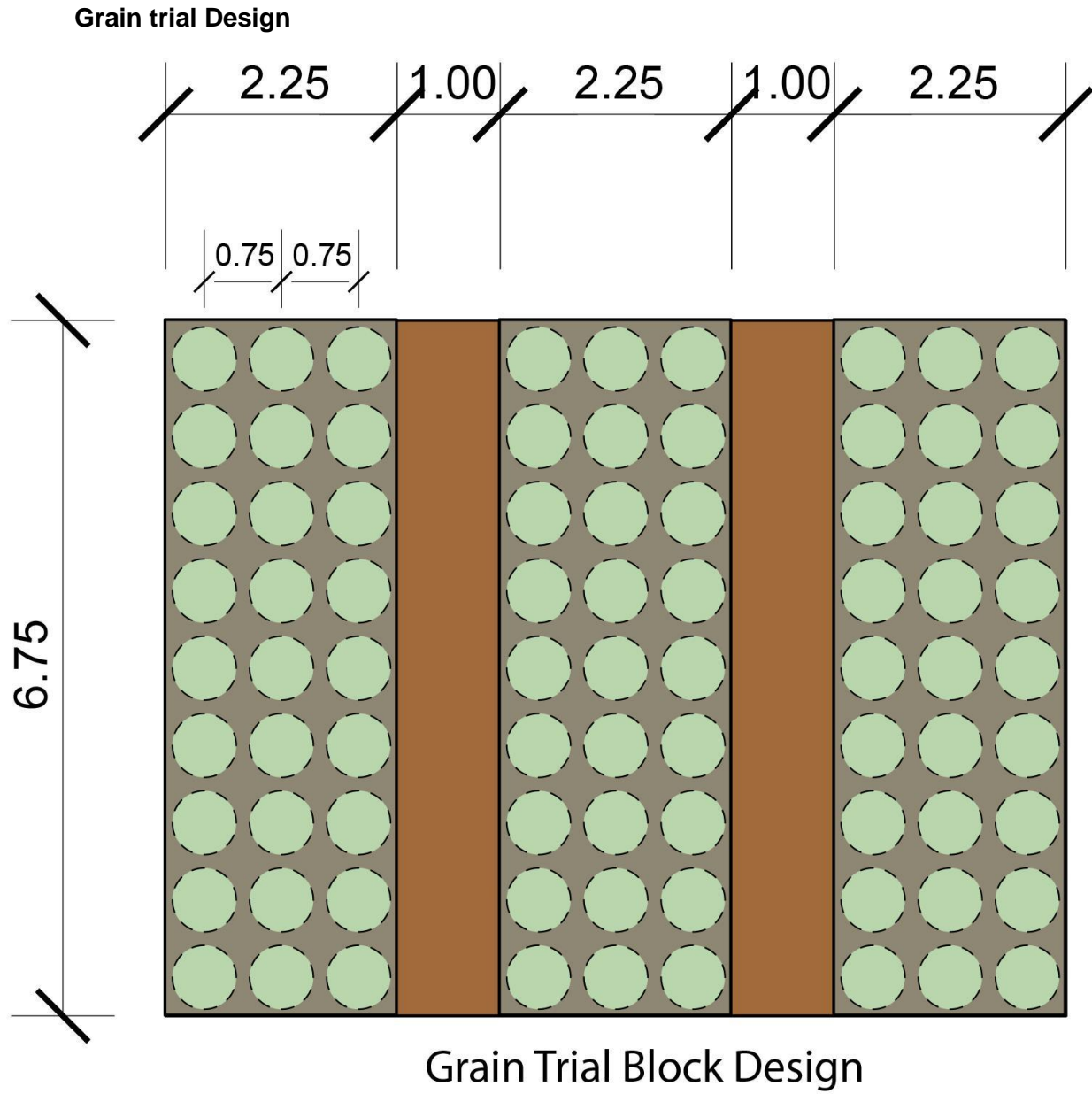
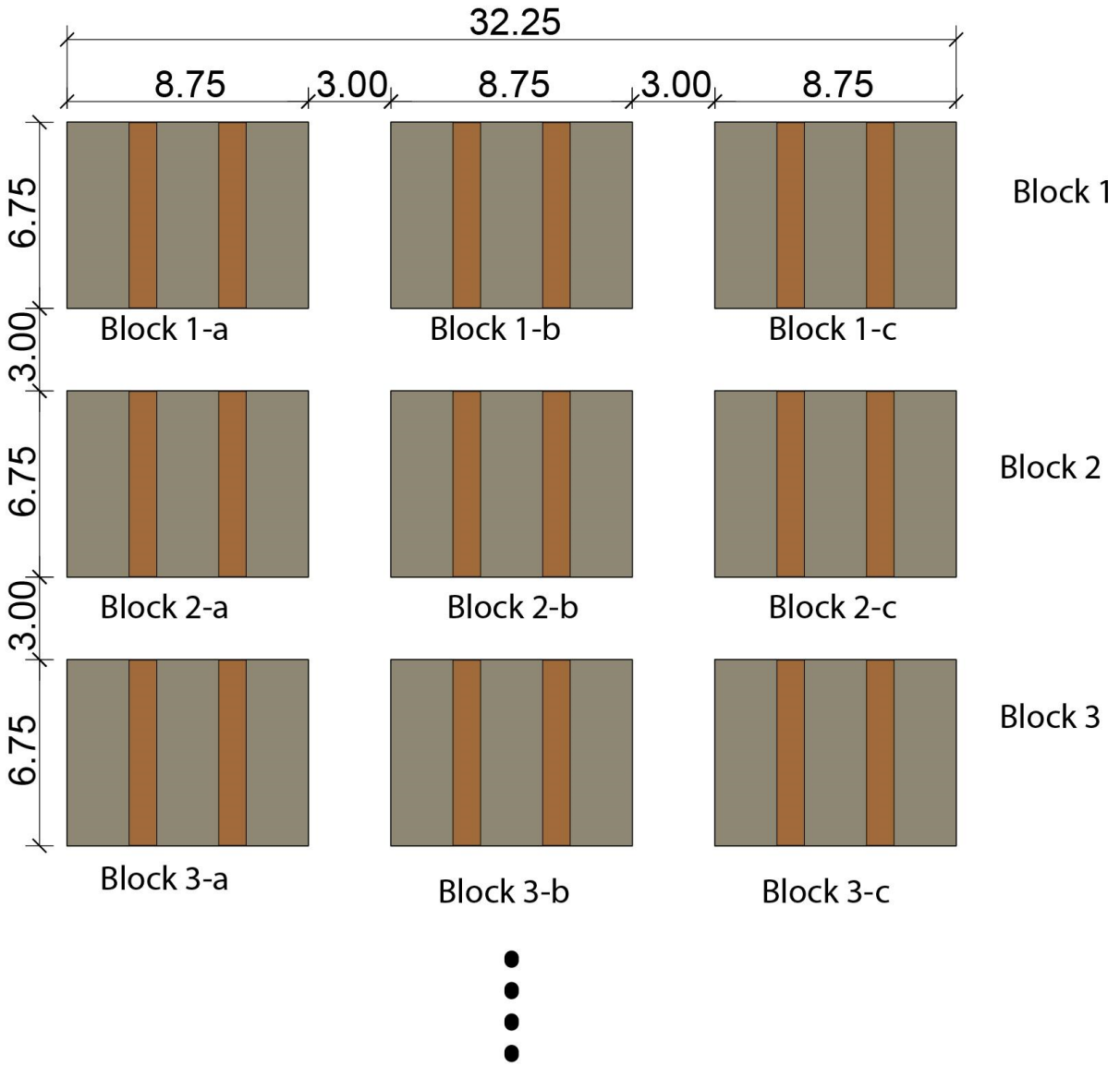


Figure 18: Grain trial single block design with dimensions (Unit:feet)



Grain Trial Blocks Design (Unit: feet)

Figure 19: Grain trial blocks design with dimensions (Unit: feet)



Figure 20: Housing area detail with key feature labeled

The housing area is the key point that improves living experience, encouraging community engagement, and expanding the potential market. The parking lot will be surrounded by native nursery and seed garden showcase, which would make a profound impression to clients and visitors.

Grain Trial Implementation Preparation and Management

Conventional herbicides are the primary weed management strategy used in agriculture, but since these same strategies are not available to organic growers they must rely more on cultural and mechanical techniques like weed prevention, crop rotation and competition, and cultivation⁶⁰. Mulching the area to be planted with straw or crop residues can be effective in suppressing weeds as it does not allow the necessary sunlight to penetrate the soil and weeds cannot germinate and grow. Cover crops can also be used to compete with weeds, with the dead material serving as mulch once the crop has terminated.

Mechanical weed control is also almost always necessary in organic systems, as cultural controls are not entirely effective. Mechanical methods include preplant tillage like discing, plowing or field cultivating. Post plant weed control can also be conducted several days after planting using implements like a rotary hoe, chain link harrow, or tine weeder. Dragging these implements over the field displaces small seedlings and exposes them to sun and wind, drying them out, without disturbing the planted crop⁶¹. The first-year trials will be small enough that the mechanical weed control can be done by hand with hoe, and the farm has a spader and a two-bottom plow that can be used for the larger trials.

The area on the farm where the initial grain trials will take place is currently planted with a diverse cover crop mix, including alfalfa, and the larger field where successive grain trials will occur will likely have a diverse mix of grasses, clover and hemp from previous year's crops. These cover crop mixes will help to suppress weeds until cultivation and seeding for grain trials occurs. If additional mixes were to be planted, we recommend a mix of crimson clover (*Trifolium incarnatum*) or cowpeas (*Vigna unguiculata*) and oats (*Avena sativa*). Crimson clover is an annual legume that can be used as a nitrogen source, to build soil and prevent erosion. Since it is quick growing it can provide weed suppression, and can supply nitrogen over a short period of time, so it is an ideal summer or fall cover. It should be broadcast at a rate of 13-18 pounds per acre six to eight weeks before the first frost, and it will winter kill. In the spring it should be planted immediately after the threat of frost is past, and can be terminated through tillage.

Cowpeas are an annual legume similar to clover in that they are fast growing and suppress weeds well, they can prevent erosion, and they provide nitrogen. They are better adapted to warm temperatures, though, and are best used as a summer cover. The seeds can be broadcast at a rate of about 70 pounds per acre, or less in a mixture, and lightly incorporated with some form of tillage. Planting should occur after the soil has reached 65 degrees Fahrenheit in the spring, or nine weeks before the first frost for the fall. Mowing can be an effective termination method, and following it with tillage ensures they will not regrow.

Oats are a quick growing cool season annual cereal grain that winter kills to provide a mellow mulch in the spring. Oats can scavenge excess nitrogen in soil, their fibrous root system can help prevent erosion, and they can improve the productivity of legumes when planted together. Oats can be broadcast at least 40-60 days before the first killing frost at a rate of 1-2

⁶⁰ Curran, W. S. (2020, February 22)

⁶¹ Curran, W. S. (2020)

bushels per acre, and should be lightly incorporated through discing or other similar activity. If used as a summer cover they can be mowed soon after the vegetative stage to terminate⁶².

Nitrogen

Nitrogen is the most limiting nutrient for wheat growth, but careful application is required as excess nitrogen can cause excess growth that may lead to lodging or increase the chance of disease, and excess runoff has negative environmental consequences. Nitrogen application is recommended based on yield goals, and Michigan wheat averages between 74-79 bushels per acre. The following table provides nitrogen application recommendations relative to wheat yield goals⁶³.

Wheat Yield Goal (bushels/acre)				
50	60	70	80	90+
Pounds N/acre				
40	60	75	90	110

Figure 24: Nitrogen fertilizer recommendations given different wheat yield goals

Phosphorus, Potassium and pH

Phosphorus application rates are determined through soil test results, and appropriate application rates are directly proportional to yield goals. Applying too much P and K will cause financial loss because of unnecessary fertilizer costs, as well as negatively impact water quality. Wheat grows best in a pH between 6-7, and liming rates are determined by soil tests⁶⁴.

Fertilizer Recommendations

Using soil test information collected from the previous masters project completed in 2017, the [MSU fertilizer recommendation](#) tool, and a conservative yield goal of 60 bushels per acre, nutrient application rates were determined.

Grain Trial Year 1 Fertilizer Recommendations		
Nitrogen	Phosphate	Potassium
65 lbs/acre	40 lbs/acre	20 pounds/acre

Figure 25: Nutrient application rate recommendations for the first-year trials

For more accurate results we recommend Nature and Nurture take a more up to date soil sample this fall and run their new results through the fertilizer recommendation tool. We recommend these nutrients come from the existing legume cover crop, and manure application in the fall before planting. The nitrogen credit from the existing alfalfa is 40 pounds for plants

⁶² Clark, A. (Ed.). (2008)

⁶³ Vitosh, M. L. (2016)

⁶⁴ Vitosh, M. L. (2016)

less than six inches, and between 60-100 pounds for plants taller than 60 inches⁶⁵. This alfalfa, or any legume cover crop they decide to plant will provide the necessary nitrogen in a stable form that is less likely to leach out of the soil, and applying manure rates to cover the potassium and phosphorus requirements will ensure any additional nitrogen requirements are met. Nature and Nurture typically use Herbrucks pelleted organic fertilizer, which is heat treated so it can be applied to crops intended for consumption. For the initial trials we recommend they use about half a ton per acre, which amounts to about 9 pounds of fertilizer.

Analysis	Percent	Pounds/ton	First Year Availability
Total Nitrogen	4.438	88.8	55.2
Phosphate	3.233	64.7	64.7
Potash	2.411	48.2	48.2
Sulfur	0.42	8.4	4.6
Magnesium	0.57	11.4	6.2
Calcium	7.165	143.3	88.8

Figure 26: The specific nutrients provided by Herbrucks pelleted organic fertilizer, which Nature and Nurture intends to use to fertilize their wheat crops

Future Trials

Once the initial small-scale trials are completed and the varieties have been tested for baking and taste quality, the second-year varieties will be determined. If any of the grains performed badly and did not yield enough for a baking and tasting trial, or did not perform well enough in the baking and tasting trials they will not be pursued in the future. Performance will be judged by Nature and Nurture and Zingerman's. The second-year trial will take place in the field that was previously hemp, northwest of the house, and similar recommendations can be made concerning field preparation, fertilizer, and planting. These plots should be bigger than the initial trial, ideally 60 square feet, 5 feet wide and 12 feet long. Row spacing is recommended to be 7.5 inches apart⁶⁶, resulting in about 6 rows per plot. The trial will consist of replicated plots, with each variety occurring once randomly in each of the three blocks, similar to the initial trial design. The check variety will remain the same as the first trial for consistency and data analysis.

Since these plots are larger than the first trials, the walk behind seeder may not be as efficient to use, and a grain drill can be used instead. The Lenawee Conservation District rents a no-till drill that can be used to drill the grain in the plots. They have a 5 ft drill which is capable of planting 6 rows of wheat, with a width is 5'3". The drill requires a 40 hp tractor with low 1" pull type hitch.

⁶⁵ Ruark, M., and Stute, J. (2014)

⁶⁶ Nagelkirk, M., & Pennington, D. (2019)

The analysis of the grain will include the same data gathered in the first year, but will gather more thorough biomass information. Biomass will be measured using a 2.5 square foot quadrat with one end open to allow for easy measurement of potentially lodged plants. One quadrat will be randomly measured in each plot within the 4 inner rows of the planting to reduce the influence of edge effects⁶⁷. The quadrat samples will be threshed, dried at 60 degrees Celsius for 48 hours, and the grain and straw will be weighed separately⁶⁸. Once grain has been weighed and some separated for other sampling, the rest can be milled for further baking trials.

Some of the grain harvested from these plots will be analyzed in the Blesh lab at the University of Michigan using a Leco TruMac Analyser to determine the percent nitrogen and protein content. These analyses require two duplicate sub-samples per variety, using about 2.5 grams per sample, totaling about 5 grams per variety⁶⁹. This information will be helpful for the bakery to have in order to determine which varieties are chemically best for baking, and how they can be expected to behave in larger scale baking. It is also helpful for consumers if they are interested in the specific nutrient content of the grain they are eating, and can be used as a marketing tool. We observed in our survey that health-related qualities of bread are highly valued by Zingerman's customers, and having access to the nutrient information for each variety could be useful for the Bakehouse. After the grain has been harvested in the summer, we recommend a fast-growing cover crop mixture be broadcast over the area to prevent weed growth and provide nitrogen.

The trials in the third year will follow a similar format with the same data collection and analytic methods and planting protocol, with trouble shooting from the first two years applied. These trials will include larger plantings, between 0.25-1 acre, and will not include any of the grain varieties that did not perform well in the second round of trials. The goal of the last round of trials is to determine which one, or several varieties will grow best in Michigan, and which offer the best baking qualities. After this trial is complete, the data from all three years should be compiled to determine which grain variety performed the best and should be pursued by Nature and Nurture, other farmers in the area, and Zingerman's. Nature and Nurture will also report the data back to Dr. Jones at the Bread Lab, so they can use the information in their future research.

Grant applications

The Sustainable Agriculture Research and Education ([SARE](#)) program offers a variety of grant opportunities that can provide funding for the grain trials included in this project. SARE's mission is to advance sustainable farming innovations by utilizing on farm insight unique to farmers, and the grants offered include Farmer and Rancher grants and Graduate Student grants. More in depth descriptions and up to date information can be found on their website, including specific due dates for 2020.

Farmer and Rancher Grant

⁶⁷ Reynolds, M. P. et al. (1994)

⁶⁸ Blesh, J. (2018)

⁶⁹ Blesh, J. (2018)

The Farmer and Rancher grant allows farmers to use sustainable agriculture practices and their own innovative ideas to solve problems utilizing on-farm research, demonstration, and education projects. The proposals are due in early December, and individuals can be awarded up to \$9,000 for projects up to 24 months long.

SARE defines sustainable agriculture as “farming that is ecologically sound, profitable, and socially responsible”, and includes the following practices related to this project; crop/landscape diversity, value added and direct marketing, and organic agriculture”⁷⁰.

The grant proposal requires a project proposal, budget, and letter of support from a community member explaining why the project is needed and how it will benefit the community. Successful proposals clearly define a problem, involve cooperators like extension agents or local conservation districts, measure the beneficial economic, social and environmental outcomes, and emphasize outreach through field days or workshops. These components are all embedded within this project, and furthering community education is a long-term goal for Nature and Nurture that could be realized through this project with grant funding. A preliminary budget can be found in appendix G to be used for grant applications.

Graduate Student Grant

The graduate student grant provides funds to students enrolled in graduate programs who are interested in exploring sustainable agriculture, and has similar requirements and expectations as the farmer and rancher grant. The proposals must be written by the student who will coordinate and conduct the project, with input from their major advisor, and ideally include farmers in the planning and implementation process. Successful proposals will explain how the project outcomes will work towards the SARE mission, how the progress will be evaluated, and the impact on farmers, communities and society. Grant applications are generally due in early April, and can be up to \$15,000 for projects lasting up to 36 months. The projects should focus on improving the profitability of farms and associated agricultural businesses, sustaining and improving the environment and natural resources farmers depend on, and enhancing the quality of life for farmers, rural communities and society as a whole. A preliminary budget can be found in appendix G to be used for grant applications.

Conclusion

While this project analyzed local grain economies on a broad scale, we also identified specific limitations for Nature and Nurture in implementing large scale grain trials and production, which we believe are relevant to other farmers with similar goals, and identified potential solutions.

The first, and most apparent limitation is the lack of equipment for grain planting, harvesting, and threshing. Nature and Nurture is primarily a seed company, so much of their production occurs at small scales geared towards saving and adapting seed, and they do not have the equipment to plant and harvest crops on a large scale. The equipment necessary for large scale grain production is expensive, generally requiring financing, and is a barrier for many farmers. While some forms of wheat are commonly grown, there is a general lack of available

⁷⁰ S. A. R. E. (n.d.)

equipment for less common grains with different requirements, and the knowledge required for adapting existing equipment to produce unique grains is also not easily accessible.

Another limitation related to equipment is a lack of on farm storage. Again, while specifically speaking from our experience with Nature and Nurture, this is likely a barrier for many small farms attempting to participate in grain production. Obtaining the infrastructure to store equipment is expensive, and with the grain economy of scale that has been created in the United States, it does not make fiscal sense to invest in storage for small amounts of grain. Having or accessing the necessary infrastructure, equipment and knowledge to effectively grow any small grain, heirloom or not, is expensive, time consuming and challenging, and has likely kept the development of local small grain economies suppressed.

One solution to the expense and lack of equipment is to create a cooperative of local grain producers who can pool resources and energy, sharing equipment and information. John Sherck from Sherck Seeds mentioned in our conversation the lack of connectivity he has seen between those involved in trialing grains, and that connection through a larger organization could be helpful for more streamlined information sharing, which could expand local grain economies even faster. The growing demand for local small grains could also increase the knowledge gained and shared about their production, since demand is the driving factor behind increased production⁷¹. From Greg Russo's (Farmer Ground Flour) perspective, consumer demand is required in order to increase the incorporation of more diversity in our food, since farmers are rarely the ones who decide to grow a new and unique crop; they simply respond to consumer demand. He has also observed from working in this field that grain processing and milling is capital intensive, and it could be most effective to have a group of businesses supporting the formation and growth of small grain economies. Because of this, he has observed that small grain economies function best at a regional scale, to allow for many different actors to provide support and resources. John Sherck of Sherck Seeds also commented on the importance of creating connections in the market before production begins, stating that the farmer, the processor and the market all need to be ready to go at the same time, otherwise there could be a grain product that cannot be processed, or a bread product that will not be purchased. While these connections can be difficult to make upfront and on the same time scale, they are integral to the success of locally produced unique small grains.

Producing heritage or heirloom grains is more costly than traditional wheat, and can be a difficult barrier for small farms to overcome. Fortunately, there is potential for farmers to earn a price premium for varieties that have special attributes. Small farms struggle to be competitive in commodity markets because success is relative to the quantity produced, but focusing on quality and providing desirable attributes that commodity grains do not provide helps set them apart and compete in the market. It has been shown that consumers are willing to pay a premium for organic and local foods at farmers markets, so it is not a stretch to assume some will also be willing to pay more for locally milled flour⁷². We found in our consumer survey that almost all options for local or regionally produced grains were more important than cost or expense. Consumers tend to prefer local production for a variety of reasons, including access to organic food, supporting local economies, and reducing the carbon footprint of food production.

⁷¹ Quanbeck, K. (2012)

⁷² Beckhusen, T. J. (2018)

Flavor, nutrition and freshness also play a role in consumer food choices, and local grains allow for bread to be produced with no preservatives or additives because there is a shorter shipping time⁷³. In Farmer Ground Flour's experience, Greg says there is more demand for the flour they produce than they can meet, but that consumer trends tend to lag in the Midwest, and can be five years behind what is happening on the East coast. Stefan (Wide Awake Bakery) also echoed this, saying that they have infinite demand, and could sell as much as they wanted to produce, and that demand can be manipulated through price changes or constraints on operation like delivery or hours open.

In order to overcome the expense, risk and time needed to work with alternative grains, many bakeries that work with these grains utilize different business models than traditional bakeries. Some examples include only opening a few days a week to have time to experiment with dough that may take longer to prove⁷⁴, or like Wide Awake Bakery, sell bread to markets and wholesalers, as well as bread to customers through a bread share, similar to a community supported agriculture model. This strategy allows for most of the bread they bake to be prepaid, mitigating much of the risk to the bakery. Stefan also suggested that Zingerman's could create an ever-changing specialty bread menu, as one of the challenges they run into is the continuous availability of specialty grains. It is difficult to ensure specific types of specialty breads are consistently available when there is only one or a few farmers growing the grain type needed. Other efforts to promote local grain economies include the [Greenmarket](#) farmers market in New York. They promote regional agriculture by providing small family farms the opportunity to sell their products, and require a minimum of 25% local grains in the baked goods sold there. This model is one that Zingerman's could follow, as they transition into using more local grains in their products, possibly committing to a minimum percentage in the future.

The popularity and expansion of local and regional grain economies has much potential, as there are many other foods that are purchased for flavor, like wine and cheese, and bread could be next⁷⁵. However, these markets and supply chains may never fully imitate that of commodity wheat flour. Greg from Farmer Ground Flour stated that while large scale production of heirloom grain flour is possible, most of their customers are not interested in replicating mass produced white flour with a different grain; they want a different product. The artisan baked goods their customers demand is inherently more expensive because they require more skill and labor to create, so heirloom grain bread may remain a niche market. While there seems to be an increase in interest in local grain production, it still takes up a small place in the larger grain economy. In 2018 the United States grew 39.6 million acres of wheat, which is about 1.88 million bushels, and of that local grain production made up less than 1%⁷⁶. Local grain economies require network connections and coordination to succeed and grow, and due to the risk and uncertainty for all involved parties, relationships between farmers, millers and bakers need to be formed before grain production begins. Research has shown collaborations that ensure farmers have buyers for their unique and diverse grain crops is one of the most effective

⁷³ O'Connell, J. (2019)

⁷⁴ Quanbeck, K. (2012)

⁷⁵ Beckhusen, T. J. (2018)

⁷⁶ Unrein, J. (2018)

ways to increase diverse crop production⁷⁷, and farmer cooperatives and increased market connectivity is one way to do this. The scenario required for local small grain markets to develop and grow is incredibly specific and requires work to establish, but each additional participant in these markets is another step towards environmentally conscious, high quality food production.

Future Design Recommendations



⁷⁷ Reiss, E. R., & Drinkwater, L. E. (2018)

Figure 21: Long-term plan

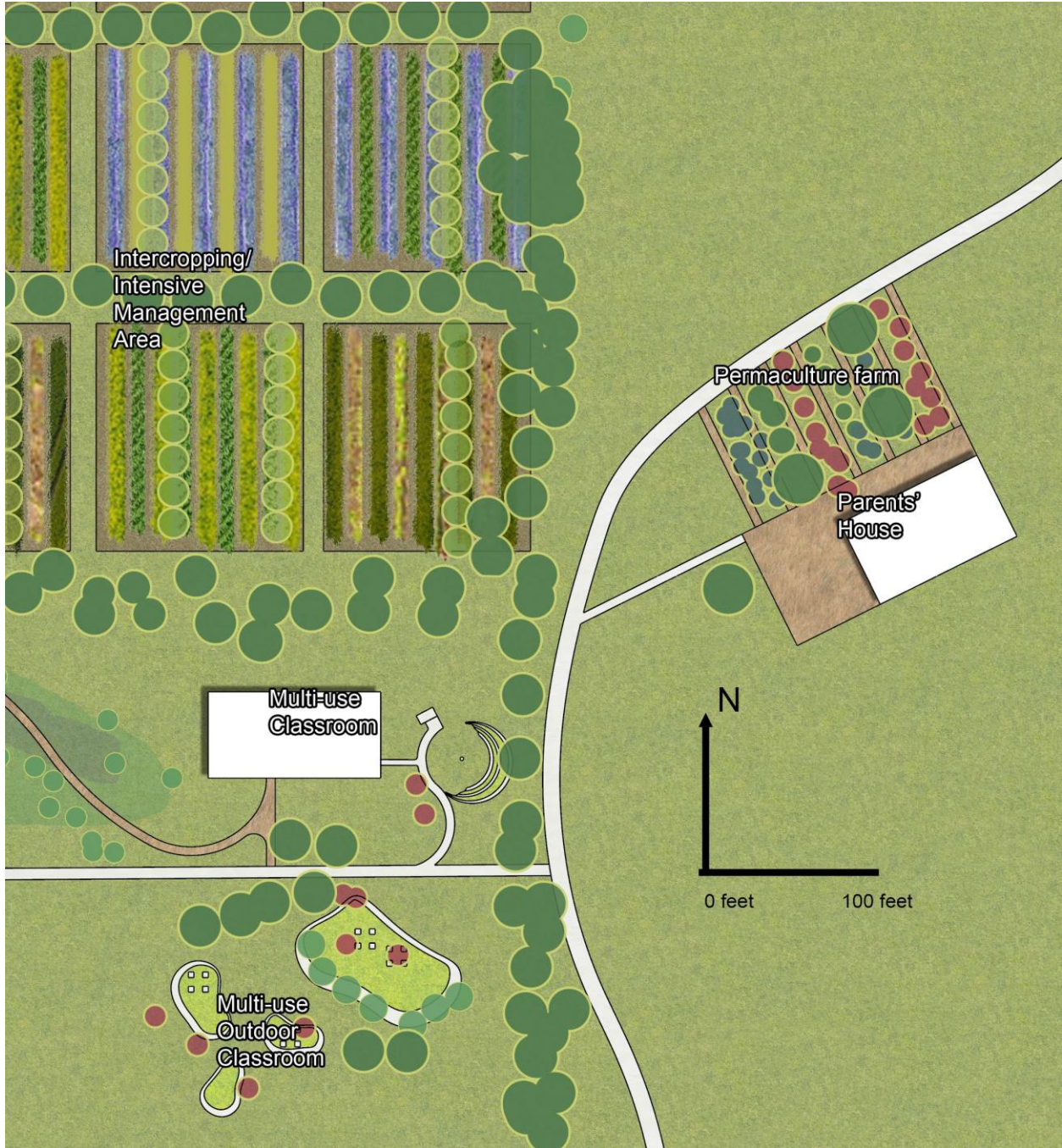


Figure 22: Multi-use classroom design with label



Figure 23: Multi-use outdoor classroom perspective

In discussions with the client and project advisors, we believe that this farmland has great potential to be showcased for marketing, be open to the public, or used for education. These opportunities could allow Nature and Nurture to diversify income streams while also continuing to benefit the community.

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Appendix A**Questions (Production)**

- From your perspective, what are the biggest barriers to incorporating more diversity in grain production at medium and large scales? (specifically- as it relates to markets, processing, equipment, knowledge of the producer or consumer)?
- Have you grown any “non-traditional” small grains besides wheat? If yes, which ones? What was that experience like?
- What challenges in grain harvesting/processing/marketing have you faced?
- What type of equipment has been limiting for planting/harvesting/processing/baking?
- Have you experienced challenges sourcing non-traditional small grain seeds? How have you overcome this?
- Have you experienced challenges in selling this type of seed since it is not traditional? If so, do you think the challenges are related to a lack of processing, consumer/business demand?
- Does the market demand match or exceed the amount of grain you produce?
- Do you think alternative small grains have similar taste and nutritional value compared to traditional spring or winter wheat?
- How have you modified your existing equipment to be able to harvest alternative grains?
- How would you suggest growing these grains in order to make harvest more efficient (e.g., planting equipment, row spacing/seeding density, planting depth, etc.)? What are the biggest management challenges you have experienced with growing alternative grains (e.g., weeds, nutrient management, harvesting, establishment, etc.)?
- Do you think there is potential for small grains other than wheat to become as mainstream and common as wheat?
- What environmental benefits do you think alternative grains provide?
- What nutritional benefits do you think alternative grains provide?

Questions (End Use)

- Do you currently use any locally grown grains in your company's products?
 - If so, why?
 - If not, why not?
- Does the market demand match or exceed the amount of bread, beer, etc. you produce?
- What have been some of the challenges you, or your business, have encountered in trying to utilize locally produced grains in your products?
- What do you think would alleviate those issues?
- In trying to increase the viability of a local grain economy in Michigan, do you think efforts should be concentrated on production or processing?

Appendix B

Farmer Ground Flour interview

Sheila: *introduces project*

Greg: I was just recently talking to some folks in WI and IL who are doing basically the same thing, basically a feasibility study to determine what is the demand and support in small grain production and milling and processing and stuff like that. So you know there are a lot of people out there who are asking the same questions you are asking and on the same path and my immediate observation is to support grain processing and milling is pretty capital intensive or enough that you're going to want more than one, or more than one group of businesses to support it, because inevitably it seems like the grain, food grade quality grain, milling, processing, cleaning and drying, it's always, there's more details than people think. It's not rocket science, but there's more details than people think off the bat, and so there always ends up being more managerial costs than people think. It's not that the equipment necessarily is out of this world expensive, it's that the farmer has to take the time to manage it basically and so it seems like it's always more at a regional scale. I'm sure all your questions will get into this but that's just my immediate kind of observations.

Sheila: So, you are on the smaller end of the scale for mills?

Greg: Yeah, we do about a million dollars in sales every year and we have five employees.

Sheila: Do you find that the amount of flour you produce meets demand, or if you were to produce more you would have infinite demand?

Greg: Yeah there's definitely more demand for what we are doing, but the New York city metro area is pretty huge, and also, a lot of demand for this kind of stuff is based on very specific consumer trends and interests. When I talk to people in the Midwest about this, they basically say those trends are five years behind out here. For example, in Chicago the demand for "local organic sustainable" grain products is not going to be as big as it is in New York City. There's this guy, David Baker, who got an NRCS grant to do a feasibility study to gauge what is the demand for this stuff in the Midwest. It was like a multi-state thing.

Sheila: Do you know who he works with?

Greg: It's the Delta institute in Chicago. I can put you in touch with him because I think he would love to talk to you.

Sheila: Yeah that would be great. It definitely seems like there are a lot of people doing these same things and asking the same questions but there's a lack of coordination.

Greg-I don't know how far your clients or the farm have been with this, but the other major piece is, as a country we've gotten used to flour or grain products being these

homogenous things, which isn't necessarily a bad thing, but if you go and ask a bakery how many pounds of all purpose flour or whatever do you use a month, that's not going to translate immediately into, you know a farmer grows wheat and the bakery can use it. It's a very different product. Anything that you can make work on a small scale like us, that's not going to be a comparable product. So that's a huge unknown is, of a bakery or food processor, of their total demand, how much of it are they going to be able to use of this different product. So, most of the bakers we sell to are blending in our flour at 40-50% with regular large-scale white flour.

Sheila-Is that just because of the way the that the flour reacts with gluten and proofing?

Greg-Yea you know there's a lot of chemistry in baking. Like I said, we've just gotten used to flour, flour and wheat historically in reality is something that varies a lot with the seasons and the climate but we've gotten used to it being this standardized homogenized thing because the milling industry has been really successful making it that way. Doing it on a small scale, it's like with local seasonal vegetables, the tomatoes you get from CA are going to be a little different than an organic heirloom tomato you get raised on a small farm nearby.

Sheila-So you mostly source from the Oechsner farm?

Greg-Yeah, he also sources from 5-6 other farms but he's our main partner farm.

Sheila-Most of the farmers you work with are in New York?

Greg-Yeah all of them

Sheila-Has that been a challenge to find enough grain in the types you want locally?

Greg-Yeah like I was saying, it's one thing to grow them but to grow them to a standard for food, and specially for bread..hold on one second.

Sheila-No problem.

Greg-Where were we?

Sheila-I was just asking about the difficulty of sourcing grain locally.

Greg-Yeah, the challenge is getting the farmer to grow it and maintain it at a quality such that we can mill it and get a high value for it.

Sheila-Do you think the solution is just time and experience of growing?

Greg-Yeah, it's just a learning curve on everyone's part. I mean that's, everyone's researching these same things across the country and basically trying to come up with a business plan for how do we do this local grain thing and there's no magic bullet its just time and experience. I'm sure it will get faster as people, but it's not ever going to be as

simple as borrow 10 million dollars and build the facilities and instantly have the farmers start producing high quality flour.

Sheila-It seems like there has to be such coordination between the producers, consumers and markets to line up in the right way at the right time.

Greg-Have you heard of a mill out in WA state called Cairnspring? They are the closest thing to having done what I just described where it's like borrow 10 million dollars build a mill and go from 0-60 because their market was this bakery called Tartine down in LA who is already a famous bakery and they already had this huge demand for flour so they could speak to that a little bit better.

Sheila-On your website you mentioned that milling is a consolidated industry and that you are breaking the mold by being smaller and local. Do you think that has a negative effect on producers for the milling industry being so consolidated? Do you think farmers have growing freedom or are too constrained to grow a specific type of grain?

Greg-You mean on the farmer end? Yeah, I mean, mainly it's that most farmers, even the most experienced farmers don't know the first thing about wheat for actual food. Even the guys that grow for us, we've taught them a little bit, but it's really hard to...you know 80% of whatever cropland in this country goes to animal feed, so there's virtually no standard there as far as the quality for what they are producing. Even just getting them to have this mentality to take this interest, you know you're not producing a commodity you are producing a nuanced food product. It's not their job necessarily to be managing those details, but yeah to have them take the time to sort of take good care of it, and for us to figure out, it's a learning curve on everyone's part, we sort of have to reinvent what quality parameters matter to us because all that information, at this point in history is so specialized and specifically focused on grain out in the western states. You know food grade wheat production is all consolidated in the wheat belt, so for those of us growing and processing wheat anywhere else in the country, we have to redefine what our quality standards are, and also, we are making different product. The demographic, or whatever the bakery market that is going to be using this stuff is a completely different set of aesthetic and quality standards, so it's, all the people you're talking to and this whole movement, we are not just trying to replicate what's, the flour that this country makes just on a smaller scale, it's kind of a different animal.

Sheila-Do you think there will have to be a change in consumer preferences for this movement to take hold since it is so different than what we are used to?

Greg-Yeah, I mean there's two options I guess if this country decides that regional or local grain production is an important thing. If the demand was great enough someone could totally build a large-scale milling operation to replicate the white flour that people are used to. I don't think, that's not what most of our customers are interested in, so I think probably it will remain somewhat of a niche thing, unless food tastes in this country, taste in general, moves away from cheap processed food. I mean the core of this that bakeries that are using this stuff, or any other grain products in general, its artisan baking which involves long fermentation which is skill and labor intensive, which

doesn't fit with the mass-produced production food model in this country. So, you know, is a large percentage of American's be willing to pay the extra money? That in itself will never be cheap, and you're not going to change that, so I don't know really.

Sheila-Do you think in expanding grain economies to use more diversity in crops and more locally sourced products, do you think that will be more on the grain production or processing end?

Greg-Like what's going to drive the..

Sheila-Yeah what would need to be improved or increased for this to really take hold?

Greg-Yeah from my perspective it's all consumer driven. It's not like there's farmers that are like hey I really want to grow einkorn, how do I find someone who wants to eat this? It's all consumer trends, the interest in ancient grains, some of it seems like agricultural literacy on the part of the general population, I was talking to a guy who is starting a business where they are trying to make crackers that are specifically made out of crops that are grown in crop rotations, and he was inspired by Dan Barbers book, basically the idea is all these crops like rye, buckwheat, organic farmers grow them because they are agronomically useful, useful for healthy soil in a crop rotation, and he's trying to take that idea and market it to people and say hey, were making this product that farmers are growing because it's good for the soil, you should buy it because that supports this farmers, which I think is pretty ambitious to expect people to even, basically all they have to understand is its good for organic farming. I think that's one of the great parts of all this is that people's interest in the environmental impacts of farming is guiding their food choices.

Sheila-We are surveying consumers on something similar to this so it will be interesting to see their responses.

Greg-I think it will be amazing when the day comes that you go to your local bakery and they have a sign that says this bread made from wheat that was grown on a farm that increased soil organic matter by .5% over five years. You know what I mean? Like that's kind of a comical level of detail but that would be pretty cool.

Sheila-What is your experience dealing with grains like spelt, einkorn and buckwheat that need to be dehulled? Do you do the dehulling?

Greg-No we don't. we're fortunate because there's a farmer in NY state that has been ahead of the curve on that stuff for a while, so he has been growing spelt for decades, and he has a dehuller. Dehulling is one of those things that takes a lot more equipment than normal grain cleaning, so there has to be a certain economy of scale there. It's sort of the last thing you can get going there because it takes so much extra equipment.

Sheila-Would that be a limiting factor for you if you had to dehull grain?

Greg-Oh yeah, even for the amount of, so we buy, we do maybe 8,000 pounds of spelt every month, and maybe 4,000 pounds of einkorn, so it would take a lot of money and

time to be doing the processing. So honestly if they weren't here, we would be buying it nationally from companies growing it elsewhere.

Sheila-So you wouldn't be able to have the local sources if you didn't have someone to dehull it near you?

Greg-Maybe we would invest in it ourselves, but again the guy that we buy from has many customers across the state and the region, so he can justify dedicating growing a field of this stuff and having a bin for it, and setting up the equipment to process it, whereas if it was just our own demand, even getting a farmer to grow it and store and dedicate a bin to it would be pretty tough.

Sheila-Are grains like spelt more difficult to work with than grains like wheat or is it pretty much the same?

Greg-After its dehulled the milling part is easy. It's exactly the same as wheat or even easier.

Sheila-Is there any difference in milling a whole grain or more refined flours?

Greg-Whole grain milling, where you aren't removing any of the material is way, way easier. That's why you see a lot of bakeries now, they'll just have a grain mill in the back and they can make their own whole wheat flour. As soon as you start, they call it sifting it, where you take out some of the bran, it gets a little more complicated. Basically, the whiter you want to make it, the more complicated it gets.

Sheila-What would be the benefit of white flour then? The baking properties?

Greg-Yeah you know it's just what we are used to in this country. It bakes easier, it makes larger, fluffier, whiter loaves. But that's just consumer preferences. If you tasted the Wide Awake bread even compared to some of the best white flour bread you might prefer the Wide Awake. It just takes a lot of time and skill to make it.

Sheila-You sell freshly milled flour?

Greg-Um yeah within two or three weeks. We store it for a little while here. That's not a huge distinction between here and what other mills do.

Sheila-Some of the reading I've done talks about the benefits of freshly milled flour, I was just wondering if you had any insight if freshly milled flour tasted better or had any other benefits.

Greg-It definitely doesn't taste as good 9 months or a year out. But I feel like if you buy a crappy flour at a grocery store in a five pound bag it's a lot older by the time it gets through the whole distribution chain, but when you're talking about an actual production bakery, even if they were buying flour from another mill, it's generally not that old.

Sheila-Do you find or know that any of the alternative or ancient grains are more nutritious or do they taste a lot better?

Greg-Yeah you can google this stuff and find the nutritional breakdowns, but einkorn is a clear difference. It has actually more fat and oils and sugars, and you can clearly taste it. It's more flavorful in a lot of ways, but I'm not 100% sure I haven't dug into that in a lot of ways. Generally whole grain flour is more nutritious than refined or white or sifted or whatever you want to call it.

Sheila-So, you like the way einkorn tastes in bread?

Greg-Yeah, I was pretty blown away with it when I first tried it. You know people don't really make a traditional bread with it because it doesn't have the same gluten, but if you just make a pancake or any kind of muffin out of it, you can totally taste, if you don't add any sugar, it's pretty noticeable. And as far as regular wheat, you know, at this point my taste preferences for the kind of bread, naturally leavened sourdoughs. So much of that is the flour we're making. Even when we sift, even when we remove some of the bran there's still a decent amount of it and then there's all these other components, the germ, and there's some inner layers to the bran, that gets retained in the flour, but most of it is the process of the baker. Because it's a fermentation process so, so much is happening there, a lot of bakers can take a whole range of different flours and make a really high-quality product out of it. When you hear people talking about the digestibility of gluten and the nutritional benefits of different kinds of flour, so much of it comes down to the baking process because there's this whole fermentation taking place that alters everything.

Sheila-I've heard the only grain that replicates the gluten properties of wheat is spelt.

Greg-Yeah people do make 100% spelt loaves, I don't know too much about that but I know there are some similar proteins. But it's a taste thing. People are making 100% einkorn or rye breads, traditionally in Germany 100% rye bread was just part of the diet, so it looks and tastes very different from what we are used to, but if it's done right it's still amazing food. The whole baking culture is changing as we speak so fast, people are developing all this stuff, so who knows what it's going to be like in another ten years. But it's just a matter of what people can get away with marketing to people in Ann Arbor basically.

Sheila-Do you think there's a chance that spelt or einkorn could ever be as dominant as wheat or do you think there's too many challenges in the way?

Greg-Not in this country. In Europe people made 100% rye bread because it was available and it was there. Wheat is always going to be special and amazing because gluten is special and amazing. I think mills like us that are small, organic, doing a bunch of grains, it's still 60-70% hard wheat products. I don't think there's anything inherently wrong with wheat, and from an environmental aspect, grains like einkorn and emmer and spelt, you get a lower yield, you get like half as much grain per acre, so then what's the carbon footprint of that? You're tilling as much soil, burning as much fuel and getting

half as much food. High yielding wheat is great. It's more just about the farmers growing practices in general, it has nothing to do with the crops they are growing.

Sheila-The only crop that we've found to have inherent environmental benefits is Kernza since it is a perennial wheat, but it seems like it's still in the testing phases and is hard to get established.

Greg-Cornell had me try and clean and mill some for them and if you're going to get into cleaning it it's just a whole different set of equipment. It's so small, it's like grass seed it's a completely different kind of grain.

Sheila-I personally feel like spelt is the best alternative grain form.

Greg-Honestly, I think einkorn is going to catch up with it pretty quickly, spelt has been around longer, and while it's different it's not vastly different from wheat. If you look up the nutritional charts you'll see what I mean. Einkorn is a very different grain and we've seen our sales of it double or triple of it over the last few years. I think its kind of the grain of the future.

Sheila-Are most or all of your grains organic?

Greg-Yeah, we are 100% organic

Sheila-Do you make those decisions based on environmental benefits?

Greg-Yeah, it's just our market niche, it would be a hassle to have a whole different line of products.

Sheila-Does that add to the difficulty of finding locally sourced grains? Does it minimize your options?

Greg-Mainly our limitation is that no one grows hard wheat in New York state, that it's all grown out west. Even if we opened ourselves up to conventional there's no one growing this stuff anyways. Which you will probably find to be the case in Michigan too. In Michigan it's all soft white and soft red. That is an advantage that you can get soft white because that isn't the case elsewhere. And it's better for milling.

Sheila-Is there anything I didn't ask you that you want to bring up?

Greg-It has to get cleaned, there's a whole range of cleaning equipment, and it has to get milled, and that can be pretty easy or pretty complicated depending on how white you want the wheat. Really what you want to do is get a sample for them to try and mill it, and that's going to take out a lot of the questions. The one thing I will say is I think there is too much emphasis on variety, like if we find the right variety than this whole local grain systems thing will work better. To me there's much more variability in how it's grown, the milling, and what the baker does with it. Most of the issues are in there. Even within a variety you'll see, so much of the protein quality, and the baking quality have to do with how it was grown, what field it was grown on, how was the nitrogen uptake,

what was the weather like in that specific year, you'll see more variation in terms of baking quality from one variety grown from one year to the next from one farm to the next than you will between two different varieties grown on the same farm in the same year. People are focusing so much on variety because it's this tangible thing that people can wrap their heads around and it seems like oh, we'll just get better varieties. And that is part of it. Different varieties have different qualities, but there's so many other variables that I think are more important.

Appendix C

Wide Awake Bakery Interview- Steff

Sheila-Tell me about your business.

Steff-We are really a very small operation, we are a small wood fired bakery, we are formal business partners with our farmer Thor Oechsner, informal partners with mill Farmer Ground Flour. Thor is a former partner of Farmer Ground Flour. We do grain testing for farmer ground flour, we are kind of like their help line, if you are a baker and have trouble with the flour they don't respond, they just hand the question over to us. We have this kind of three-legged thing going on. That was our mission, that's the whole reason we started was to do that, we didn't stumble into it, we chose to do it. We use all kinds of grains, we use a lot of wheat, einkorn, spelt, polenta, Kernza, buckwheat. Basically everything. We work with other groups too, like the NYC green market and the organic growers research information sharing network. They were very excited by a lot of this. We do a lot of teaching, and they encouraged us to do a lot of teaching, so we teach people how to use different grains. All of this stuff is pretty embedded in our work, you know like it doesn't seem special to us, it's just what we do.

Sheila-Our project is looking at using different kinds of grains in bread, and hopefully finding an alternative to wheat that may be more environmentally friendly and nutritious-

Steff-So they are going to look at spelt and the ancient grains like Kernza. Do you want me to tell you about our experience baking with those grains?

Sheila-Yeah that would be awesome.

Steff-So, we don't bake with amaranth, that just doesn't happen. As I'm sure they know at Zingerman's, a basic understanding of grain testing, from a commercial perspective you're looking at two factors-gas production and gas retention. Gas production is a matter of fermentation, and gas retention is a matter of two things, usually gluten strength and quality, and whether the gluten is penetrated by any non-glutinous material like fibrous hulls. So, all the whole grains, because of their fibrous hull, have relatively poor gas retention, with a few exceptions. Spelt has a very soft hull so it actually retains gas great, and you can get this beautiful whole grain thing going on. They are I'm sure familiar with this because bakers work with this every day and have a basic understanding of this. The fermentation properties of these grains is quite interesting, and takes a little while to get used to. As a rule, whole grains ferment faster than non-whole grain, stone ground ferments faster and more vigorously than roller milled flour, and we haven't noticed any differences within the wheat. Like we don't see excessively rapid fermentation with einkorn, spelt, emmer, any of those, buckwheat is very rapid fermentation. As I'm sure they know through their experience, rye is incredibly rapid in fermentation. I don't know how they do their process; I mean we do a long pre-ferment, just talking about the sourdough breads here. Some portion of the flour will ferment 12-14 hours before we start to do the mix, this is very common. They may or may not do

this, but I assume they do. And what we've found is we...are you an experienced baker? Like if I talk baker talk do you know what I'm talking about?

Sheila-I think so, and if I don't, I can relay the information to the Zingerman's bakers and they will have a better understanding.

Steff-What I'm trying to say is I'm going to tell you specific things about these grains from a bakers' perspective and you're going to be able to understand this?

Sheila-I think I have a decent idea, but as far as the baking goes Zingerman's will handle that.

Steff-The total fermentation time for all sourdough breads is about the same for all breads, it's just a matter of how that fermentation is allotted over time. Ours is allotted such that we get about 12 hours in the front, and another 12-15 on the rear end in a cold proof. So, we are running around 10-15% of the total flour we pre ferment in the 12-15 hour period. Now two things to note, so if they are doing everything in the same day, like if they are going to mix and bake they might be pre fermenting up to 30% of the flour, that I don't know, but what I want to tell you is this, with these grains, especially the ones that ferment noticeably more rapidly like buckwheat, rye and if they are only using white flour, any of these whole grains, the variation in that amount of flour pre fermented, the difference between 15% and 12% of the flour, or the difference between 10% or 12%, you've got to understand these are very small numbers and they make a huge difference in the final quality of the bread. And the reason for that, from the other end of it, from their perspective, what they will run into, if you imagine that this bread can be under fermented and under proofed, and over fermented and over proofed. And for a white bread, they do a lot of white bread, I know they do whole grain but they do a lot of white bread, they've got hours to play with, hours. When you start working with these stone ground local flours and variation in different crops, that window could be very short, like 20 minutes. Which sounds fine but when you are trying to run a whole bakery that time, you just blink and it's gone. So that's the thing they need to wrap their heads around, when we work with pro bakers. That window is quite short and requires a lot of attention. When you're using white flour, I mean honestly you could take a nap, because it's very strong, but when you are using these flours you have to watch them and get to know them and be very timely.

Sheila-So you said you use spelt, einkorn, buckwheat, what other grains do you use?

Steff-Well we use everything, our foundations are various stone ground wheat and rye, we do a lot of spelt, we do emmer, einkorn, we did grain corn for a while, which is a roasted grain, we do polenta, we do buckwheat, we do Kernza, we do all of those things. It's like I told you, the gas production, gas retention, and window of vulnerability.

Sheila-Were those decisions made based on the availability of grains or where there other factors that went into deciding which grains to bake with?

Steff-Oh we will bake with anything, this is just what we have. When we get new grains, we are all about them. We bake with everything.

Sheila-Has there been anything that you've tried to bake with that's been a disaster? Or something that you wouldn't want to eat?

Steff-No I mean we have had bad batches of flour with contamination, like mustard seed sometimes can contaminate flour, wild mustard seed is the same shape of wheat kernels so it gets through all the screens and you can't detect it in raw flour, but when the bread comes out of the oven and you smell it, it smells like old Chinese food. It dissipates actually eventually so if you can wait customers actually don't notice it, but it's very disturbing. Zingerman's is really one of the great American bakeries, and they will not tolerate that stuff. But that was a roller milled flour. Yeah, we do Khorasan, we do all that, those are all pretty easy.

Sheila-Can you speak more to your experience baking with these grains and the response you have had from your customers?

Steff-For us, we started with this stuff so it all feels natural to us. Coming from a white flour bakery this might seem crazy, but to us, once you're in the groove, it's just a piece of cake. There's nothing to it. The other thing to recognize, is to make the best bread you can, certain dough structures and crumbs don't suit the grain. That may tighten your crumb a little bit, or you may decide that volume or height of the bread is more important to customer appeal. Some people really like to see that high thing, so drop the hydration percent or drop the pre ferment down 1% and that gives us the extra height. What I would recommend for them to try at first is spelt, the bad part is spelt has a sticky hull that needs a separate production phase to remove, but I would be surprised if U of M didn't have a dehuller. So, if you use a dehuller, the grain is quite nice, when you stone grind it, it shatters into really really fine silky fine flour. With large pieces of very soft light golden bran. That bran is not bitter at all. Like wheat bran, it's very bitter and people don't really like it that much, and it's very stiff so it messes with your gas retention. But spelt, you get beautiful retention, you get beautiful soft dough, with very visible large bran flakes. And customers love that. They get the kind of virtuous whole grain hit. And it's really easy to work with and tastes divine.

Sheila-We have been struggling with the processing aspect of grains, and even though Zingerman's has their own mill they don't have a dehuller.

Steff-Now you know a lot of people are using a new American stone mill, those are really great mills. A lot of people are making beautiful 100% whole wheat flour with these mills. They are getting a really nice rise on it. And I think part of it is super fresh grain that grinds really nice. Some of those bakers are using ascorbic acid, we don't use that but I'm sure they know how to use it.

Sheila-What is the difference between using fresh flour versus flour that's been sitting on the shelves for a few weeks/months?

Steff-Traditionally bakers, everyone had said there's almost instantaneous quality drop after a few days with green flour, but after you age it the quality comes back. We thought that for a while, but now we don't think that. We just think we are better bakers

now. It makes no difference to us when the flour was bagged in terms of the quality, in terms of all of the external qualities of the bread. I think really fresh flour has a tiny bit more flavor, maybe, but even that is debatable. Of course, these are very expert bakers, the people buying these mills are super devoted to their project so they are the ones, they could make excellent bread out of cardboard. It may or may not be the flour. We work with fresh flour, flour that is two weeks old, six weeks old, eight weeks old. It makes no difference to us. With respect to flavor, I know that there are flavor trials and that it makes a difference, but in my view the flavor effect is miniscule. Most of the flavor comes from excellent fermentation and proper baking, and if they are doing that, I know that Zingerman's knows what they are doing and they will do a great job, that's where the flavor comes from. The flavor effect of the age of the grain, I don't know, I'm not convinced.

Sheila-Is there a big flavor difference between the different types of grains?

Steff-No, not really. Like if I gave you a piece of spelt bread you would just think oh that's good bread, you wouldn't know. Now buckwheat, buckwheat's different. We do a whole grain buckwheat; it has black hulls. They are very visible. You know there's some effect there, the visual is very important. Kernza, when you get above 15% Kernza you lose gas retention. That's an effect you really notice. That's a much more powerful sensory effect in my opinion than the flavor of the grain. That gets back to my thing though, and I'm not saying folks are so dull they can't taste the flavor of the grain. I'm saying fermentation is so powerful that it's like 95%, I'm just guessing, like a huge percentage of the flavor. So, if you do a great job on that, all the other stuff works great.

People are really interested in these different flavors of wheat, and I'm all for it, but do I actually believe it? Yeah, it's like wine snobs, there's like 2% of the population who can actually detect the flavor differences. If you blow the fermentation you can have a great grain with sucky bread. Good bread comes from good fermentation.

Sheila-Do you think any of the different grains have nutritional benefits?

Steff-Oh you know they are different.

Sheila-Do you think any of them are superior?

Steff-You are asking the wrong guy. I could go to Wikipedia and tell you.

Sheila-I understand. I know there is a lot of information out there about it but I was curious if you had any personal experiences.

Steff-I should tell you people do believe all sorts of things about them, so from a marketing perspective you put emmer in there and spelt in there and they may say oh well my gluten sensitivity disappeared. They believe anything, but as far as actual effect I don't know.

From a baker's perspective, the different amount of gluten in doughs makes them behave differently and may require different hydrations, but honestly, those guys are

pros. They aren't going to worry about that, they're just going to feel it and fix it, they aren't even going to notice they felt it.

Sheila-So, you use some organic flours but not all organic?

Steff-The flours are basically all organic, we use roller milled flour that's grown in Montreal, and most of that is transitional, so it's an organic process but not certified yet. And all of the other flour is organic.

Sheila-Do you prefer to use organic?

Steff-Um we just, you know, we think, generally I think organic is in balance better for the world. That is a complicated problem. You know, since we use a lot of stone ground flour, we use a lot of material from the bran layer and beneath the bran layer, and that's where any contaminants would be, so if we had any pesticide residue it would be there. If you are getting a roller milled flour it wouldn't make a difference if it was coated in pesticides, because that gets all sheared off. If you are doing a stone ground flour, that's all over the place. I don't make a lot of claims there, I have expert friends who tell me one thing or another, and I work in partnership with Thor Oechsner at Oechsner Farms and he grows organic grains, and I approve of organic agriculture as a practice, although I recognize that it's imperfect.

Sheila-Do you mostly source locally or all over the country?

Steff-We have basically two sources of flour, about 70% of our flour comes from the area, and 25% comes from Montreal.

Sheila-How far is that from you?

Steff-I don't know a couple hundred miles. And then 5% comes from every which where. We can't grow semolina here. We make a pasta with semolina and that comes from like North Dakota or something. And like the Khorasan, we can't grow that. It is grown in more arid places like North Dakota and Kansas and the great wheat growing places.

Sheila-Do you prefer locally sourced products?

Steff-Well remember we started in partnership with farmer ground flour and Thor Oechsner, so that is our mission. We are a non-ideological bakery. Like I don't live or die for whole grain bread. We have a lot of other missions driving us. We use white flour, but the best white flour we can get. And even better, it's organic or nearly organic. And that makes sense for us. We try to be organic in everything we do, but we don't certify. And we try to be local, but we are doing the best we can.

Sheila-I only ask because it's part of our project, we-

Steff-No I totally get it, it's a very ideologically polarizing world we live in. Everyone wants to stake out a niche. My niche is, we are non-ideological, I do care, but that's not my goal.

Sheila-We are also gauging consumer preferences and how much emphasis they put on local sourced products.

Steff-So for us, it's a very important part of our, the fact that we are like 100% local, or close to it, we work in partnership with other farms, and we are always looking for more partnerships. That's hugely important to who we are.

Sheila-Ok, so have you always had a pretty balanced supply and demand for the bread? Have you always had a good customer base or do you find you can't supply enough to meet the demand?

Steff-Well so when I started, I talked to a lot of bakers and I talked to one baker who put her kids through college owning a bakery and I said what about demand, and she said there is infinite demand. The only question is, how much of that demand do you want to serve? And that has proven to be true. You can regulate demand by adjusting your prices, you can set all kinds of constraints, like I refuse to deliver, or something like that. And Zingerman's, are you kidding me? They have infinite demand so that is a non-issue.

Sheila-We are also looking at demand in terms of the grains, but that isn't really an appropriate question for a bakery.

Steff-Well like Kernza we can't get enough Kernza because there isn't enough Kernza.

Sheila-So you find that you aren't lacking in finding flour, but you might not get the kind that you want?

Steff-Yeah so you know I have baker friends who have chosen a different path and they'll say we commit to buy all the grain of this farmers crop, and you know that's cool. But that's a very risky strategy in my view, especially if you live in the northeast, so most of the grain from farmer ground comes from Thor Oechsner, but we also contract out, so we have other farmers in the region growing grains, so it's not all from the same farm, but most of it. There was one year we had to buy wheat, and this is the kind of question you should talk to the mill about because they're the ones that have the demand problems, they have contracts and when the crops go down you've got to get the wheat from somewhere. For us, we're making bread.

Sheila-And you usually sell out, or you make as much as you can and that's as much as you sell?

Steff-No so our business runs on sort of a three-legged model, so we do markets like farmers markets, direct retail like wholesalers, and we have a very large bread share like a CSA or a bread club. All those breads are paid for before we even bake them. We don't bake any extra bread for them, and we calculate a percentage over it that we

expect to be able to sell. For the wholesale bread, we don't really do buybacks. We generally sell out. We have a lot of capacity that is yet unused. From Zingerman's perspective, those guys operate in the million or multi-million dollar world, and they would look at our unused capacity and think these guys aren't working enough. But that's not our project, that's not how we want to make money. We don't work that way. We don't come in early; we don't stay late; everybody gets time off. Whether they like it or not, we aren't running like a big factory.

Sheila-So, when you first started, you buy already processed and milled flour. Was that difficult to find with alternative grains or was that readily accessible?

Steff-It's built in, it's not like we hunt around for grains. We are partners with the mill, and the mill is like right around the corner. If I need some einkorn, I can get on the phone and say, hey Greg, can you pick me up some einkorn. Or if we walk in and he happens to be bagging einkorn we can get a few bags. We are really small so we are really nimble. We make new breads up all the time. For Zingerman's they are going to have to have a much more stable menu. And that's going to be a whole different situation. They will need access to so many pounds of einkorn flour to always have it on the menu. But we don't do that. That is something we just don't do.

Sheila-It seems like Zingerman's would have some different struggles than you guys, with finding enough of specific types of flour to keep a steady stream of bread made from it.

Steff-Oh yeah, it's really challenging, and obviously there's the thing about Zingerman's, those guys are stunningly smart. They can figure out what to do with all of this stuff. They can create an ever-changing specialty menu. That would go over great with Zingerman's customers. They would love that. They would pay \$12 a loaf for those emmer loaves of bread. They are paying \$8 for a loaf of white bread. So, you know, no problem. And they could easily start a bread CSA where people bought in up front, which is the same model as a crop CSA, so if the crop goes down, all the buyers, the members actually lose. That neighborhood would totally eat that up.

Sheila-Do you think in the future it would be possible for other grains like emmer to be as popular as wheat, or do you think wheat will remain the primary bread making grain?

Steff-You're asking me to predict the future which I don't normally do. In my view, not in your life. I think wheat gluten is a miracle, and I think emmer is a low productivity grain, and it has a hull, and spelt is a low productivity grain and it has hulls. And it's always going to be high risk because people aren't growing it all around the world. If you want wheat, you got it. There's wheat everywhere. Spelt is regarded as like a trash grain, it has a low value. Nobody wants it. Trends come, trends go, wheat rocks the world. Wheat is going to keep on going. All these big guys are looking for some little tiny portion of market share, because it's a huge market. So, if general mills could get into the Kernza business, and increase production by 5%, it's still nothing. Kernza is never going to, I mean I love Kernza I'm all about it, but there's just no way. Especially because it's going to take you years and years, its years away from viable production.

So anyway, I would love to talk to Zingerman's, and what I would say is you guys rest easy, this stuff is easy, you guys are ace bakers, I know you are. You're going to have no trouble with this. All your trouble is going to be good old-time economics. Invest in one source you're a high risk, you invest a lot in multiple sources you're at low risk, you promise a thing you're at risk of not fulfilling your promises. No promise, no risk. As far as environmental factors go, some of those grains grow well on fairly poor soil, so that could be important, if I recall the soil out there is pretty great.

Sheila-Are you familiar with teff?

Steff-Yeah, we messed with teff a little bit. It's not a grain, it has no gluten. All of the non-glutinous things in the world, you can either make pancakes out of them or you can suspend anything in a gluten network. When you are using buckwheat, you know it's not contributing anything to the gluten so it's basically suspended. And that's going to be the same with teff or chia or anything else you put in there. We mess with it just playfully; nobody grows it here.

Sheila-I had somebody recommend that to me to look into more

Steff-It is totally not a good idea. It's like eating crunchy particles. As part of your program you should do some flavor and mouthfeel tests. Wheat is a miracle, it's soft and chewy and stands up to other materials and its really miraculous blend of proteins. It's just incredible. There's nothing like it or nothing will supplant it. The reason I think spelt is so cool is that it doesn't damage, it only adds to it. Rye is kind of the same way, but there's a certain percentage where American's just walk away and say we will have none of that. Europeans will, but if you make a rye bread that is over 60 percent rye most American's won't eat it.

Sheila-So, if you make a bread with those kinds of grains it has to be in addition to wheat?

Steff-Yeah so think about the percentages of those grains, so rye percentages, like American rye bread is like 8 percent rye next to nothing. If you make a 30 percent rye dough it really changes that character of the dough, and the fermentation it requires much more skill.

Sheila-Is it the texture they don't like?

Steff-Yeah it gets much denser. And most American's don't know. They think that rye and caraway are the same thing. So anyway, that kind of percentages is an issue. Like spelt, you can do a 100% spelt bread and everyone will love it. It's really beautiful.

Sheila-Do you have any opinions or are you hesitant to use wheat because of the large monoculture type farming and agricultural subsidies that go into producing wheat?

Steff-I don't really, but 70% of my wheat is coming from over the hill, and he isn't getting those subsidies. Those are going out to Kansas. And the way that local geography here, these are tiny fields, it's a different thing, it's a totally different thing. I'm not sure if that

answers your question, but we just don't have anything to do with that. Part of our mission is about reducing alienation, and we see alienation in farming at the level you are talking about, certainly at the level of industry. Zingerman's is probably the most unusual large scale bakery there is out there, most bakeries are staffed by people who don't know and don't care about what they are doing, and they don't get skilled and that makes them more alienated because they just become cog like and you know it's very depressing. And bakers don't stay in their jobs. Our whole thing, everyone who comes and stays with us, they really learn a skill, and part of this whole process. Part of buying wheat from Thor is about creating a community of people, we all share, we all live in the same world. It's about not being alienated. That's our project. If you're buying from the farm in Dexter, I like the direction that is going personally. It definitely can be done. If you talk to Thor and Greg about their end of things, what you'll see is that it actually can be done.

One of the things you'll learn from Thor is that it's actually really hard, on our end it's easy all we have to do is be good bakers, but farming skills, oh my god that is really hard. A really good organic grain farmer, that is hard to find. That's going to be a challenge if you only have one farmer in Dexter.

Here's just one other suggestion. One thing to consider. Zingerman's can buy my flour. They can just order it and ship it. My advice to them is to create within their bakery a baking lab, they just need a couple of bakers who are willing to experiment rather than production, and what they will discover is that it will take those guys a little while, but not long. And then they can start worrying about supply. There are many places they can get it from. They can make a whole advertising pitch about moving into heritage grains and local farms, and we're developing this program here. And then meanwhile, we are working with these small producers to develop a network of people and the network is very important, it's about knowledge sharing and creating a community of small stone millers. You want information on stone milling? Good luck. There is none. So, there won't be any until this generation matures. Everybody is just doing it by the seat of their pants. To develop that culture takes time, so having Zingerman's invest money and say to their customers become part of this national community of small farmers, small millers to develop small grain crops. Let it grow in this organic way. Anyways, that's my advice and that would allow them to develop all of their skills.

Appendix D

Sherck Seeds Interview- John Sherck

John-Are you familiar with what I do?

Sheila-Yes, but feel free to elaborate on what you think is important

John-I have a very small farm so I do everything by hand, my primary goal is to produce more staple crops, primarily grains. The biggest difficulty in our region is climate, there are certain crops that are more difficult to grow, because especially where I live in Northern Indiana, I get a lot of lake effect rain. I think other parts of Michigan get less rain, but overall, that might be challenging. That will be extremely important in determining the feasibility of growing certain crops. Our climate is long enough here to grow almost anything, that's not a problem, and the soil is definitely adequate, but irrigation may be needed, and the timing of rain is important. We are experiencing a lot more early spring rains and late fall rains with less in the summer, and this could be really problematic growing on a larger scale. This is a stressful and challenging time to grow because of all of the rain, and that could affect planting timing depending on rainfall.

Sheila-How many acres is your farm? Since you said you do it all by hand.

John-It's probably 8 acres, and I have carved out an area of 3 acres that is divided up into intensively farmed beds. But actual growing space is about $\frac{3}{4}$ of an acre. So when I plant a crop, if I plant 1000 square foot of something that is a big planting. For most of the rare species I am trialing I do about 100-200 square foot plots. And my goal is to grow it and evaluate it and then increase the seed, because some of these things they aren't built for farmers and gardeners to scale up. That's one of the things that I found, is that I do get a lot of calls from small scale farmers and the difficulty is always finding seed. It is really difficult to find seed for growers, especially organic.

Sheila-Is it hard to find just because nobody is growing it?

John-For grains it becomes problematic because you can find modern varieties, well known varieties, a couple years ago I had some Amish farmers who wanted to grow einkorn, and there just wasn't a source. The only way you could find it was a farmer growing it who had some seed, but there wasn't any company at that time offering einkorn wheat. Even though einkorn has gotten extremely popular, it just is very difficult to find. Now finally after a couple years it is available from small scale seed distributors, but up until a few years ago it just wasn't available. You either had your own seed supply, in other words you couldn't just go to your local farm supply store and say give me 50 pounds of einkorn, it just didn't exist. I doubt that's changed much, but einkorn is getting a little more available.

Sheila-Do you have any ideas of what would need to change for there to be any more accessibility to the seed? Or just the popularity and the demand of the grain?

John-The way I've understood it, some of the emmer wheats, and einkorn and spelt, which is another old type of wheat, that initially when people started getting interested in it, small farms had a little bit of seed and grew it out and increased their stock until they could plant what they wanted, but they were strictly growing and milling it themselves, and then replanting the seed for their own purposes. There wasn't anybody offering it, and then of course the very large-scale conventional farming system really doesn't care about einkorn so it doesn't really fit into their equation. So, the big seed companies and suppliers, they're not even messing with it. It's kind of this in between area where, for einkorn there's probably hundreds and hundreds of different types of einkorn, and there's a lot of research that needs to be done about which varieties grow best in which regions. So there's a lot of research that needs to be done, and the universities, at least around here, aren't really doing it. So, it's left up to farmers, and if the farmer does all that work they aren't going to be willing to share that information and "trade secrets". I think it's getting better, especially in the organic, sustainable type of farmers, they are beginning to work together more and there's different kinds of coop systems, and seed banks, like living seed banks. I don't know of anything close to us, I wish there was, but that's one way that it can kind of become available.

I've got a farmer friend in Pennsylvania that started 4 years ago growing some cutting edge varieties, and I would share seed with him, nothing more than an ounce because I don't have much to begin with, and he would grow and save his seed, but now he has some incredibly rare wheats and he has enough to grow like an acre of it.

Sheila-So you grow a few different varieties of grain. What was the deciding factor in growing these different varieties?

John-When I started there just wasn't the availability of some of these grains, I couldn't find for example teff, which I love teff, it's a fantastic grain. There was no history of it being around in this region that I was aware of, so the only way to find out if it could grow here was to try it. And that's been pretty much the same thing for most of the grains. So, for barley and wheat, obviously those can be grown in our region in certain varieties, but most of the other experimental grains, it's just a matter of learning what kinds of staple crops are available, and experimenting with different kinds to see what grows in our region. There's a teff farm in Michigan, which I find very surprising, but that's pretty cool, it's a great grain. The farmers around here grow it for pasture, they have no concept of growing it to eat, which is really weird because they are growing a very ancient Ethiopian grain in their pastures for their cattle, and they have no clue this is one of the oldest, most nutritious staple crops around the world. That's like millet, it is another great crop, it grows well in our region, there's a lot of different types of millet, and it has a lot of different uses, especially African and Indian cuisine. But here in the United States Millet is birdseed, we don't consume it. In most parts of the world it is considered poor man's food, and sometimes grains don't catch on for social reasons. It's kind of bizarre, we don't really deal with that here but in some other countries, like southeast Asia, millet is very prevalent, but everybody wants rice. They want white rice, not brown rice, so it's kind of a cultural thing. So, rice is actually my biggest project right now. Upland rice grows fantastic in our climate. I took a chance and grew it and the results were fantastic. So, at that time I thought there is one variety of upland rice that

will grow here. So, after that first experiment I learned that there are literally hundreds and hundreds of types of rice that can grow in our region.

Sheila-Why do you think we don't grow rice when there are so many varieties that could grow?

John-There's probably a lot of different reasons, for example when you look at the map historically of where grains are grown and what's grown where in the United States, it's almost like the regions develop around a certain grain, and then the infrastructure in that region develops for that type of grain. The infrastructure here has developed for corn and soybeans, and maybe a little bit of wheat and barley. So, if you want to start growing rice, there's no extension agent that can help you with that, there's no historic history of rice grown in Indiana or Michigan, so there's not the infrastructure. The thing with rice is it's more difficult because if you direct seed it, it grows very, very slowly so it is difficult to cultivate. Once it takes off it can outcompete weeds, but that might be a barrier to its growth. If you are a homesteader and want to grow a quarter acre and are willing to do the work that's easy, especially if you've got kids who can do the weeding. But if you want to do it on one to two acres, there's people working on it but it's almost like we have to learn how to do it. The places where upland rice is grown today are generally in the villages of third world countries, and they do everything by hand. It is extremely labor intensive, but if there was more interest than they might start looking at machinery.

Sheila-Would you say these same constraints are the same for other non-traditional grains?

John-I would think not, because rice is unique in that it grows so slowly. Amaranth and quinoa can grow pretty fast, I'm not sure what kind of equipment would be used to plant and cultivate, but I think there's already an established norm of how to cultivate those crops mechanically. Rice has a complicated growing process, but it won't be long until more people are doing it and it becomes more common. Malt houses in southern Indiana have called me because they want to malt rice so breweries can have something new and unique in their beer.

Sheila-Do you have a lot of experience eating the grains you grow you do you just save the seed to sell or regrow?

John-I try to eat everything that I can. It's great if it's an old heritage landrace variety, those varieties tend to have a lot more biodiversity in the genetics of the actual plant. Whereas modern wheats have very narrow genetics, so they can't adapt much, but they really don't have to because conventional farming provides them with everything they need, all they have to do is just hang out and wait for the chemical fertilizer to do its job. Landrace crops have much more broad genetics, so they are better at acclimating to the climate change or whatever conditions. But with that said, with the different landraces one of my goals is to always grow enough to eat, because if it doesn't taste good what's the point. Especially the rice, I grow quite a bit of rice, and my wife and I actually end up eating quite a bit of it. So I try to do evaluations and eat everything. I have not been able

to do that with all the wheats though, some of them I have such small quantities I would have to devote a ton of space to growing it out.

Sheila-Would you say a lot of grains grow similar to wheat or are some of them difficult to work with?

John-I'll be honest with you; I think wheat is the most difficult grain to grow. It is extremely difficult, mainly because of the disease problems. There is something called fusarium head blight, there are a lot of different diseases that can affect any grains, a lot of different foliage diseases, but this one is really bad because I think the USDA allows 1 ppm. It's basically a toxin and if there's greater than 1 ppm of that than it cannot be sold for human consumption. It thrives in regions where you have a lot of wet conditions, which is pretty much Indiana and Michigan, and it can be a real issue for some growers. I have always had a challenge with wheat, so I've been working with wheat from a region that has the oldest varieties that are the most naturally disease resistant. If you grow something like amaranth, I've never had disease issues with it. And it seems to grow very quickly, and amaranth, sorghum and millet do very well on poor soils, it's not like corn that needs a lot of nitrogen, and they seem to be happy in a drought type situation, and they seem to be happy in excessive rainfalls. They don't like ponding, but if the ground just stays wet, they don't seem to have any problems in my experience. I think a lot of these grains are easier to grow than wheat. Corn is the easiest to grow so long as you can fertilizer. There's a lot of different types of corn you can grow too.

Sheila-When you say landrace what do you mean by that?

John-A land race would be, that is always a difficult term to define. The way I understand it is if you go way back to before, well if you go to Europe or Mexico, in Mexico they have a corn growing tradition, and so in a certain region the farmers there would have been growing certain types of corn for generation after generation after generation, that corn becomes very adapted to that climate and it becomes kind of culturally adapted to that region. So, landraces are generally very old varieties that have traditionally grown, in some cases thousands of years in a specific region. The nice thing about them is that they are usually very diverse genetically, and I'm no geneticist so I am giving you layman's terms, but for example modern wheat all grows the same height and matures at the same time. When you get into landraces, they can be anywhere from 3-6 feet tall, there is some variation in them, and they also all might not ripen at the same time. So that is one of the reasons vegetable farmers have bread that wildness out of them. Landraces have a lot of diversity, for example Indian corn has broad diversity in colors and kernels, and that is part of the landrace. So, landraces, the way I see it, they were over thousands of years getting introduced to other varieties, and so they are constantly adding new genetics. They are not just a stagnant variety. They are constantly evolving. Native Americans had their own "varieties" of corn they grew, but they would trade with other tribes and add diversity to their corn. Diversity allows for plants to adapt to new types of insects. That's one of the cool things about landraces is that they are hard to pin down as to what they are. Modern varieties have traceable origins of when they were created, and they are all genetically identical. When you get a

landrace wheat or corn you might get five different color types in that population, and the farmer can start selecting what they want.

Sheila-Could you take a landrace variety and grow it somewhere with a similar climate successfully?

John-Yeah, I try to find things from a somewhat similar climate, and so for us in Michigan and northern Indiana you could look at, there's something called the Koppen climate classification system. Basically, it's set up like the USDA system, but its climate groups. You can look at this map and say ok I'm in this certain type of climate, who else is similar to that. Japan is similar to what we are, and northern France, so you can kind of get an idea of where you might find crops that have been exposed to similar growing conditions, and that's where you'll find varieties you can use. Something outside of that could still grow here, it would just require adaptation and that could take anywhere from 1-20 years. I tried growing some corn from Mexico and it got about 15 feet tall because of photoperiod sensitivity. It wasn't used to the amount of daylight we got here, so it was thrown off its normal growth pattern. It takes a lot of dedication and a lot of work and a number of years to adapt a plant, but most things can be adapted to our region, but there's limits.

Sheila-Would you say there are nutritional benefits to eating landrace varieties instead of modern cultivars?

John-I could tell you what people tell me, but I can't say for sure. I know there's a lot of so called research that's been done proving that and disproving it. The one thing I can say is I would tend to believe that certain types of landrace varieties would be more nutritious, especially because some of the landrace wheats have very extensive root systems, whereas modern wheat has very shallow root systems because they are just spoon fed whatever came out of the bag. The landraces are getting their nutrients from the soil, so my guess is that older landraces and heirloom varieties would have more micronutrients. That could be done by testing, I mean obviously you could have that stuff tested and find out for sure, so I kind of steer away from that one since I can't say for sure.

I know there's a lot of stuff about the gluten in wheat, I mean older wheat vs. the modern wheat, and I don't know if there have been any good studies done on this, but people say they can tolerate the older wheat types better than the modern wheat. The problem there is there's a number of factors at play, it's not just the wheat but the chemical composition of modern wheat vs. old wheat, and the way it's grown. Most people growing einkorn probably will not be using roundup because their market is probably wanting organic, so could it even be roundup, I don't know. Maybe it's the modern varieties and the way it's grown. When it gets complicated like that nobody is going to fund that kind of research.

Sheila-Do you produce organic seed?

John-I have been organic since I started, since 1990, I am no longer certified, but once organic became part of the USDA I'm like I'm done here. The only reason organic, and I need to guard my words here, I just think a lot of people got into because they saw dollar signs. I got into when no one really knew what organic was, and I couldn't get any extra money for my extra work, I just thought it was the right thing to do. I think the most important thing nowadays for people, and obviously I'm supportive of eating local when you can, but it's getting to know who the farmers are, and getting to know who the producer is. Is it a conglomerate like hostess or kraft, you know I'm assuming Zingerman's isn't a huge conglomerate, their kind of a local, or regional processor, right? So that would be different than dealing with a conglomerate, so that's where you build your trust is at that level, and not just because of some stupid commercial or add that someone sees.

Sheila-Do you think there are any downsides to being organic or is there any reason you might change your ways eventually?

John-I mean I never will. I think the only downside is that if you are doing it truly, and not even using the word organic but maybe the word sustainable, it's probably going to be more work. And that's a hurdle. I mean farming is not profitable even for conventional farmers. So if you get into organic, you know how if you hit a trend at the right time, you know like right now everybody and their brother wants to grow cannabis, and produce CBD oil, and that's great, but I'm more interested in producing food, but they can do what they need to do. But that's just a flash in the pan. A bunch of people are going to get involved in it, and basically the market is going to fall out because there's too many people doing it, so they'll have to go back to growing potatoes. There are instances, like with organic, to be the first one at the door with that crop you might make a lot of money, but I don't know if it will last. I think we are seeing the same thing for the brew market; I think a lot of people will lose their money because it's kind of a trendy thing.

Sheila-So you mentioned using the word sustainable instead of organic. How would you describe what sustainable means?

John-That's even harder than describing landrace. There's probably a million different definitions, but the thing I learned when I got into organic farming that is the most important thing is biodiversity, and if biodiversity, starting with your soil microorganisms, and the way they relate to a plant or a cop, is way more complicated than human beings will ever be able to figure out. You're talking how many thousands or million organisms are in one square foot of soil. So that's organic, understanding and protecting that biodiversity is sustainable. Conventional farming said that's pretty much irrelevant, yeah there's life in there but we don't really care about, the dirt is there to hold the plant up, but we will provide everything it needs, of course even modern farming is understanding that that's nonsense, but they are so entrenched with the system they have its hard to get around that. A lot of the pollination that goes on in my field is done by wild bees and wasps, sustainability is preserving the biodiversity in and above the soil. I think it's also preserving water and air quality, all those things are important.

Sheila-One of the things we are looking at with the different grain types is the environmental farming practices erosion and runoff, do you think alternative grains offer any more sustainable practices than traditional wheat?

John-I would say probably not because of the grain, and more related to the method. I have a terrible problem with erosion on my farm because everything is sloped, and I don't think it matters what I grow, I need to address that erosion. Now there's systems that you could plant cover crops like clover and plant a grain into that, and certain grains would work with that and certain grains wouldn't. I've been putting in perennial strips like hazelnuts or comfrey, and it is a barrier to the water movement and the water filters in instead of eroding, the comfrey can be cut as fertilizer and dropped right in the field. I think those types of methods are probably more important than the type of crop.

Sheila-The only grain we are looking at that might offer additional benefits is Kernza since it is a perennial grain.

John-I grew some Kernza this year, I actually just harvested it, well I actually just threshed it, I harvested it probably a month ago. It's an interesting crop, I'm still not sure, I'm not even sure if the Kernza I got is anything like what the land institute has created now, mine might be closer to what the original intermediate wheatgrass looked like. But yeah, perennials, and I've tried a lot of different types of perennials like perennial rye, wheat varieties, that I've tried, I've got more I would like to try, but I've had difficulties getting anything to perennialize, but I can't say about the Kernza yet since it's only the first year we'll see if it grows again next spring. The other ones I've tried, I sometimes think they would do better in like Washington state or Oregon, because they have more temperate winters, it doesn't get as cold as we get, because most of the perennials that I've tried have just kind of died out. I get one year of growth and harvest and then they just die, but I've only ever done that on a very small scale. I would have to eat it to see if I like it, I don't have enough to eat yet, and I know the grains are very small compared to the wheat and barley I grow.

Sheila-So you harvest everything by hand, is your main limitation manpower and time?

John-Yeah, I would say that and the size of my property. I don't work with anyone else, I kind of prefer it that way. For me it's about the perfect amount, I sometimes grow 100 different crops in one season which is a lot to juggle. This year I grew about 20 different varieties of rice and barley, so logistically it's kind of complicated, so hand harvesting is perfect for what I do, there's no mechanical equipment that would work for me anyways because my plots are so small.

Sheila-That is something we are struggling with right now, is determining how the grain will be grown and processed on a larger scale.

John-In our region if a person wants to grow heritage corn that would be easy because we already have all the equipment here already needed to grow corn. When you get into something like amaranth, I wouldn't even know how to harvest or plant amaranth. There's a lot of different types of equipment that may not even be available in our

region. It's like sorghum, they used to grow it a lot in our region, so there used to be a lot of equipment for growing sorghum, and now that that's kind of in the past, if people want to get into it it's very difficult to find a sorghum press that you could press on a larger scale, so a lot of times people have to bring it from different parts of the country. Everything in America is big so it's hard to get small equipment if you only wanted to do a few acres.

Sheila-Another issue we have is the processing, because of the lack of infrastructure.

John-If you have something like einkorn or emmer wheat you have to get it dehulled, and there's very few farmers that I know that have dehulling equipment. That was one of the hurdles that I had to learn with rice, because it needs to be dehulled too, so I had to buy a hand crank, but now you can actually get small scale rice dehullers, whereas four years ago these weren't even available.

Sheila-As far as your business goes, do you find the amount of seed you produce matches demand, or is there a greater demand than you can supply?

John-I sell just in the US, if I were to expand that outside the United States, I would not even be able to come close to meeting the demand. In the US we have it pretty good right now with growing heritage crops because we don't have to deal with all the bureaucracy with Europe and the EU it's just horrible. If you want to grow something there there's a lot of bureaucracy all varieties have to be registered. So, for me my business, there's not a ton of people out there, like nature and nurture, they sell a lot of vegetables, but probably not a ton of amaranth. I think it's cool that they have it. Vegetables have a greater demand. For me my business is strictly grains, there's kind of a limited appeal to gardeners because some people won't even consider growing grains. I sell a lot more beans because people can wrap their heads around growing beans. I couldn't handle much more demand. There's a small market.

Sheila-Who do you primarily sell to?

John-Mostly backyard gardeners and homesteaders, and a few farmers who want to experiment and find new crops. That can be very advantageous for farmers to diversify more, which is smart. I think they are realizing that putting all their eggs in one basket isn't smart. Sometimes they have to get over the organic hurdle if they want to do that, but they are starting to diversify. That may be a benefit to you guys that there are more farms willing to grow these things out. You have to have the farmer, the processor and the market ready to go all at the same time. Otherwise you have the product but can't do anything to process it, or you have the processor and the farmer, but the market isn't ready (store and consumer) than you may still have a bunch of products sitting around. Shagbark mill, Athens, Ohio, they have done some cool stuff with working to mill, and work with small scale farmers to make their own tortilla chips, working with farmers to grow cool grain varieties, and they mill it and process it and make these chips. Black beans, black bean chips, they are a neat model for a small scale local minded business/coop. they did the due diligence and research on the market and equipment like you are.

Sheila-What is your advice on where to start or what needs to change in order to expand sustainable small grain economies, especially in southern Michigan?

John-For sure I think on farm trials, like einkorn wheat, what I'm working with right now is called naked einkorn which would be nice because it won't need to be dehulled. Just the idea of trialing, obviously research to find out cultivars, but trialing on test plots to get real data on how it performs. Either trialing it or finding other farmers that are growing it. Einkorn does not have near the yield as modern wheat or spelt does. People trialing these things out and getting that kind of data is the most important thing, but trials done by farmers. I think farmers are better than academics when it comes to evaluating crops. I think getting farmer participation right from the beginning is important. They are the ones that understand mechanically how to cultivate. A good farmer can tweak a combine to harvest many different kinds of crops. A poor farmer will look online and not see anyone else doing it and say it can't be done. Getting farmers involved in the development of the crops and the whole process of figuring out how to cultivate and process is super important. Not to cut the academics out, but I think we look too much to the academics and not the field worker, when it really should be a partnership. I know a number of farmers up in Michigan doing trials with native American corn and rice, and no one is really connected. People share ideas and share seed, but there is no connection through an organization. I think that has its disadvantages, but it also has an advantage because no one is being told what to do so they are using their own intuition. I think there is a loose structure there you could tap into its just finding those farmers and different people who are collaborating.

Sheila-Do you have suggestions on the best way to go about trialing a new grain?

John-It's going to be easier to work with something that is already established, like einkorn. We already know it grows in Michigan, and about the different varieties. When you get into something like amaranth I don't know if there are any larger scale amaranth growers in Michigan. Picking the low hanging fruit. Can set your aims too high and end in failure. I think upland rice has potential, but like 8 years down the road because there is no knowledge on cultivation. Starting with something already slightly established will be easier. Finding crops that have some success on a quarter or half an acre. That could set parameters on the initial type of grain. It gets more complex with variety. It's about finding the right people to talk to. It's about finding the right people. I would suggest you test a few things that have a good chance, and then one thing that is a total shot in the dark just for fun.

Appendix E

Shagbark Seed and Mill

- What challenges in grain processing or product marketing have you faced?

Beans and grains don't convey the same "wow" factor that you have seen in a lot of fruits and vegetables as the slow-food/30 mile meal/etc movements have developed in the last couple decades. Many of these products are seen as the canvas to paint a meal on more than a part of the art itself. Building excitement from a marketing standpoint has been tricky but as these movements grow and staple foods are available locally, people are taking another look

- Have you experienced challenges in selling products made with "non-traditional" grains? If so, do you think the challenges are related to a lack of consumer interest or education?

People are often intimidated by grains they're unfamiliar with. For example, we sell a Red Fife variety of wheat for our flours and cereals. Often us using the term "Red Fife" makes them feel the product is beyond their skillset to work with even though it works the same or better in recipes calling for wheat. Helping them see "Wheat" as a catch-all term is often the first step. Consumer interest is easy, it's getting them to take the plunge and try that takes a little extra work

- Does the market demand match or exceed the amount you produce? Do you generally sell as much as you make?

Everything we make is milled to order. Our turnaround time is such that this is not an issue at this time

- Do you think there is potential for small grains other than wheat to become as mainstream and common as wheat?

Certainly! Spelt is a great example given how many folks are cutting gluten in their diets.

- What environmental benefits do you think alternative small grains provide?

America is losing biodiversity at an ever growing rate. Homogenization of crops is a serious risk to food security.

- On your website you bring up the question, "why are grains and beans not part of the burgeoning local foods movement?". After being in business for many years now, do you have a better understanding for why this gap in supply exists?

These are often the sorts of crops that were simple to dry out and store for long periods of time without refrigeration or spoilage compared to meats, vegetables, fruits, etc. allowing them to become quickly centralized in modern food supply chains while the others maintained regional variation and interest. There simply wasn't interest for a long time, recently though we feel a shift happening in people looking at all aspects of their meals and taking another look at the backbone of many of these dishes

· What have been some of the challenges you have encountered in trying to utilize locally produced grains in your products?

We maintain great relationships with all our growers and generally match production very well to suit our needs. Occasionally due to either low yields or increased demand we need to find backup crops that fulfill our high standards. This can be tricky for crops like spelt that are not on a lot of farms. As we've built relationships this issue has become very manageable in the last few years.

Appendix G

Budget Category	Item Descriptions	Details	Amount
Personal	Mike Levine, farmer and project coordinator. Plant grain trials, data collection, harvest, processing, organize field days.	70 hours @\$20.00/hour=	1400
Personal	Mike Lordon, farm manager, project assistant. Assist with trial planting, data collection, harvest and processing. Perform plot maintenance and weed control	70 hours @\$20.00/hour=	1400
Personal	Hazim Tugun, Zingerman's baker. Assist with grain harvest, processing and milling, perform baking trials	20 hours @\$20.00/hour=	400
Materials and supplies	Cover crop seed to prepare area for fall planting and prevent weeds over summer	5 lbs/1000 square feet @\$17.45*2.5 for 2500 square feet =\$44.00	44
Materials and supplies	Manure fertilizer to apply to plots in the fall according to soil test recommendation needs	\$50/50 lbs @ 54 lbs=\$54	54
Other direct costs	Percent nitrogen and protein content lab testing	\$3.50/sample * 44 samples=\$154	154
Other direct costs	Drill rental for seeding 0.045 acre wheat trial plot in second year	\$75 minimum rental fee for 5 acres or less	75
Other direct costs	Hire professional to adapt existing equipment to current needs	40 hours @ \$20.00/hour=800	800
Other direct costs	Field day handouts	100 handouts @ \$1.00/handout=\$100, \$200 for design	300
Other direct costs	Field day lunch	50 lunches @ \$10/lunch =\$500	500
Materials and supplies	Tine Weeder	1@\$3,000	3000
Total			8127