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**Submitted Comment**

*Changing the California wheat supply chain to produce essential whole wheat end-products*

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## A. The conventional commodity wheat supply chain in California

### i. Commodity grain handling

There is a highly structured supply chain for conventional commodity wheat in California. In general, *conventional farmers* contract with *grain handlers* for seed supply and sale of their crop directly harvested from the field. The grain handler often manages the entire process including combine harvesting, trucking from the field, cleaning the grain, storage, and ultimately sale to a commodity *refined flour miller*. Amounts of wheat accepted by the grain handlers are usually truck-loads multiples of 50,000 pounds, from multiples of 20-acre fields producing say 2,500 pounds per acre. **The effect is that only large-scale growers of wheat are serviced in this supply chain.**

Just a few of these commodity wheat farmers use organic practices and have a market in the commodity supply chain or manage their own cleaning and storage for their own found market.

### ii. Wheat Marketing

The *California Wheat Commission* is the state organization for marketing wheat for export, and to California mills primarily. The check-off payment supporting CWC, that is made on commodity wheat sales happens conveniently when commodity grain handlers purchase wheat from the farmer. As a result, this is an organization supporting conventional commodity wheat farmers in California. However, the supply chain effectively limits the farmer's market for wheat, to sale to a grain-handler straight out of the field. In turn the grain handler sells clean wheat grain to commodity millers, or to export markets. CWC runs a wheat testing laboratory, to serve wheat breeders and growers, especially those in California.

Currently, sales are down for California white wheat exports, having met competition from other Western states and Australia for export to Pacific Rim countries. California grown hard red wheat is produced at greater expense than in the mid-west and Canada. California farmers have therefore backed off from growing hard red wheat in the commodity supply chain, since they are not able to recover their costs when selling directly from the field to grain handlers. Durum wheat exports to Italy are still active, and reflect the observation that California has ideal durum wheat conditions. Similarly white wheat grows well in California, but the current market for white wheat primarily for refined cake and cookie flour is generally smaller than for hard red wheat; it is not the preferred wheat for refined flour production.

In compensation for the reduced market for California grown commodity wheat, an increasing number of farmers now grow wheat only to green maturity. They harvest it for animal-feed as green-chop. In this case since no grain is produced, there is no corresponding check-off payment made to CWC, which in turn limits the scope of CWC work. The few organic commodity wheat farmers have an alternative market as suppliers of organic feed-wheat grain, which may or may not pass through a commodity grain handler.

Although significant amounts of wheat are grown in California (400,000 currently to 700,000 acres in earlier decades) it is not a major crop. The climate is also conducive to many other more profitable crops such as almonds and salad greens. California grown wheat is thus, not expected to serve all the wheat needs in this highly populated state.

*iii. Wheat breeding for commodity wheat supply chain*

Breeders of wheat for California aim to produce varieties that will be wanted by the refined flour millers and be disease resistant under conventional conditions with irrigation and chemical fertilization. *Improved* proprietary varieties become available every five years or so, and previously accepted varieties are usually no longer grown. These conventional varieties are generally short in stature to accommodate the dense planting, irrigation and fertilization that allows for very high yields in the conventional supply chain. In practice pleasing the refined flour miller is foremost and this means there is an emphasis on developing hard red varieties, even though California has a dry summer, which is favorable to white wheat and durum wheat. Hard red types are best suited to somewhat wet summers of the Plains states. All three types are conventionally grown in California currently.

The conventional wheat seed supply is generally patented (plant variety protected) for 20 years. As a result, and given the fast introduction of new varieties, the management of the commodity wheat seed supply is in the hands of the breeding companies and universities.

*iv. Commodity wheat flour*

The ultimately produced commodity flour is almost entirely refined and is stored by millers until sold in bulk or by the pallet of bagged flour to large scale end-users and distributors. It is estimated that just 6% of this commodity flour is reconstituted as whole grain flour. The refinement process involves initially wetting the grain. Thus, the process for reconstitution is complicated by the need to heat and dry the separated bran and germ to stabilize it against rapid oxidation, and to re-grind it to a small granulation. This reconstituted flour is shelf-stable but changed in flavor in comparison with a single step freshly stone ground whole wheat flour.

It should be noted that the highly efficient removal of bran and germ involved in the production of refined flour, means that there is a very large supply of bran and germ produced as a by-product of refined flour milling. Effectively 25% of the total wheat milled is removed as bran and germ. This wheat bran and germ is rich in nutrients and provides valuable feed for the meat industry; it encourages the use of feed-lot methods for cattle. There is therefore an interdependence between the commodity wheat millers and ranchers' feed lots.

*v. Food security and commodity flour production*

The commodity flour production supply chain was severely tested in the early days of the covid-19 lockdown. Flour for home baking was in high demand and shelves were completely emptied of such flour very quickly. Replenishment of the flour supply did not occur for several months. Fortunately, the alternative local small mill community (see below) was able to fill the need for many during this time.

*vi. Correcting wheat misinformation*

Misinformation plagues milling and baking, particularly regarding the nutritional value of refined flour. The reality is that the refinement process produces flour containing wheat endosperm, practically without any germ or bran present. However, the bran and germ hold the many essential nutrients that allow the proper assimilation of the endosperm (presented as refined flour). This lack of essential nutrients in flour consumed as basic food, was partially remedied by adding some of these known

essential nutrients back into the flour, in a process called *enrichment*. At first in the 1940s, enrichment was mandated because so many people were evidently sick from basing their diet on flour without even this enrichment. By the 1990s, the mandate was no longer in place; millers and bakers alike seemed to suddenly forget or ignore the original purpose for the enrichment. Refined flour without anything added has been sold since then as artisan flour, in very large amounts. This is coincidental with the many complaints of wheat intolerance and is the most likely cause of these complaints. The ailments are those likely to be seen for chronic B-vitamin deficiencies, as recognized in the years before refined flour enrichment was mandated. Much research since refined wheat flour was first introduced shows that we need to eat the whole grain (bran, germ and endosperm) in order to be healthy. In particular, with whole grain foods instead of refined grains at the base of the diet we can avoid obesity, constipation, diverticular disease, cardiovascular disease, diabetes, and colon cancer. Since whole grains can protect against obesity and cardiovascular disease, they also contribute to reduced severity of infection by covid-19.

## ***B. Organic non-commodity wheat in California today***

### *i. Organic wheat as a rotation crop suited for whole wheat end products*

Most non-commodity wheat in California is grown using organic practices, with wheat as a cash cover crop in rotations. Chosen wheat varieties are generally tall and non-proprietary; they include landrace selections and a few modern varieties dating from before the introduction of conventional agriculture in the 1950s. Generally, organic non-commodity wheat is produced on less than 20 acres and often only on 1-10 acres. The farmer takes on responsibility for all the steps from seed choice and maintenance and planting all the way to final sale as clean grain or whole wheat flour. Costs are high due to enhanced labor intensity at smaller scale, and products are sold at much higher prices than for the comparable commodity products.

The bran and germ of wheat are especially vulnerable to uptake of treatment chemicals during production. Ideally therefore, **organic wheat is the preferred grist for 100% whole wheat flour** so that pesticide contamination of bran and germ are avoided. Clean wheat grain or single pass milled dry grain as 100% whole wheat flour are the most usual end products sold by small scale organic wheat farmers in California. The milling method is stone milling primarily.

In a few cases, this stone milled flour is sifted free from a portion of the bran and germ and is sold as sifted flour. The very small amounts of separated bran and germ are used as organic feed for animals. Because the supply of wheat bran and germ is negligible as a milling by-product after whole grain flour production, there is less incentive to use feed-lot methods with cattle. Even so, as mentioned some organic wheat grain is being sold as animal feed to dairies. However, pasture feeding is the preferred method for organic farm animals. Organic soil builds in fertility from pasture-feeding animals in rotation with growing grains, legumes, and other crops such as brassicas and tomatoes.

### *ii. Contrasting organic and commodity wheat marketing*

The production of organic wheat independently of the commodity grain handling supply chain, means that CWC does not receive check-off funds when small scale organic

wheat is sold separately rather than through the commodity grain-handlers. Nevertheless, in recent years CWC has taken an interest in the increasing organic wheat production in California and aims to be of assistance. There is recognition that the organic supply chain is sustainable, builds soil and can help mitigate climate change, and generally aims for whole grain end use. These attributes offer an alternative and sustainable way forward for commodity wheat growers. Given the recommendation to eat at least half our grain foods in the whole grain form, it is glaringly obvious that we do not have the required amount of whole wheat flour available. Thus, there is truly an alternative opportunity here for California commodity wheat growers. However, as described below **the infrastructure for organic wheat growers and simple whole wheat flour production barely exists**. As a result, organic wheat farmers are dissuaded from expanding their efforts by this lack of infrastructure. Also, unfortunately, business-minded commodity farmers are unlikely to change their current pattern of production until an alternative organic commodity supply chain with whole grain end products is in place.

*iii. Marketing whole grain foods*

Ideally the words *whole grain* used to describe a food, would mean that all the grain ingredients were whole grain. It would also be easier for both consumers and producers if there was a concerted effort to supply enough truly whole grain foods for the population.

Instead, we have the words *whole grain* used even when almost 50% of the grain ingredients are refined, and we certainly do not have enough whole grain foods for us all to base our diets on whole grains if we so desired.

We lack strong championing of whole grain foods, which needs to come from producers, educators, and health professionals alike.

*iv. Current whole wheat flour production in California*

California was served by just two medium large, whole grain stone milling operations in the San Francisco Bay area until recently. *Giusto's Specialty Foods* has halted production presumably instead of updating their equipment. The other: *Bay State Milling* chose spice milling over whole wheat flour production. *Moore's Mill* in Redding, California is effectively the only sizeable whole grain mill left in California. *Grist & Toll* in Los Angeles is a small whole wheat flour mill with one stone mill serving mostly home bakers. *Capay Mills* has endeavored to mill local flour using a stone mill; but not all of their flour produced is whole grain; it is also small scale.

Not to be overlooked, is the growing trend for home milling whole grain flour, for home baking, using small very effective and inexpensive electric mills.

Otherwise, at least two dozen enterprising whole grain bakers in California, have installed stone mills in their bakeries. Generally, these bakers do not expect to mill all their own flour, but enough to add to breads to provide flavor and interest. There are a few exceptional miller bakers who mill all their own whole wheat flour and use it to produce 100% whole grain bread. The ultimate market for most of these local organic wheat products, is through a local farmers market stand, local grocery stores and some restaurants.

*v. Food security improved with localized flour production*

From this it can be seen that there is significant localized grass-roots effort to supply whole wheat flour. In fact, during the early stages of lockdown against covid – 19, these were the enterprises who supplied flour to home bakers continuously. This was very important given that grocery store shelves were early depleted of commodity flour and the supply from commodity millers was not regenerated for several months.

*vi. Fragility of localized organic whole wheat infrastructure*

Even so, the infrastructure for non-commodity organic wheat production in California, as elsewhere is fragile and barely exists. Until the introduction of refined flour milling in 1880, localized grain processing including milling was the norm. In the 140 years since 1880, the supply chain has evolved to the centralized commodity supply chain described above. This has led to the almost complete disappearance of localized smaller scale grain handling and practically the complete demise of large scale stone milling.

For the farmer of organic wheat, a planter and tractor are usually part of the farm equipment. However, individual small farmers cannot afford to buy the equipment for harvesting and cleaning wheat grain to the meticulous point required for milling. Local whole grain mills are in any case non-existent. Most of these farmers are still in experimental mode with wheat production and settle for cheap old equipment. Such equipment is often hard to clean out and in need of constant repair and patching. Very little sharing occurs. Distances to the few processing facilities that do offer smaller scale services are often prohibitive, because of the transportation costs that would be added to the final product. In any case the clean out costs between batches are the same for large and small batches, so making small batch servicing excessively expensive. On-farm small scale grain storage is often not well thought through and often very insecure from rodent and insect pests, even in the short term. Seed stocks are easily lost and whole crops are often lost.

Personally, I have had some help from the University of California Cooperative Extension to harvest one or two approximately one-acre plots. UCCE and the California wheat specialist Lee Jackson (now retired) have also allowed me to use their seed processing equipment and given assistance in planting and evaluating replicate test plots. Such help was given only on a one-time basis and could not be used as a routine for harvesting and cleaning local wheat. However, it suggests that the UCCE could potentially be a provider of very small-scale harvesting and grain cleaning services for local small scale wheat growers.

*vii. Mendocino Grain Project: a model for local organic grain and whole grain flour production*

An exemplary exception to this lack of supporting infrastructure, is *the Mendocino Grain Project*. This has been a project envisioned by a group of farmers in Mendocino and Lake counties, but actually enacted by just one: Doug Mosel, around 2012. By now he has retired, and the enterprise has been taken on by Rachel Britten. *Mendocino Grain Project* is a small scale grain cleaning facility, with a small stone mill so that wheat and other grains can be cleaned and milled into whole wheat flour as needed by local small scale farmers to market for themselves. Services also include custom combine harvesting using one of two harvesters according to the acres to be harvested. Farmers generally store their own grain after cleaning and market it themselves. *Mendocino Grain Project* also grows small amounts of grain for sale, and supplements income with hay-making in season. Local

bakers and households appreciate the availability of locally grown and stone milled whole wheat flour. Local economic development groups are supportive.

*viii. Seed supply for organic wheat*

The best wheat varieties for organic agriculture are the taller varieties, that were well established in the Old World as landraces, and in wide use before the advent of refined flour milling in 1880. Accessing appropriate landrace selections from the *USDA Small Grains Collection* and propagating them to farmer amounts by the non-profit *Whole Grain Connection* and others has been the seed source for most of the small scale organic wheat production in California.

By now it is evident that only a few farmers have the capacity to keep their seed supply healthy and pure from one year to the next. Therefore, *California Crop Improvement Association* has been of assistance by developing a quality assurance program for heritage (any non-proprietary) wheat seed. However, implementation and useful further development of the program are hampered by the overall lack of infrastructure for organic wheat production at every level.

*ix. Conclusion*

An organic supply chain for wheat aiming for whole grain end use, is suited to the full range of farming sizes. We need an infrastructure to match this realization. The envisioned advantages will be a soil building agricultural method that saves water, and mitigates climate change, while supplying the population with much needed basic whole grain foods. In connection with this we cannot ignore the fact that the recent covid pandemic most severely afflicts those who are obese. Protection against obesity is found when grain foods at the base of the diet are eaten in the whole grain form.

## ***C. Supply chain for organic wheat, stored as clean grain and presented as fresh whole wheat flour***

*i. An alternative wheat supply chain is necessary*

The current conventional commodity wheat supply chain is designed for refined wheat flour as a centrally stored bulk end-product and provides reconstituted whole wheat flour inefficiently and in limited amounts that are far short of the amounts needed for good health in the population.

Given that whole wheat flour is best when freshly produced by direct milling, we need to provide an alternative supply chain appropriately designed for this end-product.

Since the bran and germ of grains easily absorbs treatment chemicals, organically produced wheat should be chosen for whole grain end-products. Clean wheat grain can be stored for many years, whereas whole wheat flour is best used fresh. Thus, clean grain is the best form in which to store wheat in bulk for basic food security. In addition, since it is to be used locally for fresh milling, clean grain needs to be safely stored in bulk locally.

All wheat types can be directly milled to whole wheat flour. Therefore, in this alternative supply chain wheat breeding and selection would aim for pleasing whole grain flavor and end-use attributes as well as suitability for organic farming in a local region.

Small scale wheat growing is vital as rotation with crops such as strawberries and vegetables, and for exploring the potential for wheat farming. At this small scale of less than 10 acres, farmers are generally unable to afford to own all their own equipment. Most wheat farmers grow 20 acres or more. Even so, some grain handlers are currently unable to efficiently cope with this lower level of production and rarely offer organic conditions.

*ii. Wheat supply chain stages*

Essential stages in the wheat supply chain:

Stage	Commercial	At-cost service or on-farm activity
1	Seed sourcing	
2		Planting
3		Harvesting
4		Cleaning
5		Storage for clean grain, cool/ cold/ dry
6		Milling to whole grain flour
7	Marketing	
8	Distribution	

1. Seed sourcing would be commercial, and with *California Crop Improvement Association* oversight.

Very few modern wheat varieties have been bred for organic farming. Instead, non-proprietary selections from Old World landrace wheat varieties, or varieties that predate 1950 are currently used for most organic wheat farming.

2 - 4. Planting, harvesting, and cleaning would be managed as **at cost** services for farmers who do not provide their own equipment or facilities. These services would need to be in localized hubs and serve all levels of wheat production. A hub might consist of several independent enterprises in cooperation to serve the local grain service needs.

For small scale wheat growers (up to 10 acres), the University of California Cooperative Extension supply chain could ideally be expanded to provide planting, harvesting, and cleaning needs.

At an intermediate scale between 10 and 50 acres, the largest grain handlers could be encouraged to acquire equipment to service grain in these intermediate size batches.

Small and intermediate scale wheat growers could be encouraged with a subsidy to cover clean out costs between batches.

5. Grain storage would be managed by the farmer. Only clean grain would be stored under (dry) refrigeration – possibly solar electric powered.

Grants to build small scale solar-electric cool storage for clean grain, would be an encouragement.

6. Milling to whole grain flour

The process of milling grain directly to whole grain flour involves much simpler equipment than is needed for flour refinement. A wide range of electric motor-powered, whole grain mills are available. The classic stone mill can be used, at all levels of

production and there are some small-scale impact mills available for finer flour production. In addition, modern air swept impact mills produce a desirable fine whole grain flour on a large scale.

Since direct whole grain flour milling capacity is so sparse in California, farmers could be encouraged to produce their own whole wheat flour with grants for whole grain mill purchases.

7-8. Marketing and distribution of clean grain and whole wheat flour would be commercial, either directly by the farmer or through a chosen marketer.

*iii. Advantages for this alternative supply chain*

- The wheat farmer gains increased control of their wheat crop and can add value.
- Direct line for marketing between farmer and end user
- Transportation costs would be minimized by localizing grain services.
- Grain services could be stabilized at cost with a limited margin and specified labor charges.
- Increased diversity of wheat types is available for end use as fresh directly milled whole wheat flour
- Current grain handlers can opt to perform grain services for organic wheat farmers of all sizes.
- Provides option for all farmers to grow wheat as a soil building rotation crop.
- Marketing check-off is possible at all levels of wheat production, based on weight of clean grain obtained for each farmer at grain service hub or reported after using on-farm equipment.

*iv. Implementing local grain service hubs*

Recognize all current commodity grain handlers, other seed and feed handlers, current organic wheat service enterprises and millers in California. Invite them to enter the organic whole wheat flour supply chain by joining a local grain service hub. Grain service hubs can involve several cooperating enterprises such as a miller with a separate enterprise to the grain cleaning and harvesting service. For this they may need to make expensive up-grades to their facilities. Subsidies and grants will be necessary to bring about the needed changes as follows.

- Purchase direct whole grain milling equipment
- Obtain organic certification
- Purchase larger and / or smaller cleaning equipment
- Purchase planting and harvesting equipment large and small scale
- Hire equipment operators and managers
- Update bagging and pallet moving equipment
- Conform to at cost service pricing and check-off guidelines.
- Be provided with a subsidy for clean out costs between smallest batches. Currently the cost for cleanout can easily be more than the actual grain cleaning of a small batch.

*v. Involve CDFR, CCIA, CCOF and UCCE*

*vi. Requirement for purchasing wheat grain and whole wheat flour in California*

Ask end-users to purchase organic wheat grain and organic whole wheat flour directly from California farmers (or through a local farmers marketing group) preferentially. When supply is insufficient, to then source clean organic grain from out of state for presentation to miller for milling to whole wheat flour.

*vii. Map organic whole wheat flour service hubs*

CDFA or UCCE could be responsible for mapping the location of organic grain service hubs in California and recognizing regions that are underserved.

*viii. Install grain service hubs in underserved regions.*

*ix. Form a California Whole Grain Marketing Organization*

Formation of a California whole grain marketing group would be primarily for wheat. The need is great for an educational and promotional organization for all organic whole grain foods. Check-off could be from all whole grain end products, not just wheat.

## ***D. Increasing whole grain mill capacity in California***

*i. Inadequate whole wheat flour milling capacity in California*

The paucity of whole grain milling in California (as elsewhere) is the main force preventing farmers from conversion to growing wheat in a regenerative organic supply chain. Thus, increasing the capacity for fresh directly milled whole wheat flour would be the single most important driver for a change to growing wheat organically for whole grain end-use.

Grants, subsidies, and tax incentives for purchasing whole grain milling equipment could be used to encourage whole grain milling enterprise at all levels from the home, or farm kitchen to bakeries and restaurants and large-scale milling operations. However, the best incentive would be access to a market for whole wheat flour.

*ii. Educating bakers & consumers about 100% whole wheat end-products*

A concerted educational and promotional effort is needed, so that bakers provide enough 100% whole wheat products (without any other refined carbohydrate ingredient). Simultaneously consumers need education and encouragement to choose 100% whole wheat basic food products

*iii. USDA Food Assistance purchase of 100% whole wheat products*

USDA food assistance programs could include the procurement of clean wheat grain, especially if food service bakeries have their own mills and are producing 100% whole wheat breads and other basic whole grain foods.

The entire wheat and other grain supply chains need to be filled out with whole grain infrastructure. It will be impossible for everyone to have the choice to eat truly whole wheat and whole grain end products as the basis to their diet, until the infrastructure is re-designed so that whole wheat flour is the majority end-product instead of refined flour.