



# AN EXAMINATION OF LOCAL GRAIN SOURCING

for the Colorado Brewing  
& Distilling Industries



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# PROJECT PARTNERS

**Thomas (Gabe) Toth** is a journalist, distiller, and former brewer. He was a ten-year veteran of the newspaper industry with a bachelor's degree in mass communications and sociology when he transitioned into the beverage alcohol industry with a job at Santa Fe Brewing Company. After moving multiple times between the craft beer and craft spirits worlds, he is currently the lead distiller at The Family Jones distillery in Loveland, Colorado. He has written extensively on grain, supply chains, terroir, and a variety of additional topics for industry magazines such as The New Brewer, Artisan Spirit, Distiller, Brewer and Distiller International, and Zymurgy, and has also authored the books Craft Floor Malting: A Practical Guide and The Fermentation Kitchen.

**The Family Jones**, now in its sixth year of operations, is a craft distillery with locations in Loveland and Denver. The company focuses on using 100 percent Colorado-grown grain for its premium whiskies and other spirits, and prides itself on maintaining personal relationships with all of the growers who supply the distillery. Developing these personal relationships has opened doors for the distillery to pursue projects with growers, including a trial of five different corn varieties grown by Olander Farms in 2019 and distilled/barreled in early 2020, and an experimental single-distillation run of heirloom Abenaki corn grown by the Olanders in 2021 and distilled to fill one barrel of bourbon in early 2022.

**Root Shoot Malting/Olander Farms** is a major supplier for The Family Jones, as well as many other Colorado brewers and distillers. The malthouse is an outgrowth of the longtime Olander farm in Loveland, allowing the family to vertically integrate the local grain supply and add value to their crop. Todd and Emily Olander generously opened their doors for the farm and malthouse to be used as the primary case study in this paper.

**Mad Agriculture** is a Boulder-based nonprofit group that focuses on spreading regenerative agricultural practices with the goal of encouraging more holistic approaches compared to modern farming and food systems that view the land from a purely extractive mindset. The organization works through a variety of avenues including financing, farm and business planning, crop marketing, and community building. This work was completed through a Mad Agriculture fellowship in partial fulfillment of the requirements for the Master's of Science degree in Professional Studies.

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This Capstone Project was submitted in partial fulfillment of **Rochester Institute of Technology** MS in Professional Studies.



# INTRODUCTION

Colorado is a state with a rich agricultural history and a leading position in the grain-centric craft brewing and craft distilling industries. However, there is a profound disconnect. For the vast majority of these small producers — many of whom tap into a “local” or “Colorado-made” ethos — the default approach to sourcing grain is to rely on the international commodity grain and commodity malt systems.

Colorado’s small farmers, meanwhile, continue to fight an uphill battle in a commodity market that is optimized for efficient, low-cost production at the expense of all other factors. In the endless quest for better profit margins, more and more small- and mid-scale farmers are being squeezed out of business. The United States food system, once reliant primarily on these farmers, is increasingly becoming a system of large farms overseen by international agribusinesses (“A Comparison of the Canadian and US Grain Supply Chains” 2014, 25).

In the commodity system, malted barley is predominantly sourced from maltsters in the midwest who, in turn, rely on crops from Idaho, Montana, the Pacific Northwest, Canada, and even Europe. Raw grain such as corn, rye, and wheat are generally sourced from commodity suppliers that consolidate grain from countless small growers and ship it around the country and between continents to meet demand.

It does not have to be this way.

There is a small but growing trend towards localization, where distilleries such as Law’s Whiskey House and Peach Street Distillers, as well as breweries as small as Atom Brewing (operated out of a backyard in Lafayette) and as large as Left Hand Brewing, are looking locally and working directly with small farmers and maltsters.

However, as this paper will show, that trend remains a drop in the bucket. There remains a vast imbalance between the craft-scale beverage alcohol producers who are small and “local” and the similarly small and local growers who feed grain into an international system, hoping and praying to turn a profit at the end of the year. However, it also represents a tremendous opportunity to support local agriculture and shrink a brewer or distiller’s carbon footprint.

The commodity system continues to squeeze small farmers economically. This is the result of an arms race that was typified — though not necessarily created — in 1973 by U.S. Secretary of Agriculture Earl Butz. Notoriously, Butz encouraged commodification and consolidation by challenging

farmers to “get big or get out” and to plant commodity crops on all available land, “from fencerow to fencerow.” It is a system that relies on large scale, artificial chemical inputs, and expensive technological solutions that eliminate jobs and eat away at the farmer’s bottom line.

Environmental issues with industrial agriculture can be as small as the depletion of local populations of flora, fauna, and even microflora (reductions in the soil’s microbial diversity) or as large as the dead zone — one of the largest in the world — that nitrogen and phosphorus fertilizers creates annually where the once-fertile Mississippi River Basin flows into the Gulf of Mexico.

Modern farming methods are carbon-intensive, contributing to a global climate emergency of increasingly urgent proportions. As Craft Beer and Brewing magazine noted in their fall 2021 Brewing Industry Guide (Keene 2021, 78), “Decentralizing production and shortening supply chains is another way to support local agriculture while reducing some of the negative factors driving the climate crisis.”

The locally focused distiller or brewer can also explore a variety of avenues for product differentiation. The opportunities for credence attributes such as traceability and farm sustainability, as well as flavor differentiators such as the use of unique grain varieties and the potential for truly local, terroir-driven products will be explored at greater length below.

A more fragmented and more local supply chain will, in most cases, lead to higher costs. However, companies that have a broader vision, looking beyond their immediate profit and loss statement, will examine the entirety of their supply chain and their community and recognize benefits that broadly impact all members of their network. This is an inherent part of the holistic concept of a thoughtful, conscious business, “that all stakeholders are interdependent and that the best way to optimize long-term profits and long-term shareholder value is to simultaneously create value for the other stakeholders too.” (Mackey and Sisodia 2014, 109)



# ABSTRACT

**The goal of this work is to examine the Colorado grain and malt supply chain as it pertains to brewers and distillers.** It will look at the current scope of local sourcing and availability as compared to usage of commodity grain, and then consider the opportunities and challenges that will be present in any effort to increase the localization of the grain supply chain among brewers and distillers. This examination will tie together data on state agricultural production, processing capacity, current demand, and potential bottlenecks in the system. It also relies on interviews with farmers and maltsters, using Root Shoot Malting/Olander Farms in Loveland, Colorado, as a case study.

Finally, it will provide specific recommendations to help grow the local grain economy among craft-scale beverage alcohol producers. **The ultimate goal is to produce a roadmap for growing the statewide network of farmers, maltsters, brewers and distillers,** effectively bypassing the commodity system. In doing this, we hope to engender a virtuous cycle that reinforces itself through high quality, product differentiation, improved sustainability, and other factors that allow for a system that benefits all stakeholders.



# CROPS OF INTEREST

**CORN:** Corn is a staple ingredient in American distilling. It is the primary ingredient in bourbon whiskey, which by definition consists of more than 50 percent of the grain bill. Corn is also used in brewing, primarily to lighten the body and provide fermentable starches to light American lager. Agronomically, corn is a high-demand crop requiring more water and more nutrients (often in the form of artificial fertilizer) than small-grain crops.

**SMALL GRAINS:** Barley, rye, and wheat fall into a separate category of crop from corn. They are lower-cost, lower-input, and lower-value crops that can often be fit in between higher-margin crops if a farmer is rotating crops.

**BARLEY:** Barley is the foundational ingredient of beer and malt whiskey. While there is a small segment of distilling that relies on raw barley, generally for Irish-style whiskey, the vast majority of barley usage in brewing and distilling is malted barley.

Malted barley requires additional levels of processing, unlike other small grains has a husk, and is ideal for traditional brewing and distilling systems that rely on crushing the starchy endosperm and leaving the husk relatively intact, allowing for the separation of sugary, malty liquid from the grain solids.

There are also hullless varieties of barley — ancient varieties or recent products of modern breeding efforts to revive that characteristic — that some brewers and distillers have begun to experiment with in recent years. This remains a very small market segment that has yet to gain a foothold due primarily to low yields compared to standard varieties of malting barley.

**RYE:** Primarily used in whiskey, though rye also can be used in small amounts in specialty beers. For bourbon whiskey, rye generally consists of a minority percentage, usually in the range of 15 to 40 percent of the grain bill. Rye is also the primary ingredient in rye whiskey mashes, consisting of more than 50 percent of the grain bill.

**WHEAT:** Wheat is commonly used in brewing, a distant second in usage behind barley. There are specific styles of beer, includ-

ing hefeweizen and American wheat beer, that focus on the grain as a centerpoint. It is sometimes added to a bourbon grain bill in place of or in addition to rye, providing a softer flavor profile in whiskey. Less commonly, it can also be used to produce a wheat whiskey that centers around that softer, sweeter flavor profile.

**OATS:** Oats have traditionally been used in small amounts (ten percent or less) in certain beer styles, and have grown more common as various types of hazy IPA have grown prominent. Oats are still a minimal factor in the brewing world, and oat-based spirits are a largely unexplored area. High levels of beta-glucans and other compounds that create gumminess in a mash make processing oats difficult.

**POTATOES:** Potatoes are grown widely in the San Luis Valley. A few Colorado distilleries, including Wood's High Mountain Distillery and Woody Creek Distillers, have tapped into the use of local potatoes for vodka production. Potatoes are low-yielding (consisting primarily of water) and require specific, unique processing equipment. We will not look at potatoes in the local supply chain, but it is worth noting that they are often grown hand-in-hand with small grains such as malting barley.

**OTHER SEEDS AND PSEUDOCEREALS:** While there is lower demand in the brewing and distilling world for crops such as quinoa, millet, buckwheat, and other seeds or pseudocereals, they do offer an avenue for small growers to meet a specific, niche demand for non-standard ingredients. This includes the gluten-free market, as well as adventurous brewers and distillers who are looking for novel flavors and ingredients.

**HEIRLOOM/LANDRACE GRAINS:** Though not technically a separate category of grain, heirloom varieties can have lower requirements for water and other inputs. They are often low-yielding, more difficult to grow, or less physically consistent and more difficult to harvest compared to commodity varieties, but varieties that have evolved in a particular environment to have lower agronomic requirements can be advantageous in more difficult growing environments.





# DEFINITIONS AND TERMINOLOGY

The USDA Economic Research Service, Craft Maltsters Guild, Brewers Association, and American Craft Spirits Association provide some useful definitions to contextualize a discussion of “small,” “craft,” or “local” operators.

**Small family farms:** Those having annual gross cash farm income (GCFI) of \$1,000 to \$349,999<sup>1</sup>

**Low-sales small family farms:** Those with less than \$150,000 in GCFI<sup>1</sup>

**Moderate-sales small family farms:** Those with GCFI of between \$150,000 and \$349,000<sup>1</sup>

**Midsize family farms:** Those that report a GCFI of between \$350,000 and \$999,999<sup>1</sup>

**Large family farms:** Those with farm revenue greater than \$1 million<sup>1</sup>

**Craft maltster:** The Craft Maltsters Guild defines a craft maltster as one that is independently owned and produces between 5.5 tons and 11,000 tons of malt using at least 50 percent grain that is sourced from within 500 miles of the malthouse.<sup>2</sup>

**Craft brewery:** The Brewers Association defines a craft brewery as one that produces less than six million barrels (with 31 gallons to a brewers barrel) of beer annually, with less than 25 percent of brewery ownership controlled by a beverage alcohol industry member that is not a craft brewery.<sup>3</sup>

**Craft distillery:** The American Craft Spirits Association defines a craft distillery as one who produces less than 750,000 gallons annually and holds an ownership interest of 51 percent or more in a distilled spirits plant.<sup>4</sup>

The ERS reports that the vast majority of farms in the United States

<sup>1</sup> <https://www.ers.usda.gov/topics/farm-economy/farm-structure-and-organization/farm-structure/>

<sup>2</sup> <https://craftmalting.com/about-us/>

<sup>3</sup> <https://www.brewersassociation.org/statistics-and-data/craft-brewer-definition/>

<sup>4</sup> <https://americancraftspirits.org/about-acsa/craft/>

(90 percent by count, 62 percent by farm assets) are small family farms, while medium and large family farms account for eight percent of farms and 65 percent of agricultural production by value. Nonfamily farms consist of the final two percent of farms in the United States, but are responsible for 14 percent of agricultural output by value.<sup>1</sup>

Olander Farms, with crop revenue a little greater than \$1,000,000, is considered a large family farm. However, the ERS definitions of small, medium, and large farms paint an incomplete picture because they focus on gross revenue. Colorado farmer Marc Arnusch clears more than a million dollars of transactions in a year to put his farm business in the large family farm category, he said, but the profit margins will be one to two percent, maybe as high as five percent on a good year.

“That’s pretty easy math to see what kind of net revenue we generate every year, and to me that very much puts us on the small scale of things,” he said. “A farmer my size handles a lot of money, he just doesn’t hold on to a lot of it.”

Colorado malthouses cleanly delineate between craft — those that source within and sell primarily within Colorado — and regional — Proximity Malt’s Monte Vista facility, which sources an unknown portion of its barley from an unknown location and distributes widely to many states in the western part of the United States. The BA threshold for a craft brewer is four times the sum total of all Colorado craft beer production, while distilled spirits production in Colorado, calculated below based on public tax records, is dominated by distillers such as Stranahan’s (which also sells Tincup whiskey and is owned by global spirits brand Proximo) and Breckenridge (now owned by Canadian cannabis company Tilray).

Therefore, without analyzing annual revenue for all parties referenced in this study, “small” and “local” will be used colloquially here to refer to independent craft-scale brewers, distillers, malthouses, and the farms that supply them.



# COLORADO AGRICULTURAL PRODUCTION

According to the USDA/NASS 2020 State Agricultural Overview for Colorado, there were 38,800 farm operations in the state in 2020, covering 31.8 million acres, or an average of about 820 acres per farm (“Colorado Agricultural Statistics 2020” 2020).

**Grain produced in Colorado in 2020**

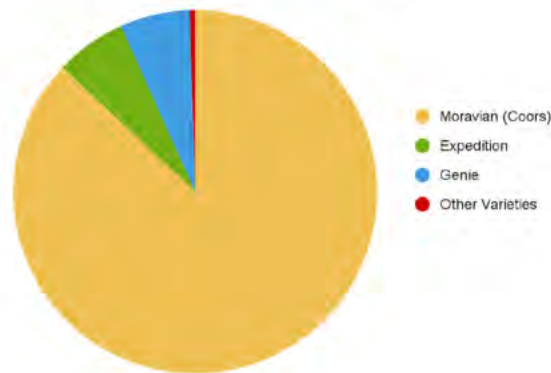
Grain	Acreage Harvested	Yield (Bushels/Acre)	Price/Bu	Total Bushels (millions)	Value/Acre	Value (millions)
Corn	1.06 million	116	\$4.70	123	\$545.20	\$577.9
Winter wheat	1.52 million	27	\$4.65	41	\$125.55	\$190.1
Barley	45,000	145	\$4.85	6.5	\$703.25	\$31.6
Millet	310,000	20	\$10.70	6.2	\$214	\$66.3

\*Rye is not tracked by USDA/NASS. It is generally used as a cover crop and not grown for harvest.

\*\*Corn yields per acre and value per acre are skewed by dryland farming. Olander estimated that corn typically yields 200 to 230 bushels per acre. Meanwhile, he estimates that barley yields are about 100 to 120 bu/acre in the front range, with higher values in the San Luis Valley.

According to the Colorado Agricultural Statistics 2020 report (featuring, coincidentally, Todd and Emily Olander on the cover), Colorado ranks fourth in the nation in barley production (four percent of national production) and winter wheat production with 7.5 percent of the national harvest (“Colorado Agricultural Statistics 2020” 2020). The state also ranks seventh in the country for potatoes (4.5 percent of national production, or 19.2 million CWT), and 17th in corn for grain — as opposed to silage — with just over one percent of the national harvest.

**Malting Barley Grown in Colorado**



The American Malting Barley Association reports that 87 percent of malting barley grown in Colorado is Moravian, the proprietary Coors variety. Expedition makes up 6.3 percent and Genie, one of Root Shoot’s preferred varieties, accounts for 6.2 percent. Other varieties make up less than one percent. Overall, of the roughly 6.5 million bushels of malting barley grown, about 850,000 bushels accounted for in the report are not going to the Coors Brewing malthouse. At 48 lbs/bushel, that’s 20,400 tons of Colorado-grown malting barley available for other users (“Barley Variety Survey - 2020” 2020).

An assessment of the local small grain supply chain in Minnesota notes a reduction in the number of acres dedicated to small grains in the last 30 years due to competitive pressure from corn and soy, as well as challenges with processing infrastructure, the ability to scale production, shifts in the climate, and changing consumer preferences for gluten-free choices (Muckey 2018).

An increased focus on corn at the federal level has changed the dynamics of the commodity grain market in the last two decades, leading to long-term increases in both the production and cost of corn and a concurrent reduced focus on small grains.

The rise in ethanol subsidies in the 2000s had a significant impact on the current state of the market; corn usage for fuel ethanol skyrocketed after 2000. The United States passed the Energy Policy Act in 2005 and the 2007 Energy Independence and Security Act, and by 2010 accounted for 57.5 percent of world fuel ethanol production. That year, according to a report comparing US and Canadian production, corn accounted for almost 65 percent of US grain production in 2010, up from about 50 percent in the early 1980s. In the ten-year period from 2001 to 2011, the amount of corn used for ethanol increased from 17.6 million tons to 114.4 million tons, with prices tripling from \$2/bushel to \$6/bushel in that time. ("A Comparison of the Canadian and US Grain Supply Chains" 2014, 9)

The comparison report attributes this to "a multi-pronged strategy of tax incentives, tax credits and legislated mandates setting the amount of bio-fuels to be blended into transportation fuels" ("A Comparison of the Canadian and US Grain Supply Chains" 2014, 10-11). The report also observes that corn for fuel accounts for 24 percent of all US domestic grain usage, while corn for feed and industrial usage accounts for 25 percent. "Companies involved in either ethanol or livestock production, such as Tyson Foods, are increasing their interests in grain production to secure feedstock for their main production" ("A Comparison of the Canadian and US Grain Supply Chains" 2014, 25). Table nine in the report shows that the total grain used for human food was only 17 percent, with corn for food accounting for nine percent of total grain usage ("A Comparison of the Canadian and US Grain Supply Chains" 2014, 22).

As a result of these demand pressures, the focus on many farms continues a longstanding trend of transitioning away from using small grains in rotation, which helps to bolster diversity and sustainability, towards an increased reliance on chemical inputs to allow for

repeated plantings of corn or soy.

Arnusch is a third-generation Colorado farmer in the plains northeast of Denver who focuses on what he calls the “craft grain space,” growing grain for the craft beer and craft spirits industries. The family farm, almost 3,000 acres, has done a lot of different things over the years, he said, including a heavy involvement in the sugar beet industry and a focus on vegetable crops such as onions. The farm once housed a packing shed to send those onions out to 30 states and four countries.

In recent years, constraints such as profitability, access to capital, and access to labor have pushed him to pivot to growing grain as a specialty crop, “essentially decommoditizing a commodity,” Arnusch said. “We don’t think about it as growing semi load after semi load of grain as a commodity, we think of it as a specialty product.” That pivot has included growing seed wheat and seed barley, craft grain, and feed ingredients such as corn silage and alfalfa for hay. The certified barley seed goes to growers such as Root Shoot and those who supply Troubadour Maltings, as well as other growers who supply craft maltsters in 15 to 20 additional states across the country. He also grows proprietary Antero wheat for Troubadour and works with Proximity Malt.

He sees these alternate grain markets as a more sound business approach. At his size, the commodity system often doesn’t provide a path to profitability; it would require him to scale up and grow hundreds of thousands or millions of bushels of corn or soy.

“We’ve always done things a little bit different than our neighbor or the guy down the road, and it’s always rewarded us at a very high level,” Arnusch said. “I wouldn’t say that we’re a niche, but we’re very much specialized. I just can’t play the large-scale game from where I’m at, with the tools I have at my disposal, so we turned to the specialty side of things.”

He didn’t originally go out looking for the specialty markets that the farm has become so focused on, he said. He was involved in specialty grains to a certain degree, but when they started to look at the supply chain backwards, from the end user and tracing it back to the farm, he started to see the potential for a more specialized approach.

“The classic farmer thinks of his crop in terms of tons, bushels, moisture content, maybe protein content. They never really inventory

some of the unique attributes of the crop they've grown," he said. He started learning about how to improve extraction, energy efficiency, gluten content, and fermentation characteristics. This allowed Arnusch to begin offering a more premium product.

"Fortunately, very early on in the process, we were able to drive greater value for the maltster, greater value for the distiller or the brewer," he said. "We discovered a few things within our farm that we can do through growing the crop that rewards everybody."



# COLORADO PROCESSING / STORAGE CAPACITY

Processing and storage can be major factors limiting supply chain localization. Raw grain must be cleaned, sometimes bagged, and stored, while malted barley requires the additional step of malting (a process that begins germination to increase the accessibility of sugars in the grain, then stopping the process by heating and drying). In a study commissioned by Patagonia titled *Barriers for Farmers & Ranchers to Adopt Regenerative Ag Practices in the US*, study author Jennifer O'Connor of Guidelight Strategies observed that the focus on commoditization in the grain supply chain has effectively gutted local resources for cleaning and storage.

“Food aggregation, processing, and distribution infrastructure is not readily or affordably accessible by a majority of small and midscale, differentiated farmers, ranchers, and artisans, and this lack of access is inhibiting the growth and development of a robust regional food economy. The disinvestment in local infrastructure, in favor of a centralized, global supply chain, has been extremely detrimental to farmers and consumers.” (O'Connor 2020, 85)

Cornell University's Brian Baker and June Russell, then with New York's Greenmarket program, elaborated in a 2017 paper published in the *American Journal of Agricultural Economics* that the reduction in local capacity was a result of equipment being scaled and produced for large commercial farms rather than smaller operators. “By the 1950s, new grain-handling equipment was built for a much larger scale and is no longer manufactured for small to mid-size farms. By the beginning of the twenty-first century, most grain-handling infrastructure was either razed or repurposed, as is evident by the number of old mills converted into bed & breakfasts or tourist novelty shops” (Baker and Russell 2017, 534).

The Colorado Agricultural Statistics report offers that there is 170 million bushels of on-farm storage capacity and 136 million bushels of off-farm storage at 113 facilities (“Colorado Agricultural Statistics 2020” 2020). However, Todd Olander noted that the vast majority of the storage capacity noted in the report is dedicated to the commodity market. “That's just a ton of farms mingled together, so you lose your traceability at that point,” he said.

In reality, storage is a bottleneck for him and for other small farmers looking to maintain segregated grain streams and offer their products locally and independently. Olander's farm/malthouse has enough storage to hold a year's worth of malting barley plus some offsite storage to cover their needs for corn, rye and wheat, but he is working to expand storage capacity to build a buffer against years where drought or other factors lead to low yields.

Other farmers who might look to localize their customer base will run into the same hurdle, especially those who are growing fewer acres or small trials. The cost to put up a small grain bin is also much higher per pound of storage than a large grain bin.

"That's a struggle, especially if there's a lot of people starting off small, with small acreages. If you're planting only 10 or 20 acres of something, it's hard to find a grain bin that small," he said. "Anybody that's doing specialty grain is going to run into that issue unless you have the money to invest in storage of your own."

Milling for brewing and distilling is not a constraining factor in accessing local grain. If they can afford the equipment and infrastructure, many brewers and distillers mill their own grain, preferring to control as many variables as possible and keeping the grain as fresh as possible. However, maltsters tend to be able to offer milled grain for an additional premium when a brewer or distiller doesn't have the capacity.

Grain needs to be cleaned prior to use in a distillery, brewery, or malthouse. The only option in northern Colorado is Twin Peaks Seed & Grain in Longmont. Olander said this stage also has the potential to be a bottleneck in the supply chain, but demand remains too low for it to currently be an issue.

Malting barley requires additional value-added processing to become malt for brewing or distilling. (There is a tradition of using unmalted barley in Irish whiskey and certain esoteric Belgian beer styles, but it remains a vanishingly small market compared to malted barley.) The malting process involves steeping the raw grain in water for about two days until it hydrates adequately, and then germinating it over a period of five to six days to break down the beta-glucan matrix that binds up starches in the barley seed, effectively unlocking the sugars in the barley to be easily accessed. Once the barley has been fully modified (the beta glucans fully broken down), it is considered malt and can be gently dried in a kiln over the course of a day and stored for future usage.





There are multiple paths to go from barley to finished malt, but the most common involves a steep tank and separate germination/kilning equipment. Because the grain is in the steep tank for a third of the time that it spends in germination and kilning, one steep tank can feed three germination/kilning vessels. This equipment can be capital-intensive, so some growers and even a few distillers have opted to start malting their own barley using the floor-malting method. This process trades off some of the automated stainless equipment for a more manual process where the barley is steeped then spread out on a floor and raked manually as germination proceeds. It is then moved into a separate kilning room to finish the malt.



# MALTHOUSES IN COLORADO

Because of the limited number of malthouses in Colorado and their importance in the processing of an ingredient essential to beer and to many types of spirits, we will examine each malthouse in further detail.

## ROOT SHOOT MALTING

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Root Shoot Malting is an outgrowth of Olander Farms in Loveland. Now managed by Todd Olander, the fifth generation in the family to oversee the property, his great great grandparents on his father's side came from Oland, Sweden and settled in the Boulder/Longmont area originally, while his grandmother's side of the family came down from Canada and purchased the property near Loveland in 1926.

Todd's father, Steve, was drafted into the Army but was able to come home early to help with the farm. (Farm work skipped over Todd's grandfather, who had polio.) Steve grew malting barley for Budweiser in the early 1980s for a few years, then transitioned to growing for Coors.

The original farm of about 350 acres remained intact until 1998, when it was divided among family members upon the passing of Todd's great grandfather. Olander Farms as currently constituted is 130 acres, and the division of the farmland has left a clear impression upon Todd.

"That's what I've seen in my life, and that's what pisses me off, seeing all of these farms getting divided up because of families wanting their money out of it," he said. "I don't want to see that happen to other families and other properties. I don't want to see it be divided up and not be able to be passed down to future generations."

He began working on the farm at age 12, continuing through summers in high school. He also had a custom harvesting business and his own combine, harvesting neighbors' crops for them in the years before college.

"I sold all that after I graduated high school, I never planned on coming back to the farm," he said. However, after graduating col-

lege in 2006, he found himself back at the farm. “Once you get out into the real world you realize it’s not really that bad,” Todd said.

The potential for making craft malt first came up in 2013 or 2014 during a tour of High Hops, a brewery/greenhouse/hop farm in Windsor. It was one of the “lightbulb moments” that preceded the founding of Root Shoot. Todd said they talked to the owners about raw ingredients, malt and hops, asking where the malt comes from. (The answer: “Canada or Minnesota.”) They let things percolate for a couple of years, but the concept was clear.

“We thought, there’s this gap in the market,” Todd said. “I’d lived in Ft. Collins and seen Odell and New Belgium and all these breweries grow, and hadn’t really thought of trying to supply these guys with the grain they needed. I really wanted to find a way to diversify the farm and stay in this area, and get more value out of each acre.”

Todd and his wife Emily saw an opportunity to transition away from relying on commodity markets and dairy farms, and an opportunity to vertically integrate the business. They leveraged everything they had — land, water rights, their home — to build the malthouse. He also noted that they had a lender willing to take a risk on them. “It was definitely a big leap of faith,” he said.

They decided to buy top-of-the-line equipment from German malt-house fabricator Kaspar-Schultz. At the time, it was one of only a few suppliers of high-quality malting equipment, and they paid accordingly.



“We weren’t going to go out on a limb and go with equipment that wasn’t proven to work. It was definitely really expensive equipment, but we were able to make it work,” he said. “That’s another reason we made such a huge investment in the malting equipment, a lot of people told us they need a consistent, quality product.”

Root Shoot Malting, as the Olanders named their venture, is able to process two million pounds of barley a year into roughly 1.75 million pounds of malt. He said 99 percent of that stays in Colorado, with a small amount going to one distiller in Texas and a couple of out-of-state collaborations beers every year. Root Shoot currently has one steep tank and two germination/kilning drums, with a third drum scheduled for installation in 2022. That will increase their production capacity to 2.65 million pounds of finished malt.

The Olanders currently have 1,800 irrigated acres that they farm, leasing the majority of that, plus 600 acres of dryland that are rotated annually, 300 acres farmed and 300 acres fallow.

## TROUBADOUR

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Troubadour Maltings, located in Fort Collins, produces a variety of malts ranging from lighter pilsner-style malt to amber stewed malts similar to Vienna and Munich malts. They also have a malt roaster, making Troubadour one of two Colorado craft malthouses able to offer roasted malt.

The malthouse consists of two five-ton germ/steep/kiln vessels. With an eight-day turnaround on batches, they average five to seven batches a month or 50,000 to 70,000 pounds of raw grain per month, with an average malting loss of 20 percent by weight. Troubadour Owner Chris Schooly said they can process around 250,000 pounds of barley per year, but he is aiming to add capacity in the next three years with a target of one million pounds per year.

## GROUSE MALT HOUSE

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Grouse Malt House is unique even for a small malster, focusing exclusively on gluten-free malts made from grains and pseudocereals such as quinoa, buckwheat, oats, and corn.

After finishing her bachelor's degree in dietetics, Grouse owner Twila Soles was a graduate student at Colorado State University in 2008 when she took the brewing sciences and technology class and fell in love with craft beer. As the class toured local breweries, including New Belgium, Odell, and CooperSmith's, she saw one classmate not drinking any beer because of celiac's disease. Soles then went out and sampled the gluten-free options that were available, and found them sorely lacking.

"I was so sad for her that her options did not taste anything like the craft beer that I was able to enjoy. I made it my personal mission to make her a great tasting gluten-free beer," she said. "That led me to Googling gluten-free malt, and when I didn't find anything I pivoted to finding some gluten-free grains and malting and brewing with them."

She began malting gluten-free grains in her kitchen, and found the first beer made with those grains was better than anything on the market. After a few years of traveling to various maltsters and learning the craft, studying further at the Canadian Malting Barley Technical Center, she and her then-husband and business partner William Soles built a fully manual one-ton unimalter (containing steeping, germination, and kilning all in one vessel), a roaster, and opened Grouse.

"When we first got going in 2013, the gluten free beer industry was in its infancy. The business and the industry has grown over the years," she said.

They quickly outgrew the initial equipment, which was procured with a \$30,000 loan from Soles' grandmother, adding automation and a steep tank and transitioning to floor malting in 2014, changing from floor malting to a pneumatic bed in 2015, then buying the first parts of their current three-ton system in 2017. They started with one germination/kilning drum from Malters Advantage and have added two more since then.

Having created a market segment where ten years ago there was nothing, Grouse sits in a unique position even among craft maltsters. “To some people, I’m a weirdo, and to others we’re heroes. It really depends on who you ask,” Soles said.

Growing the company, and by extension the broader gluten-free beer market, has been largely reliant on being able to educate the drinking public. “Unfortunately, the history of gluten-free beer, it didn’t taste good. There’s a lot of preconceived notions and a bad reputation that gluten-free beer has had,” she said.

Using products like millet and buckwheat in brewing also requires some education in how the brewing process needs to be tweaked to make the sugars available for fermentation. “There’s a lot of education that comes hand-in-hand with the development of the market,” she said.

Soles was in the right place to start experimenting with gluten-free grain, though. Colorado is the leading producer of millet in the United States, with about half of the annual national crop grown in the state. She was able to reach out initially to an organic millet farmer in Nunn, and found farms to work with from that initial contact as well as through having farmers reach out directly to work with her.

Getting farmers to grow buckwheat, a pseudo-cereal more closely related to rhubarb than to grains, has required a little more education. However, because the buckwheat plant grows a long taproot that can be very beneficial for soil health, she’s been able to get people on board.

Grouse works with farmers who have already grown organically, but they have to provide a lot of education to prevent gluten-containing ingredients from coming in contact with their grain. It requires extensive cleaning or dedicated equipment because “there are so many opportunities for that cross-contamination,” Soles said. She said Grouse primarily works with craft brewers.



## SOUTHERN COLORADO MALTHOUSES

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Many farmers in the San Luis Valley who focus on potatoes find that malting barley fits well in their crop rotations. This has been the case for generations. However, as Coors Brewing pulled back on their malt contracting in the valley, maltsters such as Colorado Malting Company and Proximity Malt stepped in to provide demand for the pre-existing supply.

## COLORADO MALTING COMPANY

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Founded in 2007 by brothers Jason and Josh Cody with their father, Wayne, Colorado Malting Company in Alamosa first came about as an extension of the Cody farm, which was first homesteaded by Josh and Jason's great grandfather in 1934. He was one of the first in the area to grow barley for Coors Brewing. However, Josh said that after farming barley for Coors for 70 years, "Like most family farms in the US, we were no longer viable. We as a small family farm couldn't survive without adding value."

At the time, he was in graduate school in Milwaukee, and his father called to talk about how to make the farm viable again. The brothers came up with the idea of converting their old dairy equipment to make malt for local craft breweries. "We gave the first malt away for free hoping that it would work. The rest is history," he said.

The Codys have continued to build all of Colorado Malting's equipment. When they started, there was no craft-scale equipment available. Now, after a recent expansion, they produce about 600 tons of malt per year, with a maximum capacity of 750 tons, as well as supplying raw grain primarily for distillers.

Their first products were base malts, such as pilsner and pale malt, and then malted wheat and rye. In 2015, they moved into more specialty malts, building five generations of malt roasters over the years, eventually landing on a design that will roast about 1,000 pounds of barley at a time. They've also built multiple smokers and now have the capacity to smoke up to two tons of malt at a time. Cody said these specialty malts have become a large part of their business in the last five years. Their lineup also includes malted buckwheat and malted red millet, and before the COVID-19 pandemic the business was the largest exporter of buckwheat in the country, sending malt-

ed buckwheat to Japan by the pallet.

The Colorado Farm Brewery was first opened as a research and development project for the malthouse, but eventually the concept of a 100-percent estate beer became viable. Josh Cody trained in Europe with a German brewmaster and does all of the brewing on a 10-hectoliter (roughly 264 gallons or 8.5 brewers barrels) system with six 20hl fermenters. Malt comes from onsite, as do some of the hops and a proprietary yeast that Jason Cody captured in their grandmother's farmhouse.

Distillers are the biggest customer for Colorado Malting, consisting of about 55 percent of their sales. Craft beer makes up the additional 45 percent. The Codys farm as much of their grain as possible, and source any grain they have to contract for within five miles of the farm to keep the soil and climate as consistent with their farm as possible.





## PROXIMITY MALT

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Proximity Malt, located in Monte Vista, aims to offer a variety of local malted and roasted barleys, as well as malted wheat, rye, and oats, on a larger scale than craft maltsters can provide. Working with a mix of small and large farmers, Proximity contracts on an annual basis, benchmarking their pricing against commodity prices. Their goal, according to Vice President of Sales and Marketing Amy Germershausen, is to source at least 75 percent of their grain from within 150 miles of the Proximity malthouses (they also operate a malthouse in Delaware to serve the east coast). The remainder may come from outside of that range to mitigate their risk.

With a capacity of up to roughly 30,000 tons per year (54 million lbs), Proximity operates above the definition of a “craft” maltster but smaller than the upper end of the market inhabited by maltsters with an international presence.

This allows them to tap into the larger end of the craft beer and spirits markets. Their size positions them to supply malt to regional breweries such as Santa Fe Brewing Co., which would be too much demand for most craft maltsters.

That scale also allows them to offer pricing competitive with larger nationwide maltsters. Germershausen noted that, as a brewers and distillers gets larger, pricing pressures increase and profit margins get narrower. It becomes more and more difficult to make a difference of 50 percent, or even 20 percent, on grain costs work for the bottom line. Their size also allows them to maintain a larger geographic footprint, distributing south as far as Texas, West to California, and east to Missouri.

“We’re well-positioned for that regionalism. Even though Texas is far away, we’re the closest malt,” Germershausen said. “If people are large enough we can provide something that either the craft maltsters can’t or the commercial maltsters can’t.”

She said more users have been looking locally during the pandemic due to turmoil in shipping — delays, higher variability in lead times, increased costs. “We’ve seen some real focus on learning your supply chain.”

Shipping out of the San Luis Valley has also been difficult for Proximity and its customers, according to Southwest Regional Manager

Jake Capron, who oversees the Monte Vista facility. With only three trucking options available, he's seen prices rising, especially on the less-than-truckload (LTL) orders he receives.

He sends out about five LTL orders per day, as well as a few full truckloads per week, moving an average of 37 pallets per day. That grain goes to customers, a distributor in Texas, and warehouses in Arizona, California, and Milwaukee that Proximity ships directly out of.

Located on a 165-acre plot that borders a meandering stretch of the Rio Grande, their wastewater goes right across the river to the Monte Vista treatment plant and back into circulation. Capron said they actually consume about 15 percent of the water that they take. The facility, a former potato starch manufacturing plant built in the 1940s, relies on one steep tank and two germination/kilning vessels scaled to a 200-metric-ton batch size. They have three 1,000-metric-ton malt storage bins for base malt, along with a couple of smaller bins for specialty malts.

Capron said 90 percent of their malting barley comes from within the San Luis Valley, consisting of the Genie and Odyssey varieties whose slightly lower enzyme content make them a good fit for all-malt brewing. Their seed comes from Limagrain. Proximity also sources and stocks flaked wheat, flaked rye, oats, dextrose, and lactose to be able to position themselves as a one-stop shop.

They malt all spring barley, which works well in the rotation for local farmers who plant potatoes to harvest in the fall. Proximity pays their farmers to store the barley at their farms into the fall.



# GRAIN USAGE IN COLORADO CRAFT BREWING AND DISTILLING

Colorado is a center of the craft beer movement and home to a vibrant craft distilling community, as well.

According to data supplied by Brewers Association Economist Bart Watson, the number of breweries in Colorado has more than tripled from 126 in 2011 to 433 in 2020. The level of production has stabilized in recent years at about 1.5 million barrels of beer annually. (New Belgium Brewing was acquired by Kirin Holdings in 2020 and removed from the BA's "craft" roster, but the brewery is estimated to have produced about 600,000 barrels in 2020.)

Year	Number of Breweries	Total Barrels Produced
2011	126	1,185,354
2012	151	1,291,771
2013	175	1,413,242
2014	235	1,673,686
2015	284	1,775,831
2016	334	1,429,130*
2017	348	1,523,204
2018	396	1,508,825
2019	425	1,555,813
2020	433	940,843** (1,540,553)

\*New Belgium Brewing opens Asheville, NC brewery and moves production for East Coast markets, resulting in a 350,000-barrel drop in Colorado production.

\*\*New Belgium is acquired by Kirin Holding Co. and removed from Brewers Association official data, but brewed approximately 600,000 in Colorado in 2020.)

Brewers overwhelmingly use malted barley for beer production, though small amounts of wheat, rye, oats, and other grains or pseudocereals are relied on to add nuance to certain styles. According to unpublished data collected in 2021 by Brewers Association Economist Bart Watson, craft brewers use about 60 pounds of malt per barrel. (Median usage skews slightly higher, about 65 pounds per barrel.)

Malted barley is unique compared to raw grain calculations, because the malting process results in losses of about 15 percent by weight. So, using an average of 68 pounds per barrel of beer, and assuming 85 percent yield of barley to malt, Colorado craft brewers plus New Belgium used approximately 54,372 tons (109 million lbs.) of barley in 2020.

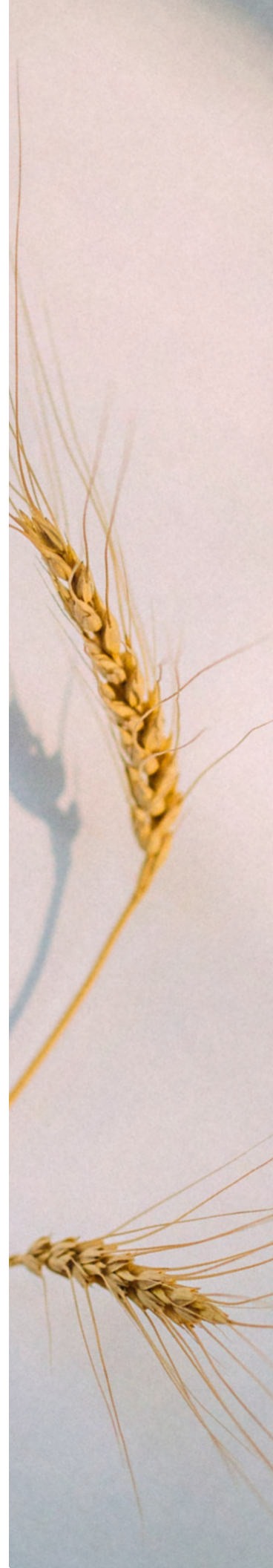
Malt per Barrel of Craft Beer	60 lbs	Lbs Grain per Proof Gallon	15 lbs
Annual Barrels Craft Beer Produced	1,540,553	Annual Proof Gallons Produced	16,200,000
Annual Craft Beer Usage of Raw Barley	54,372 tons	Annual Craft Spirits Grain Usage	121,500 tons

No similar benchmarking or production data exists in the craft spirits segment, but some information can be extrapolated from government records.

There were 139 registered Distilled Spirits Plants (DSPs) in Colorado as of May 2021 (“Distilled Spirits Producers and Bottlers 2021). This number undoubtedly includes a few distilleries in planning that may not be open. The Craft Spirits Data Project (“Annual Craft Spirits Economic Briefing” 2020) 2020 preliminary data notes that there are roughly 2,300 in the United States, a number that grew nine percent from 2019 to 2020, including 108 distilleries in operation in Colorado.

The CSDP, produced by the American Craft Spirits Association, classifies more than 90 percent of distillers as “small”, defined as removing 10,000 proof gallons or less from their bonded space per year for sales. (A proof gallon is defined as one gallon of 50 percent ABV ethanol.)

Sales by volume increased by 24 percent, or 27 percent by value, between 2014 and 2019. The average distiller sells 5,093 nine-liter cases (a standardized industry unit, consisting of 12 750ml units) per year in 2019, but less than two percent of producers are responsible for 57 percent of case volume sales.



The Family Jones, for example, uses 800 pounds of grain per batch of whiskey, which fills roughly one 53-gallon barrel, which will yield about 50 cases of 47 percent ABV whiskey in three years. (These are not precise values, but are approximations we've found to be very reliable in our planning process.)

Therefore, we take 800 pounds of grain to produce 300 bottles of whiskey, giving us 2.66 pounds of grain per bottle of whiskey at 47 percent ABV, or 12.5 pounds of grain per proof gallon. While this value will vary slightly based on the type of grain used, from distillery to distillery, and even from product to product (slightly higher for neutral spirit production) within the same distillery, it is consistent with the author's prior experience and research, so we will use an estimated average value of 15 lbs grain per proof gallon to account for less-efficient facilities and for ease of calculation.

Sales of spirits produced in Colorado, taxed according to the number of proof gallons removed from a distillery's bonded space and moved into a wholesale or retail location, rose in the three most recently available 12-month windows — beginning in Sept. 2018 and ending in August 2021 — from 13.8 million proof gallons to 14.6 to 16.2 million proof gallons in the most recently available 12-month windows ("Liquor Excise Tax Historical Report" 2021).

With our estimate of 15 pounds of grain per proof gallon, to produce 16.2 million proof gallons from Sept. 2020 through Aug. 2021 requires 243 million pounds (or 121,500 tons) of grain.



# QUALITY FACTORS FOR BREWERS/DISTILLERS

While brewers and distillers should be fluent in reading a Certificate of Analysis to understand the qualities of the grain they're using, arguably the largest factor that impacts grain or malt performance is protein content.

Protein is a major limiting factor for brewing-quality malt, though distillers have more leeway. Malting barley protein needs to be in the low teens — Root Shoot targets 10 to 12.5 percent — while wheat can be higher, 12 percent or above.

Olander describes protein as a significant quality challenge both as a farmer and as a maltster trying to produce a top-tier product. Increased protein can be caused by stress in the plant from factors such as early-season heat or a lack of water, as well as an excess of nitrogen, generally from the application of fertilizer to increase yield. He said that Olander Farms has eliminated “pretty much all nitrogen application with our barley” because he would see protein levels that were too high. “It is a balancing act. If we have less yield and lower protein, then I’m happy. I’d rather have a little less barley that’s high quality,” he said.

Other common difficulties include the danger of hail and drought, as well as late-season precipitation that can lead to pre-harvest sprouting or mold and fungal loads in the grain. One common issue with grain exposed to late moisture is fusarium blight, a fungal infection that produces dangerous mycotoxins which can carry through into a final product. The climate in the San Luis Valley is the biggest challenge the Codys face. They farm in a unique high desert environment, and face additional water issues during times of drought.

At Grouse Malt House, despite using seeds and pseudocereals unique to the malting world, some of the challenges are the same. After harvest, millet may be laid in windrows and can begin sprouting if there is late moisture. Malting barley can provide challenges with dormancy, where the grain’s internal clock tells it that it’s not time to sprout yet and the barley is slow to germinate when it’s brought in for malting. Soles hasn’t experienced that, but she’s run into grain that meets parameters but won’t kiln to the proper color and other “head-scratchers.” For her, it’s part of being in an industry

segment, the gluten-free malt market, that's nine years old rather than hundreds of years old.

"It has been a challenge, and we screen our incoming grain not only for gluten, but also protein, moisture, and germination vigor," she added.



(Root Shoot Malting)

# PRICING FACTORS

Pricing can be a hurdle for brewers and distillers who are considering localization, but it may be a lower obstacle than may be expected. Small farmers who work within the commodity market are small fish in a large system — “price takers” at the whim of larger forces, unable to influence pricing in their market. However, working locally allows farmers and maltsters to price according to their business needs.

When Todd and Emily Olander first started Root Shoot Malting, the original business plan targeted a sales price of \$1 per pound of malt, but they lowered their pricing to better compete with regional and national maltsters. (“Our competitors are not necessarily other craft malt houses,” Todd said.)

He said they charge between \$.85/lb and \$1.25/lb for specialty malts, and, depending on the grain, between \$.25/lb and \$.75/lb for raw rye, wheat, and oats.

When compared to pricing at Brewers Supply Group, the largest national supplier of ingredients for craft brewers and maltsters, Root Shoot’s per-pound grain price generally places them somewhere between domestic commodity malt and more expensive European malt. While BSG pricing data is proprietary and varies based on purchase volumes, the supplier announced a price increase in August 2021 of between \$.016/pound and \$.024/lb due to “worldwide logistics and freight costs,” leading to slightly more parity in pricing (“Price Increase August 2021” 2021) Root Shoot’s raw grain, on the other hand, is comparable in cost or even less expensive than domestic bulk grain purchased from BSG.

As Germershausen of Proximity Malt noted, larger brewers feel the pinch on their margins more than smaller brewers, who sell a higher proportion of their units through a tasting room rather than through packaged product distributed offsite. In the case of both hops and malt, trimming margins can lead to sizable financial gains for high-volume producers. A regional or larger craft brewery buying in bulk — filling silos of malt by the truckload — can expect to see significant savings in their malt prices, with bulk silo malt potentially running \$.30 to \$.35 per pound compared to \$.50 to \$.60 per



pound for bagged malt.

While the data provided by Watson indicates that the “average” brewery in Colorado produces about 3,560 barrels of beer per year, the reality is one of many small breweries (1,000 barrels or less) with a statistical long tail of much larger producers.

For Grouse Malt House, finding farmers who can meet their high standards means paying a premium. Their grain costs are not tied to commodity prices. Rather, they vary based on the year and the harvest. For example, 2020 was one of the worst millet harvests in recent memory, so prices doubled. Soles preferred not to discuss her pricing for customers, noting that a one-off order would be significantly more expensive than an order for other craft malt, but added that she provides discounts for users who set up a contract.

“We consider ourselves partners with all of our customers, and we have contracts with the vast majority of the customers that we’re working with to make it as feasible as possible for them to make gluten-free beer. Plus it helps us. We know we can count on their business,” she said.

With about .25 lbs of malt, on average, in a 12-oz. serving of beer, and up to three pounds for a 750 ml bottle of whiskey, which consists of almost 17 1.5-oz servings, the per-unit cost increase of moving to local grain is negligible for producers who can make up the difference by marketing the product appropriately and charging a little more. In addition, as Arnusch observed, “Maybe the raw commodity itself is more than what they’re used to paying for, but when you overlay transportation on it we have a huge freight advantage here in Colorado.”

An article for *The New Brewer* uses an ingredients cost of four to seven percent of the final price of the beer (Metzger 2012, 62). At the high end, if a brewery is spending \$.50/lb for commodity malt, doubling that price to \$1/lb means an increase of 12.5 cents per pour (or 2.5 percent of a \$5 beer). By comparison, the impact of adding one pound of high-end hops per barrel at \$15/lb to a beer will increase the raw materials cost by five to six cents per pour, depending on processing losses.

Finally, the dollars and cents considered here do not account for the value that local grain can add to a product. The benefits can take a variety of forms, including flavor differentiation, increased sustainability, the social benefits of supporting local jobs and local businesses, and the marketing value in telling a better story about using local raw materials from local farmers. Some of these will be explored in the next section.

# OPPORTUNITIES

While commodity malt generally beats the local supply chain on price and raw grain is competitive, there are a number of things that local supply chains undoubtedly do better than the commodity system.

Local grain can be fresher, have a lower carbon footprint and lower shipping costs, features minimal supply chain issues, allows for direct engagement with the grower and maltster, opens up a variety of opportunities for product differentiation, and can offer higher quality.

Not all supply chain complexity is inherently bad. However, a modern trend toward increased complexity in a wide variety of systems should not be conflated with progress. Change and increased complexity do not offer inherent value of their own; judging the value of one system versus another (whether supply chains, food systems, or other systems) must be done based on their results and impacts.

Since March 2020, consumers and businesses have experienced the results of a dramatic demand-capacity mismatch in globalized supply chains, resulting in significant cost increases and delays in shipping. As the fragility of globalized supply chains has been exposed, more producers are seeking ways to shorten and localize their network for greater supply chain resilience. As Albert Einstein famously said, "Everything should be made as simple as possible, but no simpler."

One of the most important aspects of local sourcing is the support it provides for the local economy. As distiller and researcher Rob Arnold commented in *The Terroir of Whiskey*, "The severing of the distillery from the farm that largely took place after Prohibition has meant in most cases that whiskey distillers do not know from exactly which farms their grain comes from. And personal relationships between farmers and distillers are increasingly rare. Unlike vineyards, grain farmers have little control over the price of their grain. Baseline prices are instead set by commodity markets, traders, and grain dealers" (Arnold 2021, 83).

This has led to a race-to-the-bottom approach to farming and grain pricing, resulting in devastating consequences to small farms over

the last 50 years and continuing today. According to Time magazine, more than 100,000 farms have been shuttered from 2011 and 2018, and more than half of all farmers have lost money every year from 2013 to 2018 (Semuels 2019). The Patagonia report states that median farm income rose slightly from -\$1,735 in 2018 to -\$1,383 in 2019 and was projected to fall to -\$1,840 in 2020. "In recent years, roughly half of farm households have had negative farm income each year and, as a result, many of these households rely on off-farm income to make ends meet," the report states (O'Connor 2017, 34).

"The USDA estimates that 70% of U.S. farmland will change hands in the next 20 years, as many family operations do not have a next generation skilled in or willing to continue farming. For each American farmer younger than 25, five are over 75 years old."

However, a grain supply chain doesn't have to be a zero-sum, lowest-common-denominator game. It can be more than the sum of its parts, a system that provides profit and unique value to all members. There are a variety of stakeholders whose commercial success is tied to the grain supply chain, including seed suppliers, grain cleaners and processors, fertilizer companies, irrigation companies, landowners, millers, bakers, restaurateurs, and, of course, brewers and distillers. The success of the supply chain affects the jobs that support these stakeholders and their families.

Whole Foods CEO and co-founder John Mackey and Conscious Capitalism Inc. co-founder Raj Sisodia write in *Conscious Capitalism* that a business' supply chain partners are only one set of stakeholders in a group that also includes the environment and the community. "Free-enterprise capitalism must be grounded in an ethical system based on value creation for all stakeholders. Money is one measure of value, but it is certainly not the only measure" (Mackey and Sisodia 2014, 22).

They write that other, non-financial stakeholders must also be considered in a company's decisions, and decry the prevalence of a "stakeholder cancer" (Mackey and Sisodia 2014, 70) where one group — usually shareholders — is elevated above other stakeholders.

"Conscious businesses believe that creating value for all their stakeholders is intrinsic to the success of their business, and they consider both communities and the environment to be important stakeholders. Creating value for these stakeholders is thus an organic part of the business philosophy and operating model of a conscious

business” (Mackey and Sisodia 2014, 37).

When a company invests in environmentally sound practices, the increased costs of such practices are not insurmountable hurdles for consumers who are increasingly looking to support such causes. Baker and Russell note that “consumers are showing a greater interest in where and how their food is produced, and are making more informed decisions with regard to their food choices” (Baker and Russell 2017, 532). Further on, they observe, “The growing local food movement is apparent in the increase in the number of local farmers’ markets and Community Supported Agriculture (CSA) enterprises, as well as the expansion of local procurement programs for restaurants, grocery stores, and institutions. There is also no shortage of marketing claims of being “local,” evident in many retail food outlets. Consumers are prioritizing the identification of the origin of the food, support for family farms, and a growing interest in traditional artisan foods.”

These consumers who are prioritizing intangible factors such as “local” or “sustainable” have made a cost-benefit calculation and are willing to accept the additional expense of supporting those practices. These intangibles, known as credence attributes, offer increased value and a variety of opportunities to various members of the supply chain.

Localizing the grain supply chain allows for increased visibility and traceability (including origin tracing), the ability to support local businesses, opportunities to collaborate on projects such as sustainability initiatives or grain varieties research, and a tandem benefit of reduced transit/improved sustainability for the heaviest and bulkiest raw ingredient used in brewing and distilling.

Colorado’s small craft malting community illustrates the variety of opportunities available in the market. Grouse Malt House has created a gluten-free craft malt segment where none existed previously. Colorado Malting Company started the Colorado Farm Brewery and found an international market eager to import their malted buckwheat. The Farm Brewery began as a research facility for the malthouse, but has grown into a commercial venture that offers 100 percent estate beers that use grain, hops, water, and even a yeast strain that all come from the family farm.

The local malthouses that Arnusch is working with, Root Shoot and Troubadour, are creating an opportunity by sourcing the same seed genetics (variety) from the same farm year after year. They’re “at the



forefront of maintaining consistency,” he said. “They’re branding around those names, that quality, and those characteristics. By comparison, the commodity market allows for interchangeability as long as the grain meets certain standards. “Sometimes those standards don’t change, but the crops you’re using to hit that target do,” he said. “Consistency and repeatability have rewarded us on our farm for a long time.”

Brewers and distillers can pursue product differentiation by marketing their ties to local agriculture, as well as by using those relationships to pursue novel flavors through nonstandard grain varieties (heirloom grains or varieties that are coming out of breeding research projects). This sort of ingredient premiumization directly results in the ability of the brewer or distiller to charge a premium price for their products and pay more for their ingredients.

For Todd Olander, the broad goal is to tap into the land and the people around him and build a micro-economy that supports itself through direct-to-consumer markets. He wants to conserve some of the land around him and keep it from being developed — including through Root Shoot’s 100 Year Lease project to create conservation easements (<https://youtu.be/RO-bSftOnog>) — so that the land can still produce quality crops. Going direct-to-consumer provides more value to the farmer and taps into the potential for the aforementioned credence attributes.

“Multiple farmers will benefit from this market that we’ve created,” he said, “and you need the extra value to farm in this area because it’s so damn expensive. That goes hand-in-hand. I’d like to be an example of what is possible if you take some of these regenerative practices and go direct-to-consumer, and hopefully show the rest of the United States that these are some of the possibilities that you can do in agriculture instead of just growing commodity grains, your corn and soybeans. It’s a big dream, I guess, but I hope that we will have that much of an impact.”

Many of these aspects of local sourcing— supporting local jobs and local agriculture, knowing farmers/maltsters personally, being community oriented, being environmentally focused — are also great marketing. They allow the brewer or distiller to tell a better story about their product. “We walk the land with every farmer who grows our grain,” or “We help to support X number of local jobs by sourcing within a 30-minute drive of our facility,” or “We’ve eliminated X pounds of carbon emissions by sourcing from within the state.”

# SUSTAINABILITY

Localizing the grain supply chain can shrink a brewery or distillery's carbon footprint through a couple of different avenues. Vastly reduced shipping distances for heavy, bulky raw materials leads to much lower emissions associated with grain transit. In addition, breweries and distilleries that have direct relationships with their growers can support the usage of more sustainable farming practices that require fewer chemical inputs and increase carbon sequestration in the soil by improving soil health.

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## COST / BENEFIT of LOCAL, SUSTAINABLE GRAIN

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COST	BENEFIT
Higher prices	Lower transit emissions Increased soil health / biodiversity Decreased water usage Reduced chemical inputs Increased carbon sequestration

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For Arnusch, sustainability means a lot of different things. It includes crop rotations, building soil health, building organic matter, sequestering soil carbon, targeting fertilizers usage better to the time and location where it's most effective, understanding their water footprint and getting the most out of every drop the farm uses.

His farm is almost 100 percent irrigated, with only a small percentage of dryland. He noted that optimizing water usage on the farm is an area where economics and ecology meet. "Here in Colorado, water is super valuable. If we can't add value to that water through what we grow, we can't afford to hold on to it," he said. Water usage is also highly scrutinized, he added, but not always by those who understand how agriculture works.

"We're not here to waste water. We're here to maximize water. Conservation on a farm looks different than conservation in the city," Arnusch said. "Unlocking greater yield potential and greater quality attributes doesn't mean using water less. It really translates to using water more wisely."

In the last several years, the impact of climate change has infused a new additional sense of urgency to reconsidering "business as usu-

al,” as extreme weather phenomena have transitioned from theoretical impacts of global warming to events experienced in real time around the world. Few places have been unaffected, from the intensifying cycle of drought and wildfires in the west, to amplified hurricanes and tropical storms that stall longer over land, to increased temperatures and melting of global ice threatening low-lying coastal areas. A report by Cosmos Magazine notes that “once-in-a-century” sea-level events should now be expected annually (Fuge 2021). Other phenomena have likewise seen an increase in severity and frequency.

In the 2021 State of Supply Chain Sustainability, issued by the Massachusetts Institute of Technology, 80 percent of companies said they didn’t deter their commitments to sustainability or increased their efforts during the COVID-19 pandemic, and 83 percent of executives said the pandemic had increased awareness and brought urgency to the topic or had accelerated their sustainability efforts. Unfortunately, most of this progress came from companies with more than 1,000 employees, but the report noted that pressure to find sustainable solutions continues to build, especially from governmental entities, investors, and international bodies. (Bateman et al. 2021, 2)

This has led to an increased focus on environmental, social, governance factors, known as ESG. Even international macrobreweries are taking notice, as observed in the report: “Earlier on in the pandemic, there [were] definitely quite a few skeptics around. But, if anything, you’ve seen an acceleration in corporate efforts and a huge increase, I think, in disclosure and transparency because we’re being asked. That’s why we issued our inaugural ESG report — and not just us; everyone is,” said Anheuser-Busch InBev Global Vice President and Head of Sustainability Ezgi Bercenas (Bateman et al. 2021, 13).

Greenhouse gas emissions — sometimes measured as a standardized CO<sub>2</sub>e (CO<sub>2</sub> equivalent) metric to compare all GHGs on an apples-to-apples basis — that resulted from the transportation sector accounted for 28.2 percent of US emissions, according to the Office of Transportation and Air Quality (“Fast Facts: U.S. Transportation Sector Greenhouse Gas Emissions” 2020), and 29 percent of global energy usage (Craig, Blanco and Sheffi 2013, 1). Commodity grain is generally moved via intermodal transport, taking advantage of the rail system with some drayage to and from the grain elevator, processing facility, or warehouse adding to emissions and lead time. In an analysis published in Transportation Research (Part D: Trans-

port and Environment), Craig, Blanco, and Sheffi (2013) determined that an average intermodal shipment (using multiple transportation modes, such as rail plus trucking in the case of commodity grain and commodity malt) produces 67 grams of carbon dioxide per ton per mile. Direct trucking, relied on for local sourcing of grain, was observed to produce more than twice that level of emissions, 125 g/ton-mile.

Given the statewide dispersion of farming around Colorado and the locations of malthouses on the Front Range and in the San Luis Valley, the single longest trek that a brewery or distillery would have to consider to source a staple grain ingredient (corn, rye, wheat, barley, or malted barley) is 260 miles, bringing malted barley from Root Shoot Malting in Loveland to the northwestern part of the state, Smoking River Brewing in Meeker. Most of the state's breweries and distilleries are clustered on the Front Range between Colorado Springs and Fort Collins, placing them in close proximity to Front Range maltsters and Eastern Plains agriculture.

By comparison, to reach a warehouse in Denver it is 817 miles from Shakopee, Minn., home of the nearest Rahr Maltings malthouse, and 1,100 miles from Manitowoc, Wis., home of the largest Briess Malt facility. Much of the malting barley processed at these facilities is grown in Saskatchewan or Alberta, Canada, another 1,000 miles away or more.

Because long-haul transport is multimodal — done via a combination of rail, truck, and (in the case of European malt) ocean — the environmental impact per mile is lower, but the overall distance reduction for local grain more than makes up for any carbon savings from mode choice.

By partnering directly with local farmers, brewers and distillers also have the opportunity to support the growers in pursuing more sustainable farming practices that reduce the need for carbon-intensive artificial inputs (fertilizers, pesticides, herbicides, fungicides) and improve soil health and fertility. It also helps to more closely connect the grain users and the final consumers more closely to the agricultural roots of beer and spirits.

The Status of the World's Soil Resources, Technical Report, issued by the United Nations in 2015, opens on page one by observing "the disconnection between our increasingly urbanized human societies and the soil" (FAO 2015, 1). It continues: "The proportion of human labor dedicated to working the soil has steadily decreased through





the past century, and hence the experience of direct contact with the soil has lessened in most regions.”

Soil health is a critical factor worldwide. Tilling the soil, or turning it over to disrupt weed growth and loosen the soil for planting, has resulted in a dramatic loss of soil fertility. It exposes the organic matter below the ground to the atmosphere, allowing carbon to be released, and reduces the soil’s ability to retain water, leading to nutrients being washed away. The use of monocropping — growing the same crop repeatedly on the same land — depletes natural nutrients that could otherwise be replenished by rotating crops, encourages crop-specific blights to take hold, and leads to an increased need for chemical inputs. Merlin Sheldrake writes in his book examining the fungal world, *Entangled Life*, “The impact of fungal diseases is increasing across the world: Unsustainable agricultural practices reduce the ability of plants to form relationships with the beneficial fungi on which they depend.” (Sheldrake 2020, 8)

The long-term solution proposed by groups such as the Land Institute is to transition into perennial grains. Grain crops that do not have to be replanted annually would dramatically lessen the disruptive impact of grain farming and encourage healthier soils. These perennial grains, for the most part, are still early on in the process of breeding and development and years or decades from being a viable option, but the perennial wheatgrass *Kernza* has been developed and is seeing increased usage. It is the leading example of this strategy, with Mad Agriculture responsible for marketing the majority of *Kernza* grown in the United States.

A New York Times article on *Kernza*, summarizes some of the soil issues:

Research suggests that the world’s soils are now eroding 100 times faster than new soil can form, and an estimated 33 percent of soil is so degraded that its ability to grow crops is compromised. Meanwhile, monoculture — the strategy of sowing huge fields with a single crop — achieves higher yields but also puts more pressure on soil and increases the risk that plants will succumb to pests or disease.

Many of humanity’s solutions to these problems also create other issues, Land Institute researchers say. Fertilizer can counter soil degradation, but it pollutes waterways and produces nitrous oxide, a potent greenhouse gas. Pesticides might reduce threats from insects, but they destroy other vital species. Cover crops

will curb erosion, but they can be difficult to plant and maintain.

And modern farming is hugely carbon intensive. Factoring in fuel for machinery and food transport, methane produced by belching livestock, and the carbon that's lost when ecosystems are converted to cropland, agriculture accounts for about a quarter of humanity's annual planet-warming emissions. (Kaplan 2021)

The Status of the World's Soil Resources, Technical Report noted, "Between 1961 and 2000, global population grew by 98 percent but food production rose by 146 percent and per capita food production increased by 24 percent" (FAO 2015, 6). Yields more than doubled, while arable land use increased by only eight percent. Much of the increases were a result of plant breeding and inputs (increased chemical and water usage).

However, the report goes on to note that these gains have come at a steep price. "The current trajectories in soil conditions have potentially catastrophic consequences that will affect millions of people in some of the most vulnerable regions over coming decades" (FAO 2015, 76). A short report by the World Resources Institute states that the agricultural sector in the United States loses \$44 billion each year because of erosion, a result of lost productivity, sedimentation, and water pollution. Lost farm income alone is pegged at \$100 million/year (Sulaeman and Westhoff 2020).

It would be naive to rely on international agribusiness to abruptly change course (or to think that such behemoths could pivot quickly if they wanted to) nor for deeply entrenched governmental interest groups to radically alter the incentives that have been built into the commodity food system. The entities that have created the current system cannot be relied on to implement sweeping changes to a system that has been so profitable for them. From the report sponsored by Patagonia:

"Our food system was not broken by the pandemic and it was not broken by independent family farmers or ranchers. It was not broken by animals/grazers on the landscape, who are now, too often, the scapegoat. It was broken by large, multinational corporations and the industry who, because of their buying power and size, have undue influence over the marketplace and over public policy. Multinational corporations have concentrated our food system to its breaking point, having extracted profits from farmers, workers, and consumers for too long.

“The virus has stripped away the veneer, shining a bright light on these longstanding abuses.” (O’Connor 2020, 7)

In the near term, any hope for incremental change lies with farmers like the Olanders. They have moved to a no-till approach and committed to using cover crops to help with soil health. They understand that growing small grains as part of a rotation helps to disrupt disease and pest cycles, reducing the need for artificial fungicides and pesticides. The current crop rotation Todd Olander is targeting is four years of alfalfa, a year of corn, a year of barley, a year of corn, another year of barley, and restarting with four years of alfalfa.

Proper soil management can reduce the need for artificially produced sources of nitrogen, phosphorus, and potassium fertilizers, which are created using fossil fuels. As already noted, Olander has eliminated nitrogen additions in favor of lower yield and higher quality. He expects regenerative practices to help level out the protein levels in his grain and reduce variation. “We’re still going to have to use some (synthetic fertilizer) to make sure we don’t have a huge drop in yield, but eventually we can taper ourselves off of it,” he said.

As part of that effort, he went “all in” on cover crops in 2021, planting 400 acres, with the expectation that results will take three to four years to materialize. He intends to plant cover crops between barley and corn crops, and also to interseed a short cover crop with his corn, leaving behind the cover crop after the corn is harvested. Having photosynthesis happening on the land for as many days as possible will have the greatest positive impact on his soil health, he said. The cover crops will also serve as ground cover to protect the soil.

A report issued in 2020 by the UN, titled the State of Knowledge of Soil Biodiversity, notes that “soils are one of the main global reservoirs of biodiversity, more than 40% of living organisms in terrestrial ecosystems are associated during their life-cycle directly with soils.” (FAO, ITPS, GSBI, SCBD and EC 2020, 2) These soil organisms both provide direct nutrients for plant growth and also transform soil nutrients to become available for plants.

At Olander Farms, making their own compost every year is an important practice that helps to support the microbial population. It also allows them to reduce the amount of material applied to each field compared to using manure; less material means fewer passes on the tractor, resulting in fuel savings and reduced soil compaction.



Less soil compaction means an expanded root zone, with plants able to more easily access moisture that's deeper down in the soil. As water becomes more scarce and water rights increasingly expensive, Olander said he hopes to "prove to people that improving your soil health reduces your water needs." This is a result of less soil compaction and better water retention leading to less runoff, and better soil coverage leading to less evaporation. "I guarantee you that if we go out and dig where we have cover crops planted, there's moisture down below three or four inches, compared to if we go to the neighbor's where they till the crap out of it, you're gonna have to go down 12 inches maybe before you find any moisture," he said.

Looking beyond changes to current farming practices, even an immediate cessation of greenhouse gas emissions would leave the planet's atmosphere at current levels or higher, as noted in the Patagonia report (O'Connor 2020, 11). However, healthy soil stores more carbon in the form of organic matter. Regenerative farm practices that help to re-sequester carbon back into the soil (after at least 50 percent of soil carbon has been released in recent centuries) offer one avenue to create a net reduction in atmospheric carbon.

The New York Times recently featured wineries in Sonoma County, California as early adopters when looking at the potential impact of the farm on the broader environmental context. Some wineries and farmers are now offering tours focused on the regenerative aspect of their operation.

"Agriculture has a unique opportunity to be a part of the climate solution," said Karissa Kruse, president of Sonoma County Winegrowers, a local trade group, which, like the California Sustainable Winegrowing Alliance and California Land Stewardship Institute, emphasizes environmental, social and economic sustainability in the region. "Best management practices optimize carbon sequestration, minimize greenhouse gas emissions and support water conservation. This matters locally as our multigenerational family farmers see themselves as caretakers of the land for the next generation." (Koch 2021)

# TRACEABILITY

The emergence of farm breweries, farm distilleries, and corresponding state laws in many places (though not yet in Colorado) carving out a unique business space for these operators highlights the prospect of truly place-based beer and spirits.

The Colorado Farm Brewery was founded three years ago by the Cody family at Colorado Malting Company. They buy from offsite for certain ingredients in certain products, but they also have beers that are 100 percent estate-sourced, not just grain and hops but including a yeast isolated onsite at the farm.

Olander noted some of those factors as key advantages in sourcing locally. Traceability of the crop, the availability of single-source single-variety grain, and “knowing the exact field the crop was grown and [what] practices were used” are the sort of opportunities that the commodity system can’t offer.

Being able to isolate grain streams allows a maltster to produce a more consistent malt by tailoring the malting schedule more precisely. A mix of grain from various farms will have slightly varying characteristics, and the resulting malt created from commodity barley can have something of a salt-and-pepper look, with greater variance from the target specifications being averaged out between multiple batches.

“A lot of it has to do with not blending, being a single-source barley,” Olander said. “Your product becomes more consistent that way, instead of being blended to spec by the larger malthouses.” Furthermore, recently completed rye varietal research by Minnesota’s Far North Distilling could have profound implications for the way distilleries choose to source their grain and the flavor impact of those decisions.

Far North owner Mike Swanson planted 15 different varieties of rye grain in 2015, 2016, and 2017, distilled the grain in separate batches, and aged the spirit made from that rye. The unaged white spirits and the aged spirits were tasted and the differences charted. In the end, despite the industrial-agriculture approach to treating all varieties as uniform, fungible commodities, “There are significant differences in flavor between rye varieties,” Swanson said in a follow-up discussion of the results. “That’s probably one of the biggest

takeaways, because that research hadn't really been done before. I expected that, but nobody had proven it before."

In the commodity grain system, grain that meets certain baseline parameters gets blended — different varieties from different farms get mixed together at the grain elevator — which prevents origin tracing or varietal tracing. "For many, the commodity system is a black box, where grain goes in from the farm and comes back out elsewhere in the country, possibly malted, and at a higher price," Swanson said. "What we're demonstrating is that direct sourcing is very important, it can be vitally important to distillers, because grain merchants don't know what variety they have."

The report opens with a paraphrasing of agricultural writer Wendell Berry: "Drinking is an agricultural act." The Far North study aims to tie the product in a whiskey glass more closely to the product coming from the farm.

"Just imagine if nine out of 10 bottles at your local wine shop were simply labeled 'grape wine', with no mention of whether it was a Cabernet or Chardonnay. That is the current state of the rye whiskey market," the study states. "... There are craft whiskey distilleries that have begun to circumvent this supply chain and buy grains directly from local farmers as a point of differentiation. Still, most of these newcomers focus on the relationship with the farmer as a feature of regional pride and profile, not as a means to highlight distinctive flavors through varietal selection."

The project began with a call from a farmer in Maine looking to source seed for AC Hazlet rye, the varietal Far North began growing in 2013. When Swanson asked why he needed that particular type of rye — after all, aren't there plenty of seed producers closer to Maine where he could get rye? — the farmer explained that the distilleries he sells rye to had been complaining that the flavor wasn't as good when he switched varieties.

"I thought, 'Wait a minute, I thought all of this stuff tasted the same,'" Swanson said. He called a small grain specialist at the University of Minnesota and asked if there was any research on the topic, and was told that it would make a really good research study. Far North submitted a proposal, received a grant from the Minnesota Department of Agriculture in 2015, and got started.

All of the varieties that were tested had known agronomic data available, so Swanson was able to select with an eye on factors such



as winter hardiness, days to heading (maturity), plant height, straw strength, ergot, test weight, and protein level, as well as ease of processing in the distillery, given rye's notoriously troublesome nature. After distillation, the spirit was aged in 15-gallon barrels for 18 months, and sensory information collected on both the aged and unaged spirit from 190 industry professionals, agricultural professors, distillers, bartenders, and members of the general public. Their hypothesis, that flavor differences existed, was validated in the clearly identified variability of the spirit based on the rye varietal. The differences among the unaged spirits was significant, Swanson said, "but what really stood out was that after aging, those differences in flavor were actually amplified. I expected them to be covered up by the barrel-aging process. I expected the barrel aging to kind of roll over the differences in varieties."

He also recognized a secondary pattern in the way the flavors were described. The hybrid ryes — those bred for homogeneity, ease of handling, uniformity, and fast pollination — all tasted good and resembled each other. The open-pollinated ryes, which are less standardized, less uniform, and slower to pollinate, exhibited a broader spectrum of flavor.

"That wasn't too much of a shock with the unaged (spirits), but when we got to the aging, the differences just become amplified, the huge spectrum of flavor among the open-pollinated varieties and not very much difference between the hybrids," Swanson said. "It wasn't bad, but it wasn't the kind of depth and complexity we saw with the open-pollinated varieties."

That wide variability and depth wasn't necessarily all good. There were varieties that produced spirits they liked and others that produced spirits they didn't like. There were also some, such as Oklon, an older variety from Oklahoma, and Spooner, an older rye from Wisconsin, whose flavors were transformed during aging.

"Both of those two were surprises, because the unaged distillate didn't taste very good at all from either of those. It came out of the barrel like a caterpillar that turns into a butterfly. It was amazing. Depth and complexity, great flavors, nice finish. We were really surprised," Swanson said.

The research results show that producers are gambling with the flavors that they're going to get using commodity grain from a merchant, since varietal information is lost very early.

“What we’re showing with the study is that varietal information is vital to the flavor of whiskey,” he said. “The farming aspect of this really matters. There’s a real voice that the farmer has in the process of making whiskey.” The complete study can be found [HERE](#).





# TERROIR

Taking the concept of traceability to the next logical step, the ability to work with specific varieties and pursue origin tracing from the farm to the finished product opens the door for brewers and distillers to explore the concept of terroir in their products. A concept traditionally applied to wine, terroir is the unique flavor expression of a particular location. While grain has been bred for uniformity and consistency, unlike wine grapes, some distillers are nonetheless taking an academic approach to exploring the sensory and chemical impact of specific growing locations.

A study that was run by Dustin Herb of Oregon State University and Mark Reynier, owner of Waterford Distillery in Ireland, examined two related varieties of barley, Athy and Bunclody, planted in two different locations in Ireland, one inland and one more coastal, featuring different soil types and environments and collecting data for two years of plantings.

Inspired by Reynier's experience with the flavor impact of biodynamic wines, the researchers conducted sensory analysis on spirits produced from those malts and subjected samples of each spirit to gas chromatography to examine variations in the chemical makeup. According to the study, "Significant differences in the intensity of sensory attributes were identified between season, variety, environment, and the interactions thereof (Table 3). For both years, variety had a significant effect on pungent and fresh fruit attributes, and environment had a significant effect on pungent, feinty/earthy, malty/biscuity, floral, fresh fruit, dried fruit, solventy, and oily finish attributes, while the interaction of variety x environment significantly affected pungent, feinty/earthy, floral, and fresh fruit attributes. Some sensory attributes were only significant for one season (Table 3)" (Kyraleou 2020).

The study concluded that "variety, environment, and the interaction of variety x environment impacted the sensory character of the new make spirits ... However, the impact of environment and the interaction of variety x environment were more pronounced than variety alone on the sensory attributes across both seasons." Furthermore, the researchers note that the significance of the variety/environment flavor impact suggests that specific combinations of environment and variety may have greater impact on the flavor profile of the final spirit.

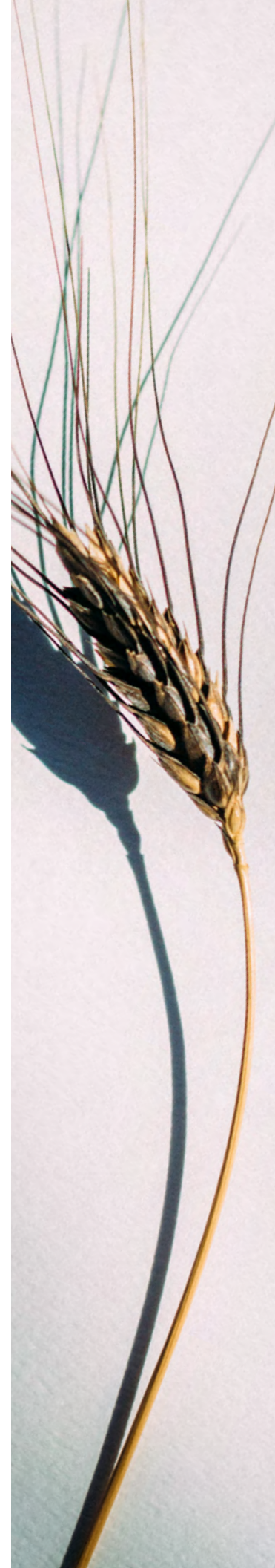
Rob Arnold, head distiller at Firestone & Robertson Distilling in Ft. Worth, Texas, decided to explore the potential for terroir in whiskey as a part of his doctoral research, publishing a book, *The Terroir of Whiskey*, in the process. He used three off-the-shelf varieties of corn — not heirloom or especially flavor-expressive varieties — from the same company, which were expected to be genetically similar. “The majority of lines in modern American breeding programs are the products of a small and stratified genetic base,” he noted (Arnold 2021, 101).

He had these varieties planted in four growing locations across Texas, selected for their varying soil and environmental factors to maximize environmental diversity and see if local variation could be identified even within a relative lack of genetic diversity.

His research identified a similar correspondence between variety and location as noted in the Waterford study, but he also explored hypotheticals that could impact terroir further. One was the potential use of new or forgotten varieties bred and selected for flavor, growing them in an environment that encourages those flavors to be “most intensely and truly expressed. Certainly that would give us a more diverse and concentrated set of flavor compounds than what we find in commodity grain. And terroir can potentially unlock and reveal flavors that have been forgotten (and maybe never experienced) in grain and whiskey” (Arnold 2021, 274).

He cited soil health and microbial diversity as factors that could potentially impact flavor, as well, based on the unique set of molecular nutrients in the soil that stimulate the production of various flavor-active compounds in the plant. Without chemical additions to mask or augment the expression of flavor as a result of environmental factors, sustainable low-input farming practices will allow the “essence” of an environment to shine through in the crops. The pursuit of terroir, according to Arnold, is a pursuit of both great flavor and great ecology.

“If we, the whiskey industry and its consumers, accept and appreciate terroir — and in doing so recruit distillers, maltsters, farmers, and plant breeders to champion the cause — then we can change the future of whiskey. Whiskey could enjoy a diversity of flavor, a meaningful existence of provenance, and a connection to the land that we have lost over the last hundred years” (Arnold 2021, 276).



# HURDLES

A few hurdles to localization have already been identified. Storage capacity is a bottleneck for small growers who want to provide traceable crops. Current malting capacity in the state only consists of a small fraction of the craft beer market. Grain cleaning is not currently an issue, but could become a pinch point as the market for local grain increases. The availability of land and water are also issues that face anyone working in or reliant on the agricultural sector.

Arnusch sees a number of bottlenecks in the local grain supply chain as it currently exists. Many are related to the scale of the current processing capacity, and broadly he sees scalability as the biggest hurdle to increasing localization of the grain supply chain. For example, he still has to bring grain to Troubadour in two-ton tote bags, known as super sacks, rather than in truckloads. It's less efficient and more expensive, but necessary because of the current capacity at the malthouse.

Inventory management can be difficult for a farmer growing specialty crops, Arnusch said. "When you're a farmer growing a commodity, you can demonstrate to your lender that you have so many bushels of wheat on your farm or so many tons of corn silage on your farm, and the lender recognizes that as having a value," he said. "When you grow a specialty crop and you tell that to a lender, he doesn't know what he can do with that in the event that you don't sell it, and they discount that value heavily because of the unknown."

Those specialty crops can become a drag on the balance sheet, he said. If that asset doesn't move quickly through the supply chain, it starts to incur carrying costs in terms of space usage, capital costs, and lost opportunity. It eventually becomes a liability rather than an asset as the carrying costs erode the profitability of the specialty crop "even when the best of intentions are in place," he said.

Another major hurdle to developing a broader local grain economy may be federal policies that are aimed at bolstering agriculture. For farmers who opt in to the commodity system, the system offers a guaranteed market and the government provides subsidies including direct payments and crop insurance.

As part of localizing their operation and trying to use more environmentally friendly practices, Olander Farms has chosen to fore-

go most forms of insurance (except for hail insurance) and other government support. Because alfalfa is not insurable, it's not as desirable a crop for the average farmer to grow, but it consists of half of the Olanders' crop rotation. In addition to not being eligible for insurance itself, rotating crops such as alfalfa disrupts the record-keeping that would be relied upon to estimate the loss in case of a crop failure.

Effectively, a farmer who rotates crops prevents themselves from being able to increase their baseline yields over time, and will be reliant on the county average for an insurance payout. "If we were doing corn on corn on corn on corn, we could increase our payout pretty easily," Olander said. "The county average is so low, especially in Larimer County. There's no way your yield is going to be lower than that, even if you have a really horrible year. It's just not worth it for us."

As a result, federal farm subsidies and crop insurance discourage crop rotations and limit the types of crops that are most appealing to a small farmer, discouraging them from doing things that are out of the norm. "If it's not an insurable crop, then why do the farmers want to do that when they can grow corn and soybeans?" Olander asked. "There's an extra risk factor in there."

He also sees an entrenched mindset among many farmers: they want to deliver their crops to a single clearinghouse (generally a feed mill or grain elevator) and get paid promptly, rather than working within a smaller system that offers more revenue for more work and over a longer time. They want to farm the grain and deliver it into the system.

Root Shoot Malting has even experienced some pushback from the farmers they contract with, because the malthouse has to pay them incrementally over a longer period. "They just want to get paid as soon as they put it into the grain bin," Olander said. "They like the simplicity of it."

The current market conditions are also not favorable to convincing farmers to switch lanes to a local system. Volatility in the commodities market has created dramatic swings in value; currently grain values are more favorable to farmers than they have been in recent years.

The corn prices that Olander Farms uses, for example, are based on values from the Chicago Board of Trade, which can fluctuate wildly.



In 2020, commodity corn was about \$4 per bushel, while in 2021 it's closer to \$7. Feed barley has gone from \$8 or \$9 per hundredweight (CWT) to a projected \$13/CWT in 2022. This has driven the price for feed barley above where premium malting-quality barley had been (\$10.50). The baseline increase disincentivizes farmers who might otherwise be interested in trying to earn a premium for their malting barley, which is now \$14.50/CWT.

"Typically there is a significant difference, however this year and next is unique," Olander said. "it's great for farmers, they're actually going to make some money this year, unlike the last eight years. But do you want to have a consistent market where you know what you're going to get paid? I think it's worth it. That's why I'm doing it."

The costs to enter the craft malt market can also be significant. Root Shoot's initial equipment cost was \$1.5 million, plus another \$500,000 to erect the building itself. Beyond that, the farm supported the malthouse by providing free grain to the malthouse for the first two years. "There are definitely cheaper ways to make malt, but we wanted to make sure we had control and quality over the malting process, (and) also limit our need for labor," Olander said, adding that they were able to set up a lease-to-own program for the equipment, allowing them to operate without money down or upfront costs.

There are also downstream hurdles from the farm or malthouse. Quality concerns persist among brewers and distillers about small craft malt producers, but they're slowly changing. The messaging from brewers and distillers is clear, though: local is fine, but quality is paramount, according to Olander. (He also sees no demand for organic at this time.)

"If we always focused on local, you don't open yourself up to being a full-time supplier. You're sort of a novelty," he said. "Once we started making sales, we didn't want to be a one-off, 'We're going to make an all-Colorado beer.' You can only make so many all-Colorado one-off beers. That's not going to support the business."

Because of its unique position in the marketplace, Grouse Malt also isn't focused on "local" as much as they are on gluten-free. "Our customer base is primarily looking for gluten-free malt. if we're in the region, that's an extra bonus that they're getting their malt from a local craft maltster, but that is not traditionally our customers' main goal," Soles said.

All of these hurdles translate to lower availability and higher cost to the consumer. Ultimately, the only source of new income in a supply chain is the final downstream customer; all other payments going up the supply chain are merely fund transfers for value-added services such as transport, cleaning, storage, or processing. The final obstacle is the willingness of customers to pay a premium price when there are lower-cost substitutes readily available from regional and global grain suppliers. As a result, the craft malt sector may find itself a focus of interest for larger maltsters, which can offer lower prices.

The Codys at Colorado Malting have seen such competition move in just to the west of their farm and malthouse. Josh Cody said the competition from their new neighbors has been direct and intense.

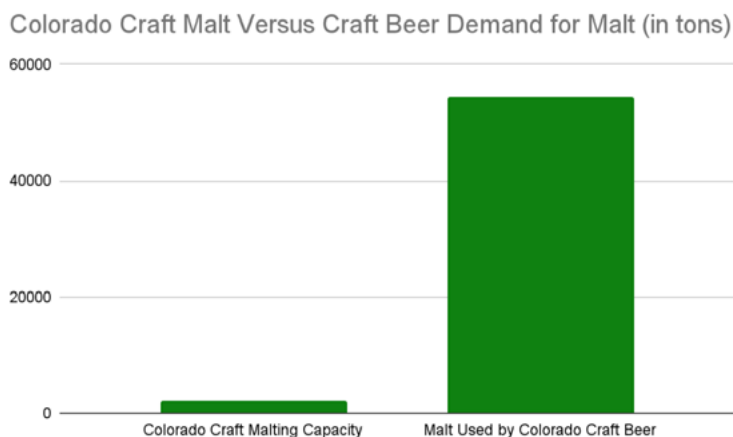


# RESULTS

Based on the data collected here, there are clear openings for growth in the local grain market. Previously referenced data notes 20,400 tons of malting barley grown in-state, which translates to about 17,300 tons of malt. Small brewers in Colorado use about 54,372 tons of malt per year.

Meanwhile, the in-state malting capacity includes Proximity at 30,000 tons, Root Shoot at 1,325 tons, Colorado Malting with 750 tons, and Troubadour at 125 tons.<sup>1</sup> Excluding Proximity, which sources in part from outside the state and distributes widely outside of Colorado, and Grouse Malting, which operates at the lower end of the scale and also relies heavily on out-of-state sales, the effective malting capacity in Colorado is 2,200 tons. This leaves a 52,172-ton differential between the usage of malt in the Colorado craft beer sector and the state craft malting capacity. To look at this another way, at maximum Colorado craft malt can supply a roughly four percent share of the state's craft beer production, assuming that zero malt is diverted to distilled products or out-of-state users.

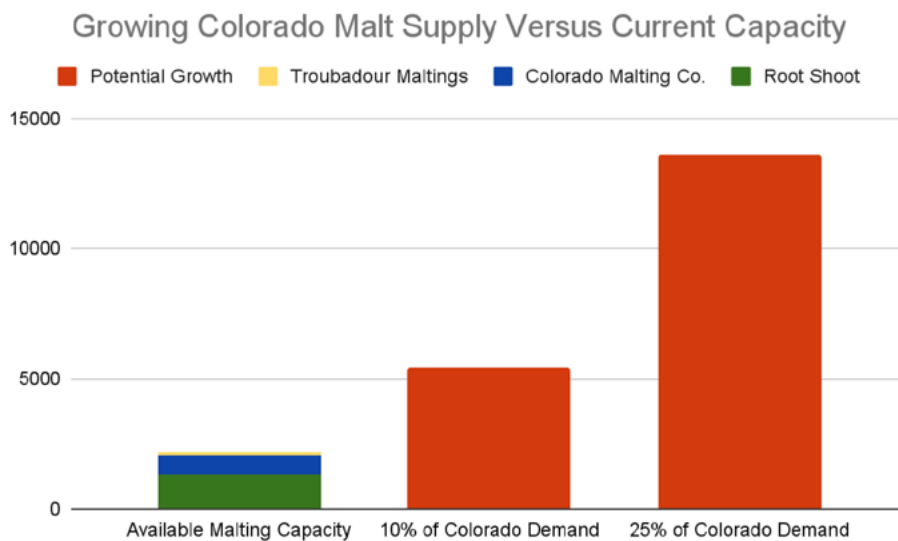
Craft beer accounted for 12.3 percent of US beer sales volume in 2020 ("National Beer Statistics and Data" 2021). However, Watson estimates that craft beer generally accounts for a 25 percent market share in Colorado due to a high concentration of on-premise accounts, which benefits craft. (In 2020, the craft market share was about 18 percent due to lockdowns and restrictions on on-premise consumption, but he expects a significant rebound in 2021.)



Meeting ten percent of malt demand in the Colorado craft beer mar-

ket would require 5,437 tons of malt; 20 percent would be 10,874 tons. If local malt were to take a similar piece of the pie within the craft beer market as craft beer has taken out of the overall beer market, a proportionally scaled niche within a niche, 25 percent of the craft industry in Colorado would entail 13,593 tons of local malt, or roughly 10 times Root Shoot’s capacity. Unless Proximity were to pull back from several other states they distribute to, focusing exclusively on sourcing and selling within the state, there appears to be significant room for additional maltsters and barley growers, and/or significant growth for existing members of the supply chain to keep pace with growing demand.

As previously calculated, distillers used an estimated 121,500 tons of grain in the 12-month window ending in August 2021. Compared just to the 2020 corn harvest, as corn is the primary ingredient in the most popular category of aged spirit (bourbon) and is the sole grain in much of the bulk neutral spirit (used for vodka, gin, and liqueurs) that is brought in by distillers from industrial plants in the Midwest, potential spirits usage is a drop in the bucket when compared to the corn grown in Colorado in 2020: 123 million bushels of corn or 3.44 million tons.



The above data indicates that there is considerable headroom for growing and malting high-quality barley for both beer and spirits. (The data on malted barley does not take into account demand from distillers, only small brewers. Real statewide demand, when accounting for spirits, is greater than the craft beer numbers noted above.) To meet demand for ten percent of malt for craft beer, 5,437 tons, would be 6,394 tons of barley, while at the upper limit, 25 per-

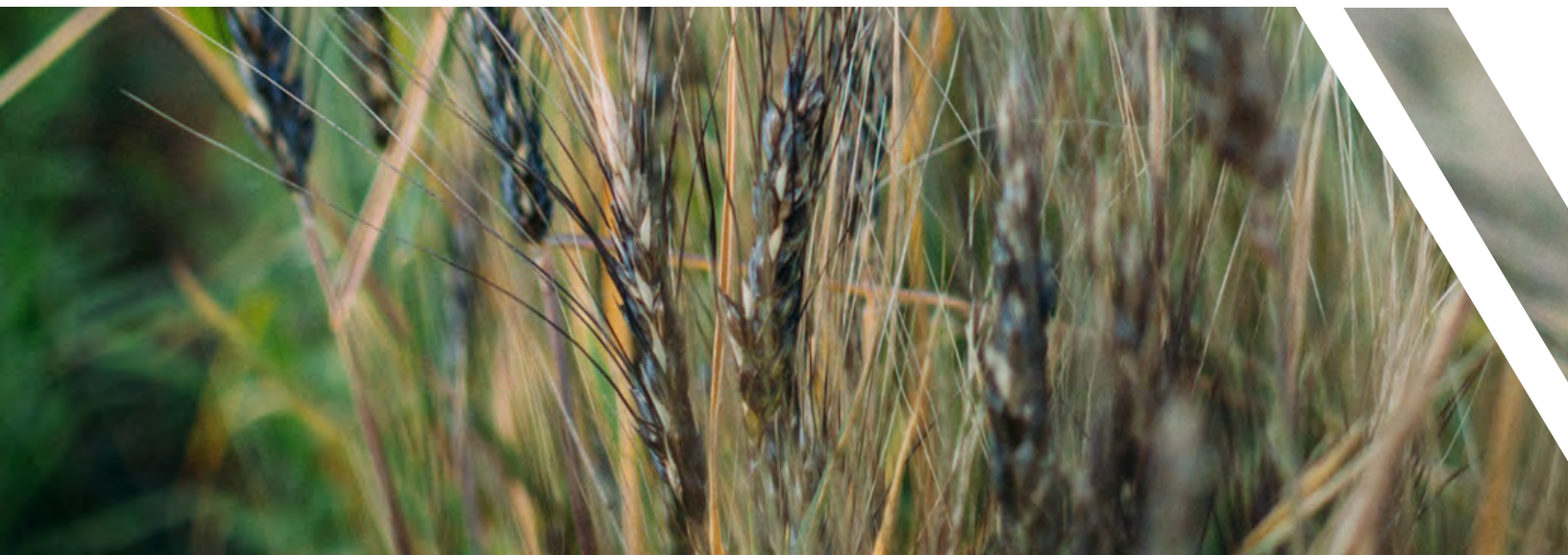
<sup>1</sup>The barley numbers reported by USDA/NASS are lower than what is used by Proximity alone. Olander observed that Proximity sources from outside of Colorado, and that not all acres are reported, which is only required to qualify for insurance and federal programs.



cent/13,593 tons would require 15,992 tons of raw barley. Using an average of 110 bu/acre based on Olander's estimate of 100 to 120 bu/acre for irrigated farmland, at 48 lbs of barley/bu, results in an estimated 2.64 tons per acre of barley. To meet ten percent of Colorado demand requires an additional 2,422 acres of barley to be planted, while 25 percent of the craft beer demand would need 6,058 acres of barley grown.

By comparison, this year Olander Farms is growing 680 acres of barley, along with two farmers contracted for 100 acres of barley each, and two additional farmers contracted for 70 and 50 acres, totaling 1,000 acres of barley to meet demand for the malthouse expansion and to boost low inventory. In the future, Root Shoot aims to grow 700 acres of barley per year, with at least 80 percent of it coming from Olander Farms. Olander observed that Coors Brewing had been reducing local contracts for some years, based on what other regions in the country were doing, but has started to contract more Colorado barley again. Meanwhile, he said, the inputs needed for corn are double what barley requires, but farmers may fear having a crop of malting barley rejected on quality factors.

While it is impossible to compete head-to-head on price with commodity grain and industrial maltsters, pricing in the last two years has been particularly erratic. The Codys have seen the cost of some grain, such as rye, more than double in the last two years. As previously noted, Olander said the price per bushel on a few different grains has been significantly up this year, potentially decreasing the motivation for farmers to transition from commodity to local.



# CALL TO ACTION

Sourcing locally means more than just buying something that was grown locally. It means being part of a place, part of the community. A more local focus connects brewers and distillers to local business owners, not just in the grain supply chain but craftspeople, shop owners, chefs, and restaurateurs, as well as local interests such as water rights and land usage.

Mackey and Sisodia comment, “The community stakeholder is one of the core constituents for a conscious business. Businesses exist within local communities, national communities, global communities, as well as virtual communities of common interests. It is unthinkable for a conscious business to see itself as separate from the rest of the human community” (2014, 123).

Farmers and maltsters, those at the top of the supply chain, offered very specific and simple ways to support the local grain community. The first is simply to work with local farmers and local maltsters. Direct business-to-business support is the most immediate and intuitive way to help those small upstream producers.

On the agricultural side, Arnusch sees a lot of room to increase localization. “As an industry, I see the desire by production agriculture to fill that demand. There’s a lot of things that we can do here in the craft grain space that other states and growing regions can’t,” he said. The essential steps to move forward are building relationships and building the supply chain, so that farmers are not handcuffed to growing for industrial maltsters or the commodity grain system.

He said there is room for farmers to develop the small-grain microindustry here, in particular with the small farmers to the east and west of the I-25 corridor. “You’re not going to make that relationship with a 25,000-acre corn farmer in Yuma County, but it’s gonna be that 500-acre grower in Boulder County, that thousand-acre farmer in Larimer County,” he said.

Many of those growers have experience working with larger maltsters already, and Arnusch said small grains are a good fit for the Front Range as the landscape, climate, and water availability continue to shift. The capacity at Root Shoot and Troubadour isn’t enough to handle all of the potential supply yet; he sees opportunity for “monumental” growth at those businesses or for additional malt-

houses to open.

Cody commented on the need to increase agricultural awareness among grain users. “Brewers and distillers need to recognize the agricultural reality of their industry and support it by getting as close to the farm as possible. The age of commodity middle men is over and the curtain has been lifted. The industry needs to connect to the farm,” he said.

Likewise, Olander and Soles both identified a need to go beyond simply purchasing and using their ingredients. Brewers and distillers need to tell the story of their grain and raise awareness among their customers of the additional benefits that come from localization. Soles expressed surprise at how long it has taken for awareness of the craft malt industry to spread even among industry professionals, let alone the broader public.

She recalled a conversation with a representative of a beer and spirits distributor just before the initial wave of COVID lockdowns in March of 2020. She said she asked about the feedback the distributor receives from customers and how important the use of local ingredients was. The answer from the distributor was disappointing, to say the least: “That’s not even on my radar.”

One helpful avenue has been for brewers to produce collaborative beers with craft maltsters to help raise the profile of the maltster. Soles said it will require a long-term effort to educate customers that involves more collaborative projects and ongoing efforts to communicate the additional benefits of localization.

“Not only are they producing a delicious beer or spirit, they’re supporting local agriculture,” she said. “To get that out to the customer and having that customer demand local products from other breweries and distilleries is where we actually see that paradigm shift. It’s great if they use it, but talk about it.”

In addition to collaborative efforts, she suggested that putting information about the farm and/or malthouse onto packaging materials and educating the staff at a brewery or distillery so that they can share the unique story of their grain could help to create demand. “It’s a push-pull,” she said. “Ideally the craft maltster’s customer, the craft brewer or the craft distiller, is asking for your product because their customer is asking for it. Or that they’re interested in it and interested in supporting local. I think it needs to come from both the consumer and the industry.”

Arnusch has had good conversations with Oskar Blues Brewery, and tried to begin the conversation with New Belgium and Odell Brewing. “They really like the idea of sourcing grain from the farmers, but the malt capacity isn’t quite there yet. There’s a lot of logistics in the supply chain that have to fall just right in order to keep local grains driving local demand,” he said. However, as the largest brewers such as New Belgium and Oskar Blues are acquired by larger corporations, it creates more disconnect.

He looked back on a discussion he had a few years ago, while sitting as a panelist for Colorado State University, with a member of the New Belgium supply chain team. The brewery employee was talking about the importance of brewing local, hiring local, buying local, but skipped right past raw materials. When the Q&A session started, Arnusch said he challenged her: “You have grain literally growing within blocks of your brewery. You’re still sourcing elsewhere when you have a lot of those natural amenities locally.”

The New Belgium employee’s response echoed what Soles heard from her distributor: “We don’t even know you exist.”

To move beyond that, he sees a need for greater scale and greater organization. He doesn’t necessarily envision a trade organization, but possibly a marketplace or a forum for growers or buyers to band together and create enough demand or enough supply to move the needle. “We need an opportunity to have the conversation,” he said.

Olander noted the value of partnering with other like-minded organizations to help promote regional agriculture and sharing the importance of supporting local. The Minnesota study examining a local small grain supply chain, likewise, noted that an “increasing presence of collaborative-style approaches found around the country ... will continue to drive market opportunities for small grain producers” (Muckey 2018, 30). Cody commented, “We need to cultivate a culture of community and support for local markets.”

While these organizations have generally focused more on the food aspect of the local grain supply chain, Colorado organizations that promote local grain include the Colorado Grain Chain and the Noble Grain Alliance. Mad Agriculture has released the Grain Revival Guide to highlight varieties that are currently available and to spotlight some of the local farmers growing those grains. Nationally, the Craft Maltsters Guild oversees the Certified Craft Malt Seal for brew-



ers and distillers who use a certain percentage of local malt.

As local demand increases, growers will be more incentivized to work locally, but education among farmers is also essential to enable a sea change in how grain is sourced. It will be important to normalize localization among small farmers and work person-to-person to overcome cultural challenges that encourage a mindset where the farmer inserts an interchangeable ingredient into a commodity system and promptly receives their minimal payment.

After that, it will take further time — and possibly risk-sharing contracts with malthouses, breweries, and distilleries — to encourage farmers to accept the risks of moving towards more sustainable practices. As Olander knows, farmers don't get a lot of shots at getting it right. "If you want to be a farmer for 50 years," he said, "that means you have 50 times to grow a crop. That's not very many times."

Beyond these initial measures, a more ambitious approach to supporting local grain usage would be to enact state-level measures that create financial advantages to local sourcing (tax incentives, lowered licensing fees) or marketing advantages (branding or labeling opportunities).

One example of legislative support is the New York State Farm Brewery license. Originally enacted in 2012, the law uses a graduated approach to local sourcing, requiring 20 percent of all hops and 20 percent of all other ingredients to be grown in-state through 2017. Beginning in 2018, the requirement jumped to 60 percent, and then in 2024 it increases again to 90 percent. This approach allows for the gradual build-up of infrastructure and capacity in the state, while providing implicit guarantees of a marketplace for growers and processors who want to tap into the local market. Similarly, the farm distillery license requires a minimum of 75 percent ingredients to be produced in-state.

On the licensing end, brewers and distillers (who need not be farmers themselves) are incentivized to tap into the farm licenses because of lower costs and reduced restrictions, as well as the opportunity to label their product accordingly. Then-Governor Andrew Cuomo of New York commented on the farm brewery bill in 2012, "In addition to producing some of the finest beer in the world, New York's craft breweries are creating jobs, supporting our state's farmers and hops growers, as well as bringing in tourism dollars in local communities across New York" ("Farm Brewery" 2022).

A set of Colorado farm brewery laws, farm distillery laws, or other state-level incentives to tap into local agriculture could help to promote local sourcing. With Colorado at the forefront of the craft brewing and craft distilling industries, it is time to encourage those local producers to look closer to home for their ingredients. It's time to support a supply chain dedicated to beer and spirits that are grown, produced, and enjoyed right here, products that are truly Colorado from the farm to the consumer.

Finally, this paper is not the last word on the topic, but merely an opening statement. There is a tremendous amount of room for further research to more precisely detail the environmental, economic, and flavor impacts of tapping into the local grainshed. There also continues to be space for educational outreach to inform growers, grain buyers, and consumers on the opportunities and outcomes of shifting toward regional supply and scale.

Arnusch voiced cautious optimism about the future growth of the local grain supply chain. He sees increasing awareness among customers who are looking for farm-to-table food, local beer, local spirits, and a greater overall connection to place.

"Since the time that I entered into this space, I've noticed a greater understanding from the consumer why it's important to source locally," he said. "The local movement isn't a casual trend. It feels like it's here to stay. You see it on certain drink menus, you hear about it in advertising, you read about it in the local newspaper or online. It matters to consumers that their dollar is staying here and not being shipped to St. Louis or Boston or somewhere else."

He sees that downstream demand as driving the ultimate growth of the local market. "We need to drive demand on the brewery side, the distillery side, the malthouse side, and then the production will follow. If that doesn't happen, I think you'll see more and more commodities grown all the time."

# RESOURCE LIST

A variety of resources exist for grain growers, processors, and users who wish to tap into the local grainshed. These organizations may have educational resources available or offer networking opportunities. Often the most valuable avenue to tapping into localization is to simply talk to those who have already joined the local grain supply chain to learn about their experience.

## COLORADO GRAIN CHAIN

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The Colorado Grain Chain is a nonprofit network of growers, processors, brewers, distillers, bakers, and chefs. The organization is focused on supporting and expanding the use of identity-preserved local grain, and offers a variety of educational opportunities through the year, including Grain School in the winter/spring and regular Grain Home School online webinars, as well as direct support for growers and grain users.

[LINK](#)

## THE GRAIN REVIVAL GUIDE

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The Grain Revival Guide, provided by Mad Agriculture, examines availability, demand, and other resources for potential grain buyers such as farmer profiles and a discussion of contracting with farmers. Key to this work is a catalog of trial wheats grown in 2021 by some of the featured farmers.

[LINK](#)

## CRAFT MALTSTERS GUILD

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The Craft Maltsters Guild is a non-profit trade group for maltsters and allied trade members. The guild offers a variety of educational opportunities, including the annual Craft Malt Conference and a number of webinars, and oversees the Certified Craft Malt Seal, a marketing tool used by brewers and distillers to identify their support of local maltsters.

[LINK](#)

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