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Case Study: Double J Dairy

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Double J Dairy and History of the Company

On a dairy located just east of Highway 99, owner Jay teVelde Jr spends much of his time contemplating the future of his business, the dairy industry, and even agriculture as a whole in the Central Valley. While water restrictions choke crops, both labor law and environmental policy reforms are causing costs to rise at an alarming rate. These combined with low milk prices make the future of dairy uncertain to say the least. With these issues in mind, teVelde wonders which is the right direction to take his business.

The family finds its dairy roots all the way back to George teVelde, the owner's grandfather. George immigrated to the Unites States from the Netherlands in 1920. After arriving in California, George found a job as a milker in southern California. Over time George saved up enough to buy some cows of his own. He was fortunate to have the support of his boss, who helped him get started. George spent much of his working life adding to his business. Eventually George's sons discovered their own passion for the dairy industry. One of his sons, Jay teVelde, branched off and started his own dairy. Jay, like his father, spent most of working life expanding his business. Also like his father George, Jay's children discovered a passion for the dairy industry.

Jay teVelde Jr grew up working for his father and, after graduating from Cal Poly with an agribusiness degree, launched himself into the industry. In 1989 he and his father built an open lot dairy in Visalia, California. After some thought they settled on the name Double J Dairy. Over time, Jay teVelde Jr., along with his wife Darlene, bought his father's ownership and came to completely own the dairy. In 1997, they decided to renovate the dairy and build freestalls in the place of open lots. As time passed, Jay stayed up with emerging technology and research

findings. He added cow cooling systems, a manure separator, and an enlarged feed/commodity area as a result of his efforts to stay ahead of changing times.

Double J Dairy milks approximately 4,300 Holstein cows. The facilities that compose the dairy include two full freestall barns, two half stall barns, open lot corrals, 800 calf hutches, a maternity barn, a hospital barn, a milk barn, and a commodity area. The freestall barns are composed of four 400 cow or 360 cow pens, depending on the barn. The milk barn has two milking pits, the milk tank room, a break room and a machinery room. Each pit is a double 32 herringbone (Exhibit 1). This means that each pit has 64 milking machines and that the cows are settled in at a diagonal position. The milk tank room holds the front quarter of each tank with the valves for loading into the milk trucks. The machine room contains chillers for temperature control in the tanks, a generator, an automated cleaning system and computerized monitors for the equipment for the milking machines in the pits. All the piping and milk storage is food grade stainless steel. The dairy runs 24 hours a day, seven days a week. The milking shifts are 10 hour shifts.

A typical day runs nearly as follows: The feeders show up and begin mixing the feed rations around 4:30 am. This is done first in order to get the cows into the stations so that the necessary pens of cows can be locked. Some of the reasons that the pens would need to be locked is for the application of medication, breeding, and veterinary checks. For the next eight or so hours, pens are worked to finish whatever work needs to be done that day. After the work is done in the pens, the outside employees move to other odd jobs that need to be tackled such as bedding maintenance, repairs to pens, and cow transfers from pen to pen. Milking continues until all the milking pens are milked and usually finishes up around 4:00 pm and is followed up by a cleaning of the milk barn. Another feeding is done in the afternoon. However, the cows are not

locked up in the afternoon as the work that needed to be accomplished was done in the morning. Part of the thought behind doing the majority of the work in the morning is to avoid the high temperatures that occur during the summer. The second milking shift begins at 6:00 pm, twelve hours after the first shift.

Pens are organized by which stage of lactation a cow is in. A cow's lactation cycle is broken into five parts. These are open/breeding, pregnant, dry, close up, and fresh. An open/breeding cow is a cow that is not pregnant and is being bred. A pregnant cow is a cow that has been confirmed pregnant by a veterinarian and is less than 220 days carried calf (DCC). A dry cow is a pregnant cow that is greater than 220 DCC and less than 260 DCC. A cow is moved to close up when she is greater than 260 DCC, which is drawing very near to her calving date. A cow is considered fresh in the days following her calving. Open/breeding cows and pregnant cows are milked while dry cows and close ups are not. Fresh cows are milked but their milk (also known as colostrum) is fed to the calves due to the raised antibody counts to help jumpstart a calf's immune system. By organizing the cows by stage of lactation, it becomes much simpler to administer what is needed to the cows due to the fact that many treatments are dependent on stage of lactation.

To cover all the necessary work during the day, teVelde employs 35 men. A sizable portion of these are involved in the milking parlor. Others are focused on feeding, breeding, cow movements, hospital work, or calf raising. Especially for employees outside of the milk barn, many of them have been working at Double J Dairy for more than a decade. Nearly all of these employees are Hispanic and are incredibly hard working.

Operations on Double J Dairy are both widespread and fairly complex. There are dozens of different jobs and processes that go on every single day. Each of these jobs and processes

fluctuates constantly in response to changes in the market, costs, laws, and technology. With all of this occurring at even more rapid pace than usual in the last several years, Jay teVelde Jr. looks to stay ahead of the game by running an efficient business and being a top producer. “It is important to get all the fruit on the lower branches of the tree, but technological advances and streamlined processes allow for [Double J Dairy] to reach for the fruit on the highest branches.”

The Dairy Industry

The dairy industry within the United States has been subject to a variety of factors that have undergone dramatic swings over the past several decades. These factors include feed prices, milk prices, milk production, the number of dairy operations, the location of these operations, technology, and the laws and regulations surrounding the dairy industry. Many of these factors are beyond the control of dairy owners, which partially explains the massive swings that have been observed. From 2014 to 2016, milk price has varied from $11.93 to $22.45 for overbase price per hundredweight (100 lbs. of raw milk) (Exhibit 2). For the last year, the dairy industry has seen the price reside around $14 for over base, besides the month of August. Fortunately, feed prices have also been fairly low during this time of low milk prices. This has allowed for dairy producers to minimize the losses that they have suffered due to the poor milk price, assuming that they run an efficient operation. However, this was not the case in the late 2000s for California dairy producers. In addition to the milk price dropping 30% in 2009, feed prices were incredibly high causing massive losses for producers.

Partially in response to these price factors, the number and size of dairy operations has seen changes over the years. In 2001, operations with less than 500 animals summed to 95,000 whereas in 2009 there were 61,500, showing a decrease of over 30%. In contrast, operations with more than 500 animals showed an increase of 17% going from 2,800 to 3,350 total operations.

Large operations, those with more than 2000 animals, also saw an increase. In 2001 there were 325 large operations, which grew over 100% to a total of 740 operations (NASS). Overall, there has been an increase in the overall number of medium and large scale operations. While every situation is different, one can see a trend where those with more capital were able to survive the hard drops in the milk price whereas those with less capital, the small operations, sold out. As these small operations sold out, cattle prices dropped which allowed the larger operations to buy up cattle and also expand if they had the capital to do so.

Along with these changes in the numbers of operations, the general locations of operations changed during the late 2000s. There was a definite move towards the western United States from the eastern states with California seeing the largest increases. Also Wisconsin and other Midwest states saw some growth (NASS). This is changing again however as the situation in California changes with the draught and new laws. Dairy owners from the Central Valley are selling out and some of these are moving to other states such as Colorado, Idaho, and the Midwest. There are several major factors that are causing this exodus. The first is the drought and new regulations that coming into effect due to the continuing drought. As water regulations call for tighter control over the amount of water used by agriculture, producers find themselves without the resources to grow a double crop throughout the year. This has incredible ramifications for dairy farmers.

In order to be in compliance with the laws regarding manure, a dairy producer must manage the large amount produced by the cows. Many do this by spreading it as fertilizer on the fields on which they grow their feed. However the laws pertaining to manure management stipulate that there must be a net zero retention of nutrients to the soil. This means that you cannot put more manure on the field than the crops can absorb. Through mathematics and soil

science, it is calculated out how many acres of land is necessary for x number of cows. Based on this number, dairy producers purchased x amount of land so that they could have their desired number of cows. However this is now a massive problem. When dairy producers bought the land, they did so with the thought that they would be able to double crop which allows them to apply more manure than if they single crop. If they now lack the water to double crop, they will find themselves out of legal compliance for their nutrient/manure management (teVelde).

The second major factor is the changing labor laws in California. The first law is the new minimum wage laws. In several years' time, $15 dollars will the statewide minimum. While this does raise labor costs for dairy producers, especially those of large size, it in itself is not the problem. The problem in regards to the new labor laws is when the new minimum wage is paired with 40 hour work weeks. While other industries have long held that time worked over the 40^{th} is overtime, agriculture as a whole has been exempt due to the seasonality in production. This exemption has shaped how dairy producers organize their work shifts and the number of employees needed on the operation. Depending on the number of cows and the milking schedule, a dairy runs usually at least 18 to 20 hours a day. Milking shifts are generally either 8 or 10/11 hour shifts, varying due to whether the cows are milked twice or three times a day. For those that milk twice a day, work hours that were costing them 12 to 13 dollars will now cost them 15 at least in addition to $22.50 for overtime pay (AB 2757). Outside of the milking parlor, many jobs on a large size dairy are set up for 10 plus hours. This overtime will raise costs tremendously for these dairies. While some are leaving in response to the labor changes, others are looking towards technology to help cut down the number of employees that it takes to get the job done.

Technology

Dairy technology is an ever widening horizon for dairymen across America. Recent developments in dairy tech have bolstered higher ability for production within the last 25 years. These advancements include: systems for computerized milking and technology-based feeding. These have allowed for greater milk production capacity. In 1993, the FDA approved the use of U.S. dairy cows to go into production with recombinant bovine somatotropin (rBST), bovine growth hormone. At the time, this hormone was used in about 20% of U.S. dairy cattle and increases their production between 10 and 20 percent (Hoovers). But, in the last 5 years or so, since the organic food push, producers are being pressured into not using rBST due to public fears of possible health problems. However, this hormone is naturally produced in dairy cattle and does not affect human health. Instead it passes right through the digestive tract (Jay teVelde Jr.).

Dairy science technology is changing management practices statewide and across the nation. The equivalent to this sort of turn over, would be cell phones phasing out home and land line telephones. Precision Dairy Farming is now coming to the fold of innovation (Hoards). Precision Dairy Farming usually refers to software and electronics that monitor and report information on the production, biological, and behavioral conditions of the animals (Agweb). Its mission is to streamline dairy herd management processes. The name of the game for herd managers is efficiency and long term savings. If the technology does not help the bottom line, it is not worth the investment. Some production processes that are real winners for dairymen include automatic calf feeders and milking systems. A few of these technologies include rumination monitors, component and dairy milk yield testing, pedometers, precision feeding, and daily body weight measurements. In 2013, at the Precision Dairy Conference in Rochester, Minn; Jeff Bewley, of the University of Kentucky, urged in his opening address that “new

technologies should improve the well-being for both cows and people." Jeff continued on in his welcoming statement with the point that for precision dairy technology to be of value to farmers, they need to collect meaningful data, be robust and flexible to withstand a farming environment, and cost-effective. It is important for players in industry to find the right balance between having increased technology and keeping folks around that have good "cow sense". Dairymen need smart employees that know cows well. The key going forward is to have automation (robots) assisting when people cannot be there to observe operations. Even though people are working at dairies 27/7, managers and employees have limited ability to look after their herds. Dairy tech is helping them to make better decisions, increased profitability, and more efficient use of time (Hoards).

Bewley explained that on site technologies will be invaluable to those employees with good cow sense. However, precision dairy farming is still in its infancy. A survey was given out in 2008 to farmers across Kentucky asking if they were cautious to bringing in new dairy technology to their operations. Their main hesitancies included: "...unfamiliarity with the options available, undesirable cost to benefit ratio, unsure how to incorporate on their farm, not enough time to spend using the technology and perceived lack of economic value"(Hoards).

Other upcoming technology in the dairy industry includes: automated calf feeders, milk yield recording systems, automated milking systems, activity monitors, and tablet & mobile applications. Automated calf feeders will alter nutritional daily values according to the individual age of the animal. Farmers get a live feed of minute by minute nutritional updates on each calf. This computer technology is optimizing calf health, while accelerating calf growth; allowing farmers to look into the other needs of their livestock (Agweb).

Milk yield recording systems pull up animal data on every cow. This includes the milk components, trends in production, and the amount of milk from every cow at every single milking. This recording system helps to show farmers trends in production that tell them how the health of their cattle relate to milk output. In addition, having this information is very valuable for culling. The advantage being to predict problems in cows that would otherwise be undetectable (Agweb).

Automated milking systems cut down on manpower and labor costs. This is basically a common goal across the industry. There are several different types. One is the rotary. A rotary is a carousel style milking platform. Most are built to hold around 80 cows at a time (Exhibit 3). For fully automated rotaries, which are very new to the industry, a cow walks into the stall and is prepped and then milked completely by robots. For base style rotary, cows are prepped and the milking machines are attached by employees. There are variations between these two with differing levels of automation (Milking Solutions). The second type of automated milking is a box style unit (Exhibit 2). These are put straight into the pens or freestall barns, rather than in a centralized milk barn. The cows determine when they wish to be milked and are welcome to move about the barn. Computerized equipment finds out who the cow it is working with, disinfects the utter, and carefully milks the cow, and lets her free when she is done being milked (Agweb).

Activity monitors like rumination collars, discover abnormal biological activity changes in the cows, which can be early warnings for farmers of possible diseases or infections in their cattle. Pedometers help tell farmers when cows are hot (going into heat) or going into labor. Mobile and computer apps are arguably one of the most important dairy technology pieces

coming into play. They are providing up to the minute information on their operations, on the go (Agweb).

At Double J Dairy, cow records are computerized through the program Dairy Comp. EID (Electronic Identification) tags and scions (hand-held computers) that synchronized to all computer records. When the EID tag is scanned with the scion it pulls up the cow's history. Having this information on hand is very helpful when making decisions when in the pens themselves. AI breeding, manure separators, cow cooling, which include fans and soakers, are other streamlined technologies that are widespread across his cattle operation (Jay teVelde Jr.).

Feed Management

Feed management for dairy cattle is all about sustainability and efficiency. Jay teVelde Jr. owns and utilizes 4,500 acres of the crop land around his dairy's for growing cattle feed crops: wheat, corn, and alfalfa. Time is of the essence in growing these commodities. Wheat takes 100 days from plant to harvest, corn is 110, and alfalfa is cut about every 35 days after reaching its initial cutting which takes about 60 days. Alfalfa has the benefit of growing back, like grass, after it's initial planting. California Lawmakers are fearful of fertilizer (in this case dairy cow manure) leaching into the water table. For this reason, all fertilizers put into the fields, must all be taken up by the plants themselves, that way all nutrient inputs and outputs come out as net zero.

What is grown on the farm is highly dependent on what the market is offering for prices on crops. If market prices are too high for Jay to purchase he will grow the higher priced feeds himself. At the moment, his company is long (excess) on wheat and corn, so in response they are growing more alfalfa right now and have planted a few more fields to alfalfa this year.

Feed rations are complex. Dairy cattle require specific nutritional components that change as they move through lactation. As such, a feed ration is made up of more than just silage, hay, and corn. It takes many different ingredients to compose a full diet. An example of a feed ration can be seen in exhibit 4. One advantage that the state of California has over most other states is the availability of byproducts as a source of feed. Due to the large amount of processing and the vast variety of agricultural products, there are many excess byproducts. Some of these can be used as feed for dairy cattle. Some examples include cotton seed, almond hulls, distiller's grains, citrus leftovers, tomatoes, and even gourds.

Waste Management

Proper waste management is essential for keeping your dairy running smoothly and it provides an opportunity to bolster your bottom line. Cows are very efficient animals in that they use almost all the energy they receive from their feed. The Double J Dairy attempts to keep a closed circle of waste management by using the waste produced to help fuel other parts of the dairy. Waste is washed through the dairy into lagoons, manure is transferred from pool to pool and drains onto corn and wheat fields as fertilizer for the dairy's feed crops (teVelde). Environmentalists worry that these lagoons are a source of groundwater contamination, but that could not be further from the truth. At Double J Dairy both of the lagoons have clay pans at the bottom that helps prevent any nutrients from penetrating the groundwater. The real groundwater contamination on dairy farms comes from the silage piles that are on the property, they are ensiled, similar to fermented, feeds that sits above ground waiting to be fed to the cattle. Unfortunately, there are bigger problems looming on the horizon for everyone in the livestock business (teVelde).

In September, Gov. Jerry Brown signed legislation that for the first time regulates heat-trapping gases from livestock operations and landfills. The new law mandates farmers to reduce their farms emissions to 40% of their 2013 levels by 2030 (Chea). This effort to reduce methane emissions is the last thing farmers need when there are so many other factors to worry about when running a livestock operation. Over the next two decades the dairy industry will see an unprecedented amount of remodels to dairy operations in order to comply with the new legislature. Many dairies will turn to manure digesters to solve their methane problem but that technology costs nearly two million dollars for just a small operation. These digesters help farmers dispose of their livestock's waste in an environmentally responsible way and provides an opportunity to gain new revenues from old resources. The digestion process starts with the separation of the solid and liquid parts from the manure leaving the farmer with two different bi-products they can use. The solids can be used as a sanitary bedding for the cows or it can be used as a peat moss replacement. On the other hand, the remaining liquid now meets high environmental standards and can be reused on the farm in any number of ways, creating a virtually waste-free, closed loop system. Once the sorting is completed the manure methane is piped into the digesters where it is heated to remove pathogens and converted into a clean biogas. The leftover biogas can be used to power your farm and excess gas can be sold for a profit. Gas can also be sold to biofuel producers where they scrub the gas and convert it to a clean energy that can power almost anything. Lastly, the nutrient recovery system extracts nitrogen and phosphorous that can be used or sold as fossil free pH bio fertilizers (Regenis). The US EPA AgSTAR Program estimates that the cost for a manure digester is approximately $550 per cow which means lucrative remodeling costs for farmers with large scale operations. It's not

all bad news for those trying to convert though, the USDA offers grants and financing options for the effort to switch.

Wages and Labor

Wages are one of the biggest pinches for Mr. teVelde and his dairy operations. One of his largest expenses as a business are wages to employees. His business philosophy surrounding wages is to pay his people a good wage and expect a lot from them. He believes that if you pay your people poorly and do not take care of them, your business will suffer and employees will not work as effectively and perhaps even steal from the business. In essence, paying good wages will aid in delivering top results for the business. However, the increase in minimum wage would greatly tax him and his business, the same is true across dairy farms around the state. With the new law, AB 2757, in place, potential unemployment could take place for Jay's dairy. However, one alternative to this issue what that instead of working 10 hour days, he could have his people worker harder and faster in 8 hour shifts, to cut back on hours and still accomplish daily tasks. Without the largely hispanic workforce, the dairy industry would have a very difficult time finding employees and would very possibly shrink to a fraction of its current size.

H2A workers can only be in the United States to work for 10 months. The biggest problem is not having people year round. And because dairies are a 24 hours a day, 7 days a week business. That is the demand and need of the industry. Hopefully, with new administration in place in the Presidency, Senate, and House of Representatives; new legislation can be put in place to permit foreign workers to come to America to uphold and bolster dairy farms not only in California, but across the nation. Since Donald Trump is in the hotel business, which employs many immigrants itself, and there is a Republican controlled House and Senate, this will hopefully give way. There is a possibility to get around the overtime pay increase to agricultural

workers. A possible way to not have to pay overtime is require employees to work a little harder and get the work done by the time 8 hours is up. Another consideration is to move to three shorter work shifts (teVelde).

Water

Water has been the big issue of California agriculture for the last several years. Due to the drought and the reduced surface water availability, farmers, through the feed they sell, and dairymen face some serious problems. The first is the reduced feed availability. Without the water necessary to grow full crops, farmers have lesser yields. This leads to higher feed prices and lower quality feed. Corn in particular has jumped in price. Mr. teVelde expanded on this point. He explained that corn, which is a key component of dairy cattle diets, saw a massive increase in demand due to the use of ethanol as a fuel. Ethanol plants used 5 billion bushels of corn, which is 40% of the United State's corn production (Conca). When it became mandated that ethanol be used as fuel, competition for the corn supply skyrocketed causing the price to rise drastically.

There is another facet within the water issue that is contributing to the rising feed costs. Because of the low value of row crops like wheat, corn, and alfalfa, farmers are moving away from these crops. They are instead putting their water towards nut trees, which have had a very strong market for the past several years. Mr. teVelde believes in the coming years that cheap dairy feed is going to disappear completely unless more water is diverted to the Central Valley. Fortunately, Mr. teVelde is able to grow much of his feed himself rather than depend on the market. This may not last however.

Prior to the newly passed water regulations, the mentality was "whoever has the deepest straw will get the last drink" by many in the Central Valley according to teVelde. New water

regulations stipulate that groundwater usage must be a net zero drain at minimum. This means that farmers are going to be unable to draw more water than is being replenished into the water table. There is not much recharge to the water table through rainfall through the last several years as exhibit 6 shows. Because of this, many will have to rely on surface water. There are issues with this.

The first issue is the environmental protection laws that were passed in 1992. These laws were passed in order to protect the Delta Smelt, a small fish that lives in the Sacramento Delta. Prior to these laws, water was being pumped from the Delta through the all the canals that were built as a part of the Central Valley Project. It was claimed that the pumps were causing the decline in the smelt population. The laws prevented the pumps from being run and as a result, the water that was running through the canals no longer does. This has not stopped the decline of the smelt population. A striper that also lives within the Delta is a natural predator to the smelt and is killing the smelt off. The laws have proven ineffective at protecting the smelt. Yet they have not been overturned.

This situation is somewhat frustrating to Mr. teVelde. There are millions of people in the world that underfed due to lack of food. Jay teVelde Jr. put it this way, “To let the surface water run into the ocean instead of sending it to farmers is like having four hungry children, a pantry full of food, but not letting them have it so that the mice (smelt) can be comfortable and full.” He thinks that it seems that lawmakers have prioritized a fish that is dying off regardless of the efforts to save it, over a massive number of people that do not have enough food. “The Central Valley is a farmland unlike any other. Due to the amount of heat units per day and the fertile soil, farmers can grow more and a greater variety of crops than anywhere in the world.” As time moves forward, teVelde must decide what the best use of his available water is.

Co-operative Issues

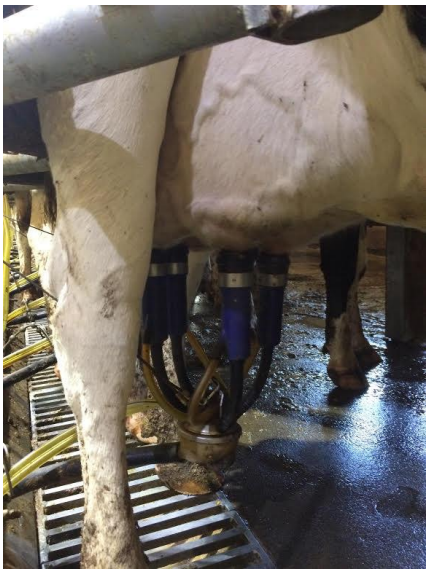
A cooperative business structure is an association of people that come together in order to meet common needs. In the case of a dairy cooperative, dairy farmers get together to form an entity to help market their milk. Double J Dairy is a member of CDI, which stands for California Dairies, Incorporated. Although this cooperative only markets milk in the state of California, it is the third largest dairy cooperative in the U.S. in terms of revenues, with close to $5B in 2014. There are two larger cooperatives that market milk nationwide, The largest dairy cooperative in the United States is Dairy Farmers of America (DFA) with 2014 revenues of $17.8 Billion, and Land O'Lakes, Inc is the 2nd largest, bringing in over $15 Billion in the same year. These cooperatives not only gather to market their milk to dairy processors (over 50 in California), but they often run their own dairy processing facilities. For example, Land O'Lakes has a big share of the retail butter industry, and competes heavily with CDI's Challenge butter brand in California. In the dairy industry, prices change every day. According to Jay Jr., "if milk prices increase by just a few cents, it creates huge income for producers. For example, if the price of milk were to increase by 10 cents, that could equate to $350 per day increase in profits. Over a year that could mean over one hundred thousand dollars in added revenue. Pennies matter in the dairy business." Although cooperatives are not without their problems. At times they create conflict between producers whose visions of what the future of the co-op should be do not match up. In addition, it creates competition between producers belonging to different co-ops. Overall there are many marketing advantages to co-ops but it can lead to some squabbling (teVelde).

Conclusion

The dairy industry and the issues surrounding it are both numerous and complex. Producers everywhere are finding it ever more challenging to turn a profit, especially in

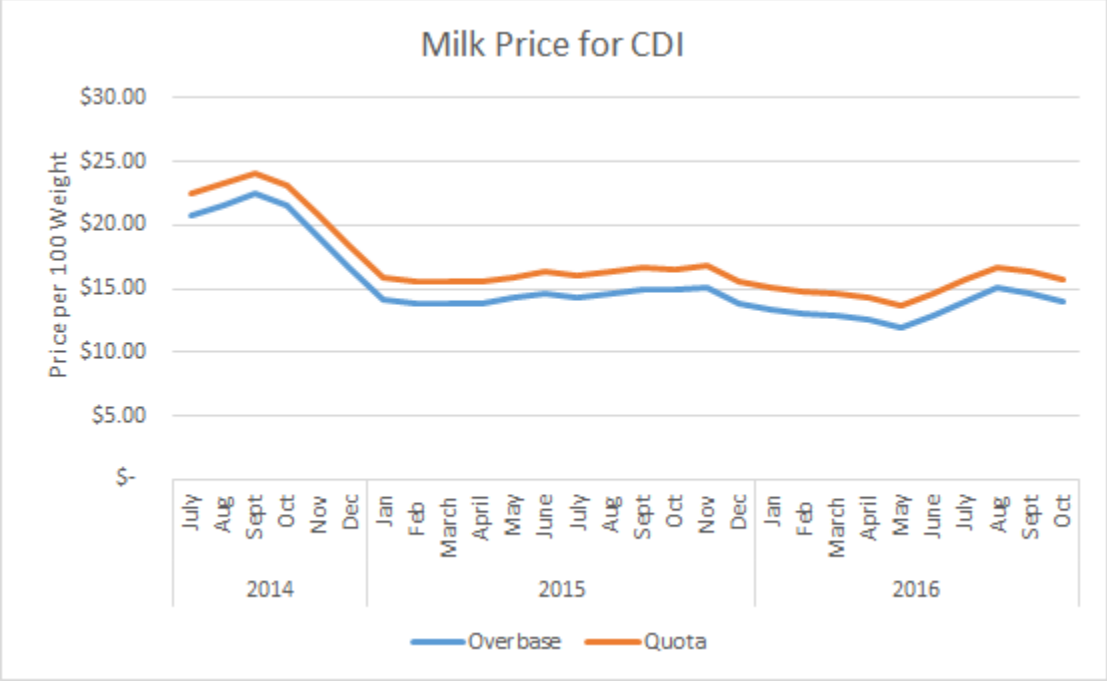
California. Dairymen across the state are at war with a business environment hostile to their bottom line. The dairy business is now a proving grounds for who can stick it out the longest, or drop out. People on the production side of milk are either leaving, staying steady, or consolidating across the map. Obstacles between them and profit include: the statewide drought, water restrictions due to environmental policy, government regulations, market structure, commodity prices, and much more. For these reasons, we are seeing owners of production facilities welcome in technology that can help save them on every dollar spent on operations. Mr teVelde is considering much of this himself. He hopes that sooner or later some sort of reform will need to take place to help dairy production be a sustainable business. But until that time he has many decisions to make. Which technologies are worth the investment? What is the best use of his available water? How to optimally utilize his current labor system in light of the new laws? As he considers the full scope of these issues, one can only look at the industry and wonder what the future holds.

Exhibit 1



Photos taken by authors

Exhibit 2



Price Information from CDI Member Newsletter, Graph created by authors

Exhibit 3

http://apple-creek-oh.all.biz/milking-systems-swiftflo-revolver-rotary-g73621

http://www.delaval-us.com/About-DeLaval/DeLaval-Newsroom/?nid=6264

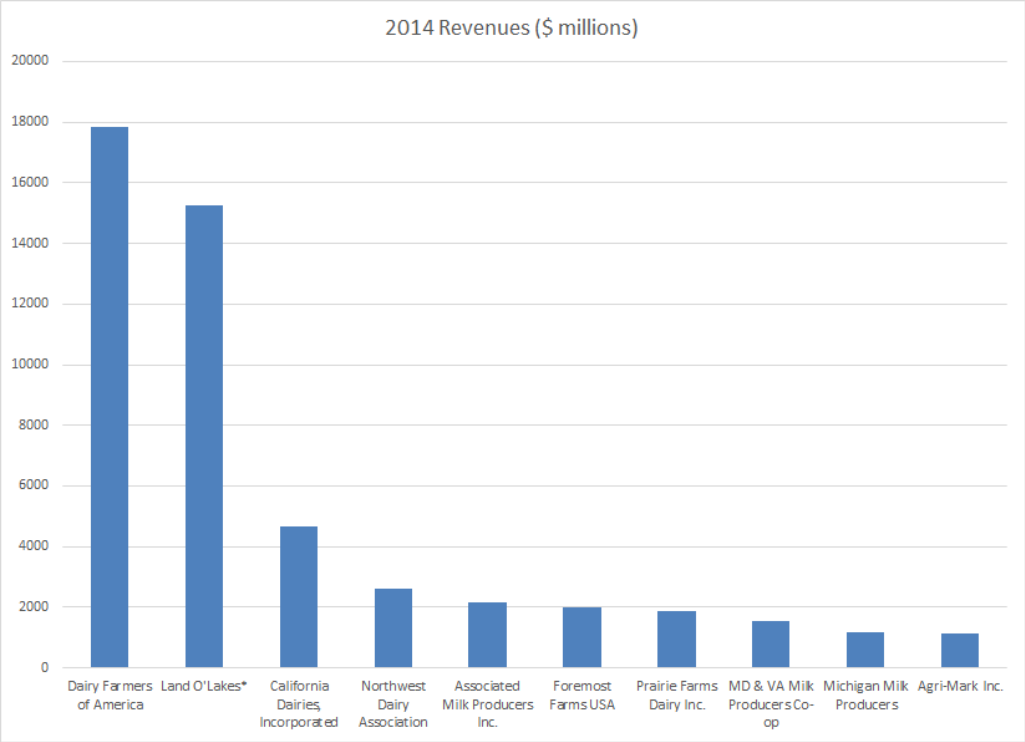
Exhibit 4

FORAGES FORMULATED IN A DAIRY DIET DESIGNED FOR EARLY LACTATION DAIRY COWS

	"As Fed" Diet (kg)	Standard-Diet Ingredient Moisture (%)	Standard-Diet DMI (kg)	Wet-Diet Ingredient Moisture (%)	Wet-Diet DMI (kg)
Corn silage	23	33	7.6	28	6.4
Alf. Hay	8	90	7.2	85	6.8
Grain Corn	7	90	6.3	90	6.3
34% Supp.	2	90	1.8	90	1.8
Brewer's grain	1	20	0.2	20	0.2
Bypass fat	0.5	100	0.5	100	0.5
Totals	**41.5**	**56.7%**	**23.6**	**53.0%**	**22.0**

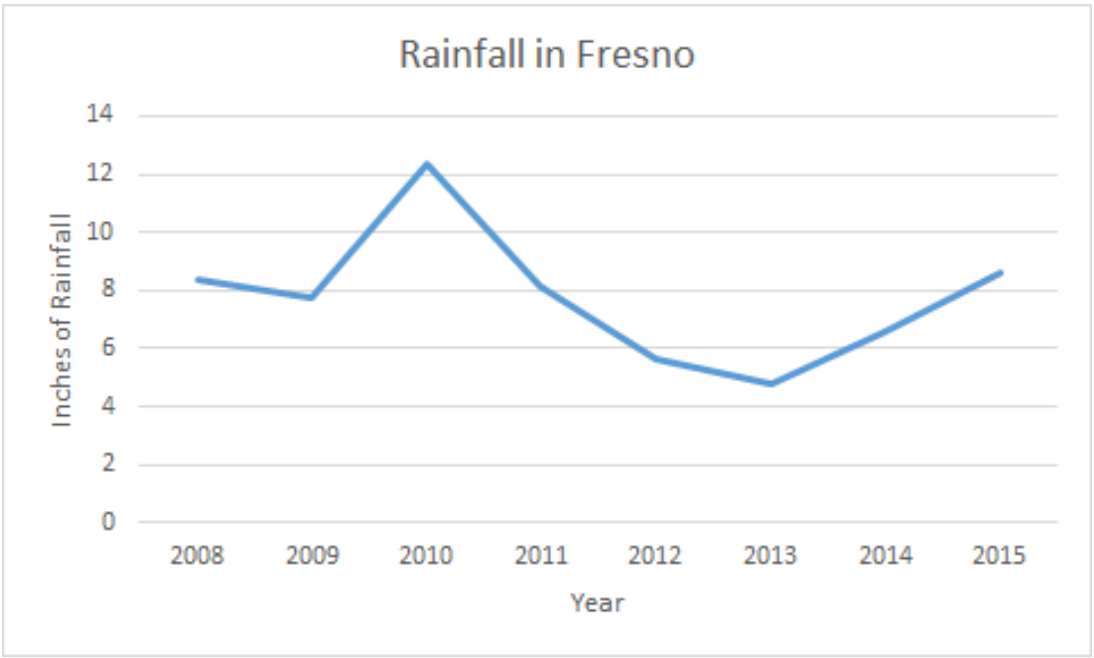
http://www.cowsmo.com/articles/moisture-forage-provides-greatest-impact-dairy-cows/

Exhibit 5



http://www.dairyherd.com/news/industry/22-dairy-co-ops-nation%E2%80%99s-%E2%80%98top-100%E2%80%99-list

Exhibit 6



Information from ggweather.com, Graph created by authors. Average expected rainfall is around 11 inches.

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