The Analysis and Comparison of Organic Dairy Operations and Conventional Dairy Operations in Terms of Milk Quality, Animal Health, Nutrition, Market Aspects and Economic Benefits

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Abstract

The dairy industry in California has two very vital sectors that make up the production and marketing landscape: Organic and Conventional dairy production systems. The objective of this review of literature is to explore the differences and contrasting views of milk quality, reproduction, animal health, nutrition, market aspects and pricing systems within each industry and determine how each industry has the potential for tremendous success among its producers. It is important to understand the aspects of each industry because of the advantages and disadvantages each industry imposes on different producers located all around the state. Organic production systems have very detailed requirements and guidelines, set in place by the United States Department of Agriculture, that greatly differ from conventional dairy farming practices and organic systems must comply with these guidelines in order to legally produce and ship organic milk. Milk quality reviews and investigation entails that conventional operations produce a greater milk yield per cow as well as higher fat and solids testing because of the utilization of diversified commodities in total mixed rations. Animal health studies have revealed that organic dairies have less of an occurrence of clinical mastitis cases than do conventional dairies but have the potential to have a greater occurrence of metabolic diseases because of the struggle organic dairy farms have with maintaining a positive energy balance after calving into early lactation. Rations in both organic and conventional production systems utilize different resources such as grass and diversification of concentrates, respectively, to maximize milk production and health. Recent innovations in nutrition and diet formulations have been researched in order to utilize the alternative technologies this industry has to offer. The demand for organic milk

has been met in recent years and its consumer base for the high priced products have been established for individuals who are of higher education and have a higher income bracket than are those of conventional milk product purchasers. The economics of owning and operating a conventional or organic operation share advantages and disadvantages in production costs and efficiency and profit maximization by using new technologies. The prices for milk and feed in the organic industry both greatly surpass prices in the conventional industry but that does not mean the profit margin in organic dairy farming is larger than in conventional dairy farming; budgeting and management practices need to be monitored and well executed in both in order to have a profitable business. Overall both industries have the potential to be very profitable but this is only possible by executing farming practices efficiently and with the correct use of available resources. Both industries will not be the best, most profitable option for every producer, this literature review allows producers and individuals to see the industry differences and that both have great potential.

Key words: organic, conventional, dairy industry, animal health, economic analysis.

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I would like to thank all of the organic and conventional producers that took the time to provide valuable producer information regarding milk prices and feed prices. It was very important to have first hand industry information in order to depict a realistic view of the industry and its production costs. I would also like to thank Dr. Leanne Berning for her input and help in executing this literature review in an organized and timely fashion.

Introduction

Over the last twenty years, the organic dairy industry has been gaining size and popularity across the nation as consumers perceive added value with organic products. This growing sector of the dairy industry provides the potential for economic benefits to dairy producers. Due to the current status of the economy, the dairy industry has had a very difficult time bouncing back from the economic ruin that was created in late 2008 and in 2009. Some conventional dairy producers were faced with scaling down production, selling their herds, or transitioning to organic production because there no other options which resulted in maintaining financial stability. In the face of the economic downturn, the organic dairy industry started expanding because of the tremendous price incentive offered to producers and decrease in production costs.

The organic dairy industry has existed prior to 2009; during the 1990's organic milk was produced and sold in very small quantities and products were sold only in specialty stores across the nation. During 2005 and 2006, the organic dairy industry experienced a shortage in organic milk which suggested that current customer demand was not being met based on current market prices (Dimitri and Venezia, 2007). This newly established demand in the organic industry increased the need for producers and with the elevated new market price, producers were offered an opportunity that some couldn't pass up. Currently, the organic dairy industry has grown in size and demand for products has tripled and is still continuing to grow.

Since the transition to organic operations has been increasing amongst the dairy community in California, it is important to understand and determine the differences among both industries and what benefits they offer producers. Exploring the rate of

success and economic feasibility of the new and booming organic dairy industry, as well as the effects on production, components, efficiency and intake would be a constructive way to deem if this new aspect of the dairy industry is one that can be profitable and practical for producers. A producer's location must be taken into consideration when determining the potential for economic feasibility of organic operations. Location is significant because there are certain regions in California that impose a greater effort in organic dairy farming in terms of access to pasture, access to farm land for crop production.

Exploring the differences in both industries will allow producers to determine on their own which method of husbandry better suits their needs as producers in terms of the comfort of their animals and the maximization of efficiency and profitability. Evaluating all aspects of each industry will allow producers to make a more educated decision of which method better suits their herd because not all producers can maximize profitability within the conventional dairy industry or within the organic dairy industry. There are numerous different demands each industry imposes and not all of them can be reasonably met.

In this review of literature, the objective is to explore the differences and contrasting views of milk quality, reproduction, animal health, nutrition, market aspects and pricing systems within each industry and determine how each industry has the potential for tremendous success among its producers. It's important to understand that the goal of this literature review is to not show which industry is better than the other, it is simply to offer information that highlights each advantage organic or conventional dairy farms have based on location and access to resources.

Differentiation of each Industry

Organic

The organic transition process and management for dairy producers is an extensive, demanding process but in the end, it rewards producers with a bigger milk check at the end of each month and ensures consumers that the products they buy with the United States Department of Agriculture (USDA) Organic label on them are produced in a safe, environmentally friendly manner.

The National Organic Program (NOP) was first discussed and initiated through the Organic Foods Production Act in the 1990 Farm Bill. The United States Department of Agriculture stated the NOP in full effect over decade later October of 2002 after a lot public commenting and multiple revisions (Kiesel and Villas-Boas, 2007). This program was created for all organic growers and handlers to follow along with the requirement for certification by the residing state or private agency accredited under the implemented standards enforced by the USDA (Dimitri and Venezia, 2007).

The NOP enforces numerous rules and guidelines along with the requirement of documents from organic husbandry practices in order for certification (United States Government Printing Office, 2013). Among numerous others there are three main guidelines that set the organic dairy industry apart from the conventional industry. Again, there are many rules and guide lines established by the NOP but these three are the deal breakers that truly determine what management systems and geographical locations have what it takes to achieve a successful organic husbandry operation.

The first significant requirement is that of a 120-day minimum grazing season for all livestock (United States Government Printing Office, 2013). During this grazing season, cows must have access to pasture throughout the full 120-day period, no exceptions. Conventional husbandry programs are under no requirement to provide their cows with pasture access for a certain amount of time or even at all if they don't deem it necessary.

The second unique requirement states that no more than an average of 70% of a ruminant's dry matter demand can come from dry matter fed during the grazing season (United States Government Printing Office, 2013). This means that the diet of ruminants during their grazing season has an average make-up of no more than 70% of dry matter from total mixed ration and 30% from pasture.

The third unique requirement is that the use of antibiotics and other hormones on lactating or nonlactating dairy cattle is absolutely prohibited (United States Government Printing Office, 2013). This serves as a true deal breaker for implementing management practices in terms of cattle health, comfort and wellness. In an organic operation, antibiotics can be administered in special occasions when the cow's health and safety become a danger but after antibiotics are administered, the animal cannot enter back into the milking string as an organic producing animal. Usually the cow has to spend her withholding period in the hospital string and is culled shortly afterward as conventional beef or into a conventional dairy operation. The only way organic production systems can administer antibiotics or hormones is in the event that a vet makes an educated suggestion because of reasons concerning overall animal health and well-being. Even then, proper documentation must be made in order to do so. Conventional operations are permitted to

use antibiotics and allow their animals to enter back into the milking string after the antibiotic has cleared their system. According to § 205.238 Livestock health care practice standard under Title 7: Agriculture, Part 205: National Organic Program it states that, "c) the producer of an organic operation must not: 3) administer hormones for growth promotion." Having stated these subparts, among many others in the National Organic Program, it is determined that hormones created in a non-organic setting are not allowed to be administered to cattle. This includes the main growth hormone utilized by the conventional dairy industry, Recombinant Bovine Somatotropin (rBST) and IGF-1 (Growth Hormone which is administered commonly in young stock). The only synthetic hormone that is allowed in organic husbandry practices is Oxytocin and that is only used in the event to aid calving ease but there are some organic agencies such as CROPP, the cooperative that Organic Valley is involved with, that do not allow their producers to administer the hormone under any circumstance.

Realistically, the success of organic operations is based solely on disease control and prevention because unlike the conventional industry, the organic industry cannot turn to antibiotics as a quick fix. They have to resort to alternative options such as natural remedies or culling.

Certification Process

Achieving organic certification is not an easy process by any means. Producers are required to go through a three year transition period in which they convert their cattle and land to organic through implementing organic farming practices and cattle care. According to the USDA National Organic Program's certification qualifications (United

States Government Printing Office, 2013), operations must keep both financial and farm records that signify that they have been implementing organic farming practices for five years prior to selling an organic dairy product. Records and standards for the specific operation are required at the time of on farm certification and are as follows:

- an extensively detailed organic production and handling systems plan,
- a livestock health care practice standard,
- a pasture practice standard,
- a facility pest management standard,
- a wild-crop harvesting practice standard,
- a crop rotation practice standard,
- soil fertility and crop nutrient management standard, and
- A commingling and contact with prohibited substance prevention practice standard (NOP).

Only after the presentation of all of the mentioned materials, multiple step transition of cattle, certification of equipment, and the testing and approval of land to organic may an operation be eligible to produce and sell an organic product (United States Government Printing Office, 2013).

Producer Differences

This process requires a lot of time, energy and money to complete and not a lot of producers have the resources or believe the time and money invested is worth it in the long run especially when considering the current status of our economy. On account that the paperwork is so complex, currently only individuals who are dedicated to following

the regulations and completing the paperwork take the time to become a certified organic operation. The extensive recordkeeping these organic milk producers complete ensures consumers that the organic product they are spending the extra money on at the grocery store is indeed 100% USDA Organic Certified. Since the on farm record keeping and implementation of organic husbandry practices are quite difficult and usually demanding, the organic industry has a wonderful price incentive for its producers. Sierra Organics, a national co-op, has reported to be giving producers around $29.98/CWT which is around 40% higher than conventional milk prices. This consumer and price-based motivation drives most dairy producers to seriously consider their available resources and look into the transition into organic production.

Conventional

Unlike the organic dairy industry, dairy producers do not have to complete nearly the same amount of paperwork or comply with the extensive set of NOP requirements. The only required documents conventional dairy producers have to complete are environmental impact and waste forms and those are usually dictated by county. Other than that, there is no paperwork due to the state that proves management, operational or husbandry practices.

The conventional dairy industry is permitted to test and use all of the latest technologies pertaining to reproduction, production, feed efficiency, disease prevention and health treatments. It is very common for conventional producers to administer rBST to increase production levels as well as use different feeding supplements to increase feed intake and efficiency, administer antibiotics on an as needed basis and administer

different hormone therapies during the reproductive cycle. The utilization of technologies like these makes the dairy industry more efficient, maximizes cow comfort and has the potential to maximize overall profits.

Location Differences

Here in state of California, there are two completely different regions for dairy farming; one of which is the Central Valley and the other being Northern California. The difference in these geographic locations is the main contributing factor for the success of an organic or conventional operation.

With the elevated temperatures, limited land, diversified crop production and flat landscape in the Central Valley, it is very difficult for producers to maintain their large cow herds and (United States Government Printing Office, 2013), all ruminants must have access to pasture and grazing every day throughout the designated grazing season. It also states that there shall be no overcrowding or continuous confinement of ruminant livestock in yards or pens. Realistically, the large dairies found in the central valley cannot follow either of these rules set by the National Organic Program due to the fact dairies in the valley often use the remainder of their land surrounding the dairy to grow crops to either for sale or feed. Though producers in the valley are at a disadvantage in the organic dairy industry, the conventional dairy industry is where they shine. They have the resources to maximize production and have thousand plus cow dairies while producing their own crops that for internal use.

Northern California dairy farmers, unlike those in the central valley, have the opportunity to truly benefit from the organic dairy industry because of their surrounding

pasture based landscape and because dairies in northern California are drastically smaller in cow numbers. Northern California dairy farmers also have access to pasture, something that not all dairy farmers are fortunate to have.

Milk Quality

In comparing organic and conventional farming systems and final products, milk composition and quality is the first concern in the investigation. For pricing reasons, it is in the best interest of the producer to deliver the best quality product in terms of Somatic Cell Counts (**SCC**), milk components and fatty acid compounds to receive the highest revenue possible.

In a study conducted by Croissant et al. (2007), it was established through milk solids analysis that milk from a pasture based feeding system and milk from a Total Mixed Ration (**TMR**) based feeding system varied in components. This study observed two different split herds and analyzed the difference of chemical properties of the milk produced over the growing season during 2006. The comparison was also broken down into to breed subcategories, Holsteins and Jerseys, within the two separate feeding systems. Farm 1 was the TMR based feeding system and the ration fed consisted of the following:

- corn silage,
- alfalfa haylage,
- grain concentrate at 10% total crude protein (soybean meal, ground corn, minerals),
- whole cottonseed,
- soybean hulls,
- pelleted corn gluten,
- Nutrimax Bypass and,

- cottonseed hulls.

The diet formulated on Farm 2, the pasture based feeding system, was composed of 60% pasture (on average), 30% ground corn and 10% whole cottonseed. Both herds were also noted to be similar in genetics because they were both state owned. Cows were separated by breed and milked twice a day and at the time of milk sampling, 3-6 cows within each breed were collected. Note that neither of the herds observed administered rBST to animals. TMR samples were taken daily and grab pasture samples were taken randomly on the property and were collected during spring and late into summer. All samples were sent to the North Carolina Department of Agriculture, Forage Laboratory for analysis. Milk solids analysis and microbial analysis were also done on the milk samples.

Holsteins and Jerseys on the TMR based feeding system had overall higher % fat tests and higher % total solids than did the pasture based feeding system. The only advantages the pasture based feeding system had were in the analysis of % solids not fat and in the ratio of saturated to unsaturated fatty acids. While TMR based feeding systems produce higher components testing, pasture based feeding systems were shown to produce a product with a greater concentration of unsaturated fatty acids in the finished product. In a fatty acid analysis done in the same study by Croissant et al. (2007), it was discovered that pasture based feeding systems had a greater percentage concentration of Conjugated Linoleic Acids (CLA) of 60% as well as a greater ratio of unsaturated fatty acids to saturated fatty acids.

The overall advantage of unsaturated fatty acids in the finished organic milk product allows us to conclude that organic dairy products have an overall higher health value because of the value unsaturated fatty acids serve to our diets. This can successfully be concluded because it was shown in a study done by Hu et al. (1999) that dairy products were one of the top elements of dietary intake that contained high levels of saturated fatty acids. The results from this study concluded that ingestion of foods with high amounts of saturated fatty acids was found to be associated with a higher risk of coronary heart disease. Since organic milk from pasture based systems had a lower level of saturated fatty acids than did conventional milk, we can conclude from both studies that organic milk has a more significant health value to consumers than conventional milk does.

It has also been reported that organic milk with incorporated grazing had an overall higher ratio of Polyunsaturated Fatty Acids, n-3 fatty acids and a lower n-6: n-3 fatty acid ratio than conventional milk. Inversely, conventional milk had a higher ratio of Monounsaturated Fatty Acids (Ellis et al., 2006). In this study, 19 conventional and 17 organic dairy farms were chosen for monthly milk samples during a 12-month period for a comparison of overall fatty acid composition. Interview questionnaire's were issued, farm record analysis, management and feeding practices were all obtained and considered throughout the course of this observation process.

A study conducted by O'Donnell et al. (2010) was conducted to determine the fatty acid composition of labeled retail milk in label claims based on production management practices. In this study, retail milk was obtained from different stores within the United States under the category labeling of organic, conventional (products that have

no claim to rBST use) and rBST-free. Milk was chose based on freshness based on expiration date, whole milk for fat testing and analysis and whether it was packaged in either paper or plastic. All milk was pasteurized with traditional methods for the purpose of excluding differences in composition that different processing techniques may produce. A fatty acid analysis was done on all samples to determine the different profiles found in each of the categories.

The study concluded that there was no statistical difference between rBST free milk and conventional milk but there was a statistical difference between both of those types and organic milk. Overall, the differences discovered by determining the fatty acid profiles of each category was minor and had no relevance to public health. The study continued on to explain that dietary components and ration formulation are the contributing factors that affect the overall fatty acid composition of milk rather than production management practices. Feeding more concentrates or forages in rations are going to produce altered fatty acid profiles that are unique for each industry (O'Donnell et al. 2010).

The clear advantage in these fatty acid complexes found in the organic milk can be attributed to the difference in season, farm management practices and nutrition factors. Seasonal changes in weather, management conditions and cattle diets range greatly from the winter to summer months and create larger variability within the organic systems than in the conventional systems.

Animal Health

The top concern for managers and producers within the dairy industry is cow comfort and health. If cows aren't happy and healthy, they are not going to produce to their maximum potential of production. When cows are not reaching maximum efficiency, producers lose money which realistically, no one wants. With that being said, it's important to maintain health of all animals of all stages of life in a husbandry operation regardless of their organic or conventional status. In the proceeding section, different aspects of animal health will be discussed and evaluated pertaining to the differences and advantages either industry possesses.

Productive Life

Sustaining and maximizing milk production are very important goals for management teams to have because of such benefits like profitability and feed efficiency.

In 2001, an observational study of 31 organic dairy herds and 93 conventional dairy herds was done that was able to identify many contributing factors between organic and conventional productive lives within dairy cattle. The study was conducted in Norwegian herds of organic and conventional dairy cattle and the unity of study of this observation was one lactation period for each animal. Herds with a total of less than five cow-years were excluded from the study. Comparing the energy adjusted 305-day milk yield was also incorporated into this study and was calculated by the following formula:

0.297 * 505-d milk yield + 11.8 * [(mean fat % * 305-d milk yield)/100] + 7 * [(mean protein % * 305-d milk yield)/100]

After observation and collecting data, it was concluded that the organic had a higher mean lactation number of 2.97 lactations and conventional cows had a lactation number of 2.35 lactations. In the same article, it was also reported that organic cows also were culled at an older age of 5 years and 4 months versus conventional which culled cows at 4 years and 6 months (Hardeng & Edge, 2001). The data collected pertaining to the lifespan of dairy animals in inverse operations clearly indicates organic animals have a longer productive life and life spans for which more profit can potentially be made.

In terms of production it was shown that organic dairy cows had an overall 22% lower energy adjusted 305-d milk yield than did conventional cows (Hardeng & Edge, 2001). This is mainly due to the fact that the feeding of concentrates in organic feeding systems is at a lower rate than in conventional TMR-based feeding systems. Hardeng and Edge (2001) found a strong correlation between the milk yield per lactation and feeding concentrates.

Overall Somatic Cell Counts (SCC) was observed to have an overall higher average SCC, more specifically higher in later lactations within organic cows. The formula used to derive the total number of SCC's per lactation is as follows:

$$\frac{\textbf{HIGH SCC}}{\textbf{TOTAL SCC}} = \frac{\text{number with SCC exceeding 200,000}}{\text{total number of counts}}$$

Organic cows were shown to have lower levels of SCC in first and second lactation but exponentially grew in third and higher lactations compared to conventional cows that experienced a gradual increase of SCC as lactation number increased. Note the

research conducted showed that from six lactation and greater, SCC in conventional cows was averaged to be around 50,000 less than organic cows (Hardeng & Edge, 2001).

Culling cows is an important aspect of herd management. Its purpose is to eliminate animals that are using more money than are making. By culling animals, herd managers are able to shape a herd into what it needs to be in terms of production, reproduction and health status. A comparison of production and management between organic and conventional dairy farms in Wisconsin was conducted by Sato et al. (2005). The results had information pertaining to the culling practices within each type of operation. Thirty organic dairy farms, all residing in the same region, were chosen and every one of the organic dairies chosen, they had to choose a neighboring conventional dairy operation to serve as a control. All herds were visited twice, in March and September, for data collection.

The culling rate in this study was determined to be higher in conventional dairy farming systems compared to organic. Organic reported 17.2 cases of culling per 100 cow years and conventional reported 18.0 cases per 100 cow years (the unit of cases per 100 cow years was used throughout this study). The mortality was also recorded in this study as 3.1 cases per 100 cow years for organic and 4.2 cases per 100 cow years in conventional farms (Sato et al. 2005).

Body Condition Score (**BCS**) is a very important health aspect for cattle during their dry period and during their lactation. Their BCS determines how well they will adapt during the very difficult transition period from dry to milking when a cow's body is in negative energy balance. It is the goal of every dairy farmer to make sure their cattle

are prepared for transitions by having a target BCS of 3.25 to 3.5 during their dry period because otherwise it will lose them money on production lost and treatments for the animals if they don't transition properly. In Sato et al. (2005), it was reported that organic dairy farms had a significantly lower BCS than did conventional herds. The low BCS scores in organic herds were observed mainly in the spring and this can be attributed to the fact that cattle were out on pasture at this point in time and not receiving as full of a ration in the barn as they had been over the winter months. In the process of determining BCS in the herds observed, ten cows were chosen at random at each location and the mean of the BCS scores were recorded.

Because organic cows have been recorded to have a significantly lower BCS than conventional cows, it can be concluded that organic cows have a higher risk of metabolic problems when entering the milking herd post partum than would conventional dairy cows. Cows with a BCS of lower than a 3.25 have a higher chance of developing a displaced abomasum, ketosis and milk fever when fresh. This is because upon their entrance into milk production, postpartum, they do not have the body mass to support maintenance and production at the same time.

Conventional dairy operations have the opportunity to utilize new technologies that increase feed efficiency, milk production and overall profitability. Products like rBST can drastically improve milk production by close to 10 lbs. of milk per cow per day. When administered between weeks nine and ten of milk production, cows in every lactation group sustain their peak of milk production for a longer period of time when compared to cows that were not administered rBST. Later lactation cows have a more significant response to the effects of rBST.

Breeding and Reproduction

Reproductive success is one of the top aspects of the dairy industry that translates in both organic and conventional industries. Having high reproductive success within a herd maximizes the profitability of the operation and the efficiency of the herd as a whole. When viewing research of reproductive success in both the organic and conventional industry, one of the aspects most commonly looked at is days spent open during a 305-day lactation.

Information was collected in Norway through a cohort study of reproductive success by observing 29 organically managed herds and 87 conventionally managed herds over a three year period between 1994 and 1996 (Resken et al. 1999). The study was adjusted for geographical distribution and herd size by grouping conventional herds and organic herds together for the final cohorts. During the three years of observation, one day per month samples from rations and milk samples were taken for analysis and record. Day's open, calving interval, calving to first artificial insemination interval, calving to last artificial insemination interval and artificial insemination per cow were all reproductive variables used.

It was observed over the three year period that organic herd management recorded a significantly smaller amount of days open per cow of 113.1 days versus conventional herds within that same time period that recorded 129.2 days open (Resken et al. 1999). In the same study, it was determined that the reproductive success of animals in the observed herds was directly impacted by season. During the winter months, cows experienced a reproductive impairment versus during the summer months making the

summer months the most desirable time to breed cows during the summer. This is mainly because energy requirements cannot be fully met during the winter months based on the fact that the cows could not utilize fresh pasture during the peak of their milk production in relationship with the low concentrate ration implemented by organic husbandry operations.

Replacements are also another aspect of reproduction that is crucial to the success of a herd. Conventional herds reported a significantly higher replacement rate of 35% compared to organic with 23%. This can be attributed to the fact that reproductive traits in conventional herds have most likely been positively influenced by the culling of cows with delayed or insufficient reproductive traits thus increasing conventional herd replacement rates. Conversely, organic herds showed an advantage in breeding performance which can be accredited to the fact that organic herds traditionally have a larger maturity distribution with mostly equal amounts of cattle in early and late lactations (Resken et al. 1999). This wide distribution enables organic herds to maintain a high reproductive success throughout lactation.

There also were noticeable breeding differentiations between organic and conventional management systems. Natural breeding accounted for 19-27% of pregnancies in the organic management operations and only 3-5% in the conventional operations (Resken et al. 1999). This cause can be attributed to the fact that on average, organic herds are much smaller than conventional herds allowing them to easily use and track a clean-up bull with their problem breeders. Conventional herds are not as likely to use natural insemination techniques because of the difficulty caused with tracking pregnancy and heat cycle among reproductively challenged cows.

Lof et al. (2007) conducted a study based on associations between herd characteristics and reproductive efficiency in dairy herds in Sweden. Herds were observed and data was collected from September 2004 to August 2005. All farms that participated in the study had more that 45 milking cows and all information that was obtained during the study period was calculated and represented in averages. The averages were then summed and divided by the number of total animals so an accurate representation could be depicted for each single herd. The Swedish Official Milk Recording Scheme and the Swedish Dairy Association were two sources in which information was obtained for the study.

Results from the study's objective was to measure the difference in calving interval, calving to first artificial insemination interval, calving to last artificial insemination interval and culling attributed to reproductive problems. In terms of calving interval, organic operations showed to be shorter compared to conventional operations. Similarly, non-TMR diets (most commonly implemented in organic operations) also had a shorter calving interval than did TMR diets. In low –yielding herds, the calving interval was also shown to be longer than in high-yielding herds. Overall, this study concluded that organic operations have a longer calving interval than conventional operations which is also supported by the data regarding low-yielding herds and non-TMR diets. It was also observed that the calving interval in herds that use do-it-yourself inseminations was longer than in herds that had a professional breeder (Lof et al. 2007).

Calving to first artificial insemination service, which can also be called a voluntary wait period, was measured and it was shown that in operations that are organically managed are shorter than conventionally managed herds. Calving to last

artificial insemination service was also shown to be shorter in organic operations when compared to conventional operations (Lof et al. 2007). This information suggests that cows in an organic operation are being bred sooner and are showing pregnancies quicker than conventionally managed cows. This could be attributed to the fact that since organic cows have an overall lower milk yield than conventional cows, they can dedicate more energy from their daily intake to reproduction than do conventional cows that produce significantly higher amounts of milk per day than do organic.

Culling attributed to reproductive problems was greater in smaller herds than in larger herds. Low-yielding herds were also more likely to cull animals based on reproductive problems than high-producing herds. These both contradict the observation that organic herds cull fewer cows based on reproductive problems, which was also reported in the study (Lof et al. 2007). Because of the lack of detail this study offers towards where herds fall within each category measured makes it hard to interpret the results and derive a general consensus. In this specific case, the area of culling attributed to reproductive problems is unclear in the sense that organic herds are traditionally smaller in size than conventional herds and are lower-yielding than conventional. Yet the results of smaller operations and low producing milk yield are exactly opposite of results found in organic herds. This study could have been executed more clearly and concisely by having researchers specify the criteria of dairy farms that fall within each category because many of them overlap.

Overall reproduction between conventional and organic operations differs in the aspect that in both cases it was reported that organic herds had an advantage in less days open and earlier artificial insemination dates than did conventional herds.

Disease and Infection

The occurrence of disease and infection within a dairy herd is strictly dependent on the management team and the steps taken for prevention. Without following proper protocol, management teams and employees can easily overlook an infection or disease that could potentially cost producers hundreds or thousands of dollars. Organic and conventional operations have two different methods in which they approach and treat diseases and infection. While conventional producers have the luxury of using antibiotics for treatment of common infections, organic producers can only resort to natural remedies or only products that are approved for use by the NOP (United States Government Printing Office, 2013). Even though prevention and control of diseases and infections should be a priority of all management teams on all dairy farms, it's because of these industry differentiations that organic husbandry practices have a greater reliance control and prevention than do conventional husbandry practices. The occurrence of disease and infection will be further explored in this section in both husbandry practices.

In a study done by Hardeng and Edge (2001), along with concluding aspects regarding productive life, the survey also served as a disease investigation article. The occurrence of mastitis, ketosis and milk fever were monitored and separated by lactation and series of occurrence in the 31 organic and 93 conventional Norwegian dairy herds. It was established that the overall occurrence of mastitis, ketosis and milk fever was significantly lower in organic herds than case occurrence in conventional dairy herds. A formula of value, simulated by the researchers conducting the study, was given to portray the disease risk each animal develops during her productive life. It is as follows:

MASTITIS = $\frac{\text{no. of lactations with mastitis 14 d prior to calving until 14 d prior to next calving}}{\text{total no. of lactations}}$

KETOSIS = $\frac{\text{no. of lactations with ketosis in the first 60 d of lactations}}{\text{no. of lactations with a duration of at least 60 d}}$

MILK FEVER = $\frac{\text{no. of lactations with milk fever from 2 d before to 7 d after calving, after 3rd calf}}{\text{total no. of calvings, after 3rd calf}}$

Based on these formulas, this study was able to formulate, compare and conclude that the disease risk of conventional cows postpartum was significantly higher than within organic herds. Note the mastitis formula measures 14 days prior to calving which does not exhibit complete logic because monitoring mastitis before calving is an unheard of practice. The formulated risk of mastitis within conventional herds observed (based on the model formula) was close to twice as high during the first week of calving and hit a high at week 28 post partum than in organic herds. Ketosis had an overall high formulated disease risk at 12 weeks post partum of three times greater of a risk in conventional cows than in organic. Milk Fever had approximately a third lower risk in organic herds when compared to conventional herds at 14 days after pregnancy. The authors concluded that organic herds have an overall lower risk of disease than do conventional herds (Hardeng and Edge, 2001). This overall advantage in lowered disease risk among organic operations can be attributed to the decreased stress cows are under in terms of production. Organic dairy cows traditionally produce a lower milk yield in each lactation and are therefore not under the same stress conventional animals are under as high producers when they enter the milking string after calving. The decrease in ketosis can specifically be attributed to the fact that organic cows do not have the same reliance

on concentrates as well as having more variation of forage composition in their diet that conventional animals do.

Mastitis itself is such a widespread and continuous issue dairy producers are faced with every day. An observational study was done that analyzed the effect of mastitis treatment and SCC counts on milk yield in Danish organic dairy cows during the four year period of 1997 to 2001(Bennedsgaard et al. 2003). Monthly reports of daily milk production, SCC diagnoses and dates of veterinary treatments, reproductive events and culling were available for analysis.

The animals observed were between 9 and 305 days in milk to eliminate variability in SCC counts because of fresh cows or cows that received preferential treatment for one reason or another. Parities of 1, 2 and 3+ were configured according to herd level averages of production, SCC and incidences of mastitis and other disease treatments. On test day, all parities showed the same negative effect of SCC below 1,500,000 cells/ml was at its lowest point around 60 days and peaked at the end of lactation therefore causing a steeper drop of the lactation curve.

Organic dairy cows treated for mastitis once had an overall lower production average. A second round of treatment for a case of mastitis had an overall more negative effect on second and above lactation animals when comparing to first lactation animals. Cows having been treated for mastitis in the previous lactation were shown to have an overall higher production record than cows that were not treated for a case of mastitis in their previous lactation (Bennedsgaard et al. 2003).

In the study conducted by Sato et al. (2005), which compared organic and conventional production and management practices in Wisconsin, mastitis treatment and prevention data was collected and recorded. The overall consensus was drawn that organic farms had a mean clinical mastitis occurrence of 12.5% lower than conventional farms.

Since it is prohibited to administer antibiotics or antimicrobial drugs or treatments to organic dairy cattle, only conventional operations made up the portion of this study. Twenty six out of the 30 dairies monitored reported that they used antibiotic udder infusions for dry cow treatment. Eighteen producers reported regular use of antimicrobial udder infusions for chronic mastitis treatment. Producers named treatments of udder infusions of cephapirin and administration of shots of penicillin. Seven of the dairies reported no antimicrobial usage on their operation. Another popular form of treatment was using oxytocin and frequent stripping out as clinical mastitis treatment (Sato et al. 2005).

On the organic operations, they reported using anti-inflammatory drugs and stripping out quarters as frequent as possible as the most utilized clinical mastitis treatment forms. Nineteen farms used alternative options for treatment like Vitamin E, Vitamin C and selenium. These farms also utilized the availability of natural remedies such as whey products, herb, mineral oil and vinegar (Sato et al. 2005).

When reviewing the method in which the data was collected in the Sato et al. (2005) study, it appears that there is a large gap in which information or lack thereof has not been considered. In conventional operations, it is vital they record incidences of

mastitis, cases of clinical mastitis and the according treatments so that there will be no possibility of antimicrobial drug residue contaminating a tank of milk. In organic operations, since no antimicrobial drugs are used, there is no true need to religiously record incidences of mastitis aside from management purposes. If mastitis cases are not recorded on an organic operation, realistically speaking, it wouldn't be the end of the world. This gives us reason to question if the incidence of clinical mastitis cases is truly lower in organic than in conventional operations.

The usage of antimicrobial drugs to treat diseases and infections such as mastitis, metritis, retained placenta, respiratory disease and foot problems is very common and widely advised within the dairy industry. Zwald et al. (2004) conducted a survey for the purpose of observing management practices and antimicrobial usage on organic and conventional dairy farms in Michigan, Minnesota, New York and Wisconsin between May 2000 and March 2001. Farms were recruited based on information given out, regarding conventional producers, by the state department of agriculture as well as information obtained through organic milk cooperatives, certification agencies, and independent contacts (on account there is no central data base for organic certified dairy farms). Questionnaires were administered that covered all management practices, but it mainly focused on health and the frequency and treatment of infections and diseases in terms of antimicrobial administration, antibiotic treatments, and intramammary treatments. In the questionnaire, management was asked to answer questions regarding the herd for the last 60 days to eliminate bias. During the time this study was conducted, there was no national standard for organic food production, so technically the use of antibiotics was not deemed illegal in organic production systems. Most of the organic

herds that appeared in this study were already in compliance with the standards because of enforcement by their cooperatives. Shortly after this study was concluded, the NOP standards were implemented by the USDA.

Results concluded that conventional herds had an overall higher usage of antibiotics in lactating and non-lactating dairy cows. It was specified that in conventional herds, respiratory disease, mastitis, metritis or retained placenta and foot problems were treated more often than on organic dairy operations. During the 60-d period, it was reported that approximately between 1% and 10% of cows in conventional operations received antibiotics and no cows received any antimicrobial antibiotics on most of the organic herds. The only time antibiotics were administered on organic operations was in the event of respiratory disease, retained placenta or metritis and foot problems in some of the organic dairies; antibiotics were never administered for mastitis cases, clinical or chronic. Table 1 explains the occurrences of diseases and illnesses that were treated with antibiotics within conventional and organic operations. Organic operations used Ceftiofur antibiotics to treat all diseases whereas conventional operations used a variation of tetracycline's, penicillin's, ampicillin's and sulfonamide's.

Table 1. Use of antibiotics to treat selected diseases in lactating cows.

Disease	Conventional (%)	Organic (%)
Respiratory Disease	97.0	12.5
Mastitis	79.8	0.0
Metritis or Retained Placenta	79.8	3.1
Foot Problems	82.8	6.3

Recreated from Zwald et al. (2004).

On organic operations, it was reported that 93.3% of all herds surveyed reported that they separated (meaning that the animals were moved to a location that had no contact with organic animals or they were sold) cows that were treated with antibiotics. The animals that were separated from the herd either by sale or location change also had the option of utilizing an implemented extended withdrawal period allowed by some organic certifying agencies (this extended withdrawal period allowed the milk from treated cows to re-enter the organic production channel after an extended withdrawal period was passed). Table 2 is a detailed list of the frequency and type of antibiotics used by organic and conventional herds during the 60-day period.

Table 2. Types of antibiotics reported used in previous 60 days by organic and conventional dairy herds.

Antibiotic	Conventional (%)	Organic (%)
Penicillin Type	85.9	6.5
Cephalosporin Type	77.85	9.7
Tetracycline Type	41.4	3.2
Sulfonamides	27.3	0.0
Florfenicol	26.3	6.5
Other Antibiotics	37.4	9.7

Recreated from Zwald et al (2004)

Overall, this study could have been improved by further characterizing the organic and conventional operations that utilized antibiotics. The questionnaires could have been further utilized to determine trends in the corresponding regions, for example there could have been a significant difference between occurrences of diseases and infection in New York compared to Wisconsin. It also could have been further specified by season; questionnaires could have been administered twice a year, in the winter and spring/early summer to contrast the occurrence of disease and treatment methods.

A study conducted by Pol and Ruegg (2007), antimicrobial drug usage was measured within conventional and organic dairy farms in Wisconsin to determine the treatment practices and quantification in which antimicrobials were utilized. This study was a variation of the study previously discussed by Zwald et al. (2004) only it went further in depth in terms of season in which diseases and infection occurred. The same criteria was used to determine the sample size of farms from the Zwald et al. (2004) study and this time an 84-questionnaire was administered during an actual on-farm visit. Dairies were visited between June 2004 and July of 2005 for the purpose of making sure each season was analyzed accurately.

The occurrence of disease was reported within the year in terms of the four major categories of disease and infection: mastitis, respiratory disease, foot infection and metritis or retained placentas. Conventional and organic farmers both shared the fact that each had yearly occurrences of metritis and mastitis cases in lactating dairy cows. In terms of respiratory disease and foot infections, organic farms reported fewer cases compared to conventional farms. Table 3 shows the occurrence of disease within organic and conventional operations that were observed in this study.

Table 3. Yearly frequency of selected diseases for conventional cows and organic cows

	Clinical Mastitis		*Respiratory Disease*	
	Conventional	Organic	Conventional	Organic
Number of farms with reported cases (%)	20 (100.0%)	20 (100.0%)	20 (100.0%)	4 (20.0%)
Number of reported cases per year (% of total cows)	1,612 (40.9%)	298 (20.5%)	130 (3.3%)	13 (0.8%)
Range of yearly frequency (% of total cows)	4.0-156.0	4.0-57.0	1.0-24.0	0.0-10.0
Clinical cases treated per year (% of total cases)	94.0	71.0	99.0	92.0

Recreated from Pol and Ruegg (2007)

	Metritis		*Foot Infection*	
	Conventional	Organic	Conventional	Organic
Number of farms with reported cases (%)	20 (100.0%)	19 (95.0%)	19 (95.0%)	12 (60.0%)
Number of reported cases per year (% of total cows)	605 (15.3%)	136 (9.3%)	779 (19.7%)	357 (24.6%)
Range of yearly frequency (% of total cows)	3.0-42.0	0.0-23.0	0.0-111.0	0.0-69.0
Clinical cases treated per year (% of total cases)	95.0	71.0	96.0	97.0

Recreated from Pol and Ruegg (2007)

In treating clinical cases of mastitis, most of the conventional producers reported treating cows with Cephapirin, an intramammary compound. Amoxicillin and pirlimycin was also frequently used. All three are antimicrobial drugs. Conventional producers also reported that they administered one or more antimicrobial drugs for treatment for one third of the reported mastitis cases and believed that only half of the treated cases were cured. Eighty percent of conventional producers were also shown to rotate antimicrobial drug treatments for intramammary products so cows would be less likely to develop antibiotic resistance (Pol and Ruegg 2007). In a similar study conducted by Roesch et al. (2006), it was discovered that alternating clinical mastitis treatments was very important in order to avoid bacterial resistance because the four most common strains of clinical mastitis (Staphylococcus aureus, nonaureus Staphylococci, Streptococcus uberis and Streptococcus dysgalactiae), in both organic and conventional production systems, all showed resistance to at least three out of the eleven antimicrobial drugs tested. In Pol and Ruegg (2007), it was observed that only 40% of conventional producers showed satisfaction with the products used to cure cases of clinical mastitis.

Conversely, organic farmers all reported no use of antimicrobial drugs to treat mastitis which follows the NOP that all organic producers must follow in order to ship and sell an organic product. Organic producers have had to resort to using alternative, organic treatments for mastitis. Bovine whey products, garlic tincture, aloe vera and vitamin C were among the common treatment methods. Similar to conventional farmers, organic dairy farmers also believed that about half of the cases treated were cured. It was also reported that 74% of organic farmers were satisfied with treatment methods used to cure mastitis.

In terms of treatment for respiratory diseases, metritis and foot infections, conventional producers used mainly Ceftiofur as well as (but not as regularly) tetracycline and ampicillin. Organic farmers used natural compounds listed below:

- Aloe vera,
- Asprin,
- Botanic tincture,
- Botanic-mineral paste (Mineral oil, diatomaceous earth, sodium bicarbonate, tea tree oil and eucalyptus oil),
- Garlic tincture,
- Homeopathy,
- Multivitamin/microbial (Vitamins A, C, D, E and live lactic acid producing bacteria),
- Nutritional supplements,
- Vinegar, and
- Vitamin C.

Dry cow therapy was utilized and administered by both conventional and organic production systems. Intramammary antimicrobial treatments were used and rotated brands biannually in conventional operations at the time of dry-off. One of the organic operations participating in this study reported the use of antimicrobials for dry cow therapy to treat a few quarters at the time of dry off. This violates the National Organic Program because it was not noted that the administration of antimicrobials was recommended and verified by a veterinarian. In the National Organic Program, it is noted

that antibiotics and non-synthetic products can be administered to dairy cattle upon recommended by a veterinarian if there is a true problem that is seriously threatening the health of the herd and the quality of product being produced (National Organic Program, 2013).

Half of the organic producers participating in the study utilized products such as ultra filtered bovine whey as well as other remedies as mentioned above for dry cow therapy. Conventional producers reported to use penicillin and streptomycin the most compared to other antibiotics because of their success.

Overall, Pol and Ruegg (2007) concluded that in conventional dairy operations, intramammary antimicrobial drugs for mastitis treatment accounted for 38% of the total usage of antimicrobial usage.

It was very intriguing that organic producers were more satisfied with their method of treatments when compared to conventional producers. This could be mainly attributed to the fact that organic producers have a lower expectation for treatment because of the products they were able to use and when they actually worked, they were pleasantly surprised. Conventional producers had the option to use antimicrobial drugs for treatment which clearly has a more successful rate for cure than natural remedies. This may have caused them to have higher expectations for their methods and when they were unsuccessful, satisfaction decreased.

Overall, both industries have advantages and disadvantages in the category of disease and infection because of the resources each industry possesses over the other. From a management standpoint, production costs in the area of veterinary expenses have

been shown to be extremely lower in organic dairy production systems because of the good herd health maintained by culling, lack of herd wide administration of antibiotics, seldom treatment of antibiotics followed by sale and having animals out on pasture for a large portion of the year (Rotz et al (2007). Conventional dairy operations poses the overall advantage in treating and preventing disease and infection because of the allowance of the use of antimicrobial drugs to treat a variety of health problems that can arise within lactating dairy cattle.

Nutrition

Organic and conventional production systems have drastically different rations that they feed cattle in each operation because of the different nutritional requirements imposed by each industry. Conventional dairy operations have the option to utilize diversified commodities and feed a Total Mixed Ration (TMR) which is composed mainly of concentrates, forages and mineral & vitamin supplements. In recent years, conventional producers have become more welcoming to feeding supplements that increase feed efficiency and help improve rumen and gastrointestinal health. Organic operations must follow the guidelines set by the National Organic Program (NOP) that requires them to feed a ration that requires 30% of the dry matter intake to be supplied by pasture during the grazing season. The other 70% of the ration must be composed of commodities that have been raised and certified in accordance to the NOP. Commodities must present the according certificates signifying proper certification upon sale and delivery.

Ration Formulations

The conventional dairy industry has the availability to compile different rations with many different concentrates and forages while the organic dairy industry has little variation in terms of ration composition because of the strict requirements regarding dry matter intake. A previous study already discussed in this literature had a basic example of ration formulation in both organic and conventional industries. I have recorded the ration formulation for review. Note that the ration listed below is recorded as “pasture-based” feeding systems rather than specified as organic. These “pasture-based” feeding systems

nearly or fully comply with the standards set in the NOP therefore they will be considered in compliance with organic requirements.

In the study conducted by Croissant et al. (2007), previously discussed in *Milk Quality*, the difference of components in the milk produced by each production system was explored. The pasture- based ration and TMR was recorded as follows in Figure 4 and 5, respectively.

Table 4. Formulation and nutrient content of total ration fed to pasture-based cows.

Item	Annual Ryegrass	Matua Bromegrass	Sorghum Sudan	Bermuda Grass	Fescue Clover
Whole Cottonseed	10	10	10	10	10
Ground Corn	30	30	30	30	30
Fresh Forage	60	60	60	60	60
DM%	47.3 +/- 1.1	47.4	49.1 +/- 1.5	51.3 +/- 1.9	48.5
CP%	17.4 +/- 1.6	17.9	14.2 +/- 0.5	14.9 +/- 1.1	12.0
ADF%	19.1 +/- 1.5	19.0	24.5 +/- 0.7	24.4 +/- 0.6	29.2
Mcal/kg	1.68 +/- 0.06	1.68	1.52 +/- 0.02	1.57 +/- 0.01	1.39

Recreated from Croissant et al. (2007). Note: Values are % of total ration DM.

Table 5. Formulation and nutrient content of total ration fed to TMR cows.

Item	TMR
Corn Silage	37
Alfalfa haylage	16
Grain Concentrate, 10% CP (soybean meal, ground corn, minerals)	15
Whole cottonseed	12
Soybean hulls	7
Cottonseed hulls	2
Pelleted corn gluten	5
Bypass blend*	3
DM %	53.2 +/- 2.3
CP %	18.0 +/- 1.1
ADF %	25.7 +/- 1.3
Mcal/kg	1.52 +/- 0.02

Recreated from Croissant et al. (2007). Note: Values are % of total ration DM.

**Meal made from different animal by-products.*

The pasture based ration incorporated different grasses that naturally grow on the pasture land of the dairies that participated in this study. Each type of grass was collected at different times of year when the cows were grazing on them. The annual ryegrass was collected in March to April and September to October, the matua bromegrass was collected in March, the sorghumsudan was collected from April to May, the bermudagrass was collected from May to August and the fescueclover was collected in March. The diet consisted of 10% whole cottonseed, 30% ground corn and 60% reliance on pasture. To calculate the 60% average reliance on pasture in the diet, expected DMI (17-22 kg/day), concentrate allowances (6-9 kg/d), milk production and size of the animal were taken into account and calculated (Croissant et al. 2007).

Conventional TMR consisted of a more diversified combination of concentrates and forages. One of the components of the TMR is not commonly used today in

conventional dairy practices. That ingredient is bypass meal which is made up of meat & bone meal, flash-dried blood meal, fish meal, hydrolyzed poultry feathers and poultry by-product meal. It is the only aspect of this ration that is questionable because the meat & bone meal and flash-dried blood meal because it was not specified as to what animal it was derived from. Today, meat & bone meal and flash-dried blood meal cannot be used because laws placed by the Food and Drug Administration (FDA) that prohibit the feeding of ruminant meat & bone meal and flash-dried blood meal to other ruminants. This is because the transmission of diseases, such as Bovine Spongiform Encephalopathy (BSE) (also known to the public as "Mad Cow Disease"), are easily and quickly spread when ruminants consume other infected ruminant byproducts (Eastridge, 2006).

Overall this study showed the TMR conventional ration showed higher percentages of fat and total solids (TS) components in testing than did the pasture-based feeding system. This is because TMR's can better utilize concentrates and their production of elevated fat and total solids levels in the final fluid milk product. Pasture-based feeding systems can potentially utilize more concentrates in feeding practices but producers and nutritionists need to make sure the DM of each commodity complies with the standards set especially if the pasture-based feeding system is certified organic.

In organic management practices, it is complicated to create a ration that fulfills all nutrient requirements and still follows the guidelines set by the National Organic Program in terms of dry matter in a ration. The use of carbohydrates is limited in organic rations for dairy cattle and it is a priority to try and make up for the lack of carbohydrates with alternatives. In a study conducted by Delahoy et al. 2003, supplemental carbohydrate sources for lactating dairy cows on pasture was explored in order to offer

alternatives for organic producers. Steam-flaked corn and non-forage fiber sources were supplemented for carbohydrates. Steam flaking of corn has a different affect on ruminal availability compared to cracked corn or ground corn by increasing the ruminal availability of carbohydrates and decreasing the availability of protein which increases more nitrogen utilization (Delahoy et al. 2003).

In this experiment, there were two groups of cows in which animals were paired up by similar milk production, days in milk and body condition score. In the first group, one cow within the pair was fed a diet of pasture and cracked corn and the second cow was fed a diet of pasture and steam flaked corn. In the second group, one cow within the pair was fed a diet of pasture and ground corn and the second cow was fed a diet of pasture and a non-forage fiber based supplement. The ruminal availability and degradation of dry matter and nitrogen was measured.

Results conclude that feeding steamed flake corn on a high quality pasture resulted in lower milk urea nitrogen levels which insinuates animals consuming steamed flake corn developed a more efficient utilization of nitrogen compared with cows fed cracked corn. In feeding a non-forage fiber supplement resulted in an overall higher fat percentage at the time of testing but it did not have an effect on milk production, dry matter intake or milk composition. The overall results concluded that using a starch-based substitute on lower quality pastures could be more beneficial while conversely, a forage based substitute would be more beneficial when cows are grazing on higher quality pastures (Delahoy et al. 2003). The challenge of fulfilling nutrient requirements in organic dairy cows can be assisted with seasonal changes in concentrate sources. This

could be a way for dairy producers to maximize ruminal availability as well as feed efficiency within their herds.

The overall difference in rations of lactating dairy cattle in organic and conventional operations has the potential to affect the behavior of cows in the barn, free stall areas and out on pasture. A study conducted by Langford et al. (2011), conducted in the United Kingdom, was aimed to determine the overall behavior of cows during and after peak feed times on both organic and conventional dairy farms. The farms used in this study were predominately Holstein-Friesian herds that were composed of more than 50 cows. The surveyors attempted to match farms in both organic and conventional sectors. Housing type, genetic merit, herd size and location in the UK were all criteria in which each match pair was chosen. Farm visits were conducted and animals were observed for two and a half days.

Results concluded that feed-bunk face was directly correlated with the aggression of animals in feed bunks. In open-faced feed bunks, animals were shown to be more aggressive. To support this claim, it was also reported that organic cows showed a higher proportion of the herd feeding during the first 80-100 minutes post milking. Because organic animals are not eating a ration that has the same dry matter value as a traditional TMR, Langford et al. (2011) proposed the theory that the lack of concentrates in organic diets provokes Holstein-Friesian cows to exhibit more hunger and therefore show more aggression in the feed bunk to fulfill their nutrient requirements. Langford et al. (2011) continue and discuss options to reduce hunger and their main solution is to select for genetic merit of milk production and feeding practices.

Recent Improvements

Throughout the last 25 years, the dairy industry has noticed a lot of improvements in terms of production, nutritional efficiency, energy requirements and numerous others. Eastridge (2006) complied a review of major advances in applied dairy cattle nutrition. He reported that within the last 25 years, milk yield per how has risen by 2% which has therefore risen the energy requirements and DMI of cattle because of this increase in nutrient demand. This has lead nutritionists to provide rations in dairy production operations that are significantly higher in nutrient density. In order to fulfill this new nutrient density, Eastridge shares that new research has been conducted in the area of feed quality, increasing feedstuff, diet digestibility, alternative ingredients, efficiency of ruminal fermentation and better defining nutrient requirements among ages and lactation groups.

Pasture based feeding systems are one of the newly used methods of nutrition in the dairy industry that have been requiring further research. Rotational grazing on certain forages as well as stages of maturity of forages have been monitored and explored in order to determine the most successful method in which to utilize certain forages. The challenge of maintaining a positive energy balance in transition and early lactation animals that are fed a pasture based diet have also been explored in order to develop diets and methods that could potentially decrease the occurrence of metabolic diseases.

The administration of recombinant Bovine Somatotropin Hormone (rBST) to lactating dairy cows has created a need to reformulate rations in order to support the increased energy requirements. Management practices also need to be better monitored

and improved when administering rBST because cows develop a higher incidence of metabolic diseases, mastitis, decreased reproductive performance and heat stress when their milk yield is at a maximum (Eastridge, 2006).

The conventional dairy industry has the advantage of using supplements, additives, specified animal by-products, pelleted forages, or feed with Ionophores or antibiotics incorporated within it. According to the § 205.237 Livestock feed subpart of the National Organic program, organic producers are prohibited of using or feeding any of the above (NOP, 2013). To work in accordance with the NOP requirements, organic producers have to go without using feed supplements like rumensin that promotes rumen health and feed efficiency. Overall, the organic industry is at a disadvantage in this area because they are not permitted to administer any supplements that can promote health and efficiency.

In terms of nutrition, conventional operations have the overall advantage in ration formulation and utilization of different nutrient sources. Because of the variations of carbohydrate, protein and lipids incorporated in a TMR for conventional cows, they are able to immobilize and translate nutrients better and have an overall higher milk yield and richer composition in the finished product. Though organic operations cannot feed as complex of a ration as conventional operations, they do have an advantage in a reduced production cost because of this reason exactly.

Market Analysis

In order to sell a product, there must be a market in which to sell that given product. The conventional dairy industry has had a steady consumer base across the nation that is composed of all backgrounds, income brackets, level of education and geographic location. The organic dairy industry is a different story. Since the 1990's, the retailing of organic milk has drastically changed because the only places that sold organic milk in the '90's were specialty food stores. Now consumers can find organic milk products sharing shelf space with conventional products in a wide variety of supermarkets across the nation.

Consumer Base

According to a study conducted by Dimitri and Venezia (2005), it has been shown that "purchasers of organic milk are White, high income, and well educated," which is accurate when considering that organic milk has a much higher cost than conventional milk in retail. The same study reported that the eastern and western regions of the United States consumed more organic milk than conventional while it was completely opposite in the central and southern regions of the US.

Dimitri and Venizia (2005) summarized and reported results pertaining to milk type and consumption that were collected in the form of a Nielsen Homescan Panel. This panel was a nationwide panel of 41,000 households that scanned their food purchases at home and recorded price, quantity and characteristics of all food items purchased. From the data collected, data pertaining to milk purchases during the year of 2004 were utilized and a total of 38,375 households purchased milk during the year. From those households

selected, grocery stores accounted for the highest nationwide sale of milk for both organic and conventional products. Table 6 explains the locations for purchase and prices in which products sold for.

Table 6. Percent of milk purchases and average retail prices.

Type of Store	Share of Sales *Organic* (%)	Average Price *Organic* ($)	Share of Sales *Conventional* (%)	Average Price *Conventional* ($)
Grocery Stores	87	3.98	75	2.06
Drug Stores	0	NA	3	1.83
Mass Merchandisers	0	3.63	2	1.80
Supercenters	7	4.08	10	1.84
Club Stores	0	2.20	4	1.99
Other*	5	4.98	3	2.19

*Recreated from Dimitri and Venezia (2005). Milk prices were calculated for half gallon sizes. *Other includes health food stores and small independent stores.*

The Nielsen Homescan panel was taken of the entire US, so this table is not region-specific. By specifying the percentage of sales by region, it would allow readers to interpret which region of the country had the highest demand for organic or conventional milk and the data could be further interpreted and broken down because of the characteristics consumers poses by living in different regions.

This Nielsen Homescan panel was also discussed in Kiesel and Villas-Boas (2007) and through their data interpretation, they found that the implementation of the NOP and the appearance of the USDA seal on products was a causal influence on consumer perception and willingness to buy organic products. The data analyzed suggested that consumers were willing to pay the extra premium in order to assure the authenticity of the product in terms of its label's dedication to health concerns and

environmental sustainability by displaying the USDA Organic label and other important information pertaining to the organic dairy industry.

The entire basis of the organic dairy industry falls upon the consumer perception that an organic dairy product contains more health benefits and has less of an environmental impact than a conventional dairy product. As previously established by Croissant et al. (2007), milk produced from pasture based feeding systems has a higher ratio of unsaturated fatty acids to saturated fatty acids. With the knowledge of unsaturated fatty acids being less detrimental to heart health than saturated fatty acids, we can conclude that organic milk does contain a healthier composition. Note that there have been no confirmed health benefits among human consumption of organic milk in comparison to conventional milk, the conclusion has been drawn based on the fatty acid composition shown in the research conducted by Croissant et al. (2007). With that being said, consumer perception is the entire basis for demand of organic dairy products.

The analysis of fatty acid composition shown in the studies by Croissant et al. (2007) and Ellis et al. (2006), discussed previously, analyzes the differences between organic and conventional production systems and the product produced. The differences discovered regarding fatty acid composition and other components can potentially serve as a determining factor for marketing standpoints between both of these individualized products. Utilization of this knowledge can set organic products far ahead conventional products in both aspects of price and level of sales due to the characteristics of consumers. It has been determined that 51% of organic milk consumers have graduated from college or have completed some sort of post graduate work. This means that this group has a higher level of education which most likely puts them in a higher level of the

income bracket than individuals that have not completed college or post-grad work. Since these individuals are making more money, they are shown to be more likely to purchase organic milk with its higher price simply because they do not share the same financial strains of customers that belong in lower income brackets (Dimitri and Venezia, 2007). The research done in light of benefits of fatty acid composition can be marketed successfully to people within this income bracket and level of education. The sales gained by the organic dairy industry have the potential to show through sales lost in the conventional industry.

The conventional dairy industry already has an established role in the United States today which can be attributed to regulatory, marketing and educational agencies like the National Dairy Council, California Milk Processor Board, Dairy Council of California, the California Milk Advisory Board and others. All of these agencies strive to educate the public on the nutritional value of dairy products in an every-day diet and the industry in which produces them.

When comparing the organic and conventional dairy industry, the organic dairy industry advances in consumer recognition of authenticity because of the highly identified USDA Organic seal. This seal has been gaining recognition year by year with 19% of consumer recognition in 2003 and 40% in 2005 (Dimitri and Venezia, 2005). Being that we are now early in 2013, it is imaginable consumer recognition has grown drastically because of the significant growth the organic dairy industry has experienced in the past eight years.

In response to this increase of consumer recognition, the increase in sales of organic dairy products has followed. A study was conducted by Glaser and Thompson (2000) that was aimed at following and interpreting the demand of organic and conventional beverage milk in supermarkets across the U.S. During the eight years the study covered, it was reported that organic milk sales in supermarkets grew drastically. During the last two years of the study, sales doubled from a recorded $30.1 million in 1997 to $75.5 million in 1999. Again, because this survey was conducted over a decade ago, the drastic growth of sales shown in between 1997-1999 leads us to believe that organic milk sales in recent years have followed the growing trend exhibited in that two year period.

The main reason why the USDA Organic seal receives more customer recognition is because of the validity and authenticity the seal offers. Producers and processors that are able to display the label on their products are promising that they follow every single rule and regulation the USDA has set in place within the National Organic Program. This usually means ruling out the ever-so controversial issue of the use of Recombinant Bovine Somatotropin hormone (**rBST**) in lactating dairy cows. It is known by dairy producers what the effect of rBST has on cows, their production and the milk they produce but unfortunately consumers do not share the same knowledge and understanding.

Anyone involved within the dairy industry knows that using rBST on animals does not translate into elevated levels of BST the milk a cow produces and even if it did, BST is not a hormone human bodies recognize. The numerous misconceptions and false information spread across the media, created and spread by organizations like PETA and

the Humane Society, has left the dairy industry unable to completely clear the bad reputation rBST has developed. These misconceptions are bound to affect the likeliness of choosing organic dairy products, which are promised to not include rBST as stated in the NOP, over conventional dairy products that may or may not have labeling pertaining to the use of rBST. It's an unfortunate truth, but it must be considered because of the competition between organic and conventional dairy products due to consumer bias and false information.

Supply and Demand

The dairy industry has had a very volatile past in pair with the United States economy. The instability of the current economy has left some dairy producers with the idea of completely selling their herd of cows or finding an alternative. This is where the field of Organic Agriculture comes into play because of its perks for producers. Despite the financial struggles experienced by the industry in late 2007 through December of 2010, some dairy producers have been able to overcome financial challenges and expand their profit margin into positive revenue in 2012 by making this transition to organic dairy farming.

It was reported by Dimitri and Venezia (2005) that starting in 2004, the demand for organic milk has been growing much faster than the supply. The positive movement of supply and demand in this new flourishing market allows price premiums for both producers and retailers to increase simultaneously.

Unfortunately, for the conventional dairy industry, they have not been as fortunate. As milk prices peaked in the late months of 2008, so did the supply of

conventional milk. Without having the same demand as before, prices of milk fell in partnership with the stock market crash in late 2008 to early 2009. This left producers with a surplus of milk and very low demand. This caused prices to drop in both the retail and producer front making it harder for producers to make money, with a low milk price and high production costs, and for retailers to get milk off the shelf. The economy has bounced back somewhat from the disaster it was at during 2009, but some conventional dairy farmers are still trying to recover.

Economic Analysis

The number one goal of business owners in any market is profitability. In order to maximize profitability, efficient management practices need to be implemented, a market analysis needs to be made to determine the projected success of the given business and an economic analysis needs to be considered in order to determine if this business is worth opening or continuing.

In the dairy industry, there are many factors that need to be taken into consideration when starting or just simply continuing to run a dairy husbandry operation. Cost of production as well as revenue for product sales are two of the main aspects that need to be considered. Ever since the economic downturn occurred at the end of 2008, dairy producers have had a very difficult time maximizing profitability during these past four years because of the sky high feed costs and the all-time low milk prices. In December of 2008, the California Department of Food and Agriculture reported milk pooling prices as $14.11 for quota milk and $12.41 for base milk, which was a $3 decrease from prices in October (CDFA, 2008). This drastic decrease in milk prices occurred because there was entirely too much milk in the supply and nowhere for it to go. Since milk supply and production were at an all-time high, demand of commodities were also in high demand. Feed co-ops were able to charge excessively high corn, hay, soybean and other commodity prices to producers because they knew, regardless, they needed the product so they would have to buy it.

The conventional and organic dairy industries in California both have completely different bases in which pricing of their milk is calculated. Conventional pricing is

calculated by the California Department of Food and Agriculture's Animal and Food Safety Division. Specifically, it is within Milk & Dairy Foods Safety subcategory: Milk Pooling Branch.

Pricing and Stabilization

Price volatility and instability has historically been a national trend in the dairy industry. During the Great Depression, dairy farmers experienced a drastic drop in prices causing widespread economic distress among dairy farmers everywhere. This economic downturn was very similar to what occurred to present day dairymen in 2009. In response to this price drop, the Agricultural Act of 1949 was established in order to create a milk price support program for producers in hopes that this would not happen again. The 50 years preceding the pass of this farm bill, aspects were amended because of the drastic evolution of the practices pertaining to milk processing, producing and marketing. In 1981, a change in pricing formulation made a move away from the volatility of parity pricing to a more stable set price which is written into legislation, making it harder for changes to be made in a short period of time. In 1996, a Farm Act was implemented that had intentions to change the stability of support pricing (Manchester and Blayney, 2001). Overall, price stabilization has come into great use within the past five years because of the economic crisis producers across the nation fell subject to in 2009.

Pricing systems across the nation are based on various elements that directly impact the dairy industry. These elements consist of the cost of production, price relation to the federal milk marketing orders, economic formulas and hearings which involves producers, processors and consumer groups (Manchester and Blayney, 2001).

California Milk Pool Pricing

California has a completely separate pricing system that was partially derived from the federal pricing system but has been adjusted to meet and fill the needs of dairy producers across our unique state. The Young Act of 1935 created price regulation amongst producers and created a minimum price in which fluid milk would be paid on. Standards were developed and considered when formulating and establishing prices and they are as follows:

- "A reasonable and sound economic relationship with the price of manufacturing grade milk,
- Current and prospective supply and demand relationships for fluid milk and,
- Assuring an adequate, continuous supply of pure, wholesome milk to consumers at fair and reasonable prices." (Manchester and Blayney, 2001)

This new price formulation, which at this time did not include pooling, allowed some producers that had high priority within Class I to poses an unfair advantage in pricing. To counteract the Young Act, the Gonsalves Milk Pooling Act of 1967 established an effective system in which producers across the state would be paid fairly (Manchester and Blayney, 2001). This milk pooling system is still in effect today in California.

The California Department of Food and Agriculture (CDFA), Milk pooling branch formulates milk prices per hundred weight (CWT) in which all creameries and cooperatives in the state of California must issue at the least to their producers. The

California pool price for CWT, fat and solids not fat are announced monthy. Cooperatives have the opportunity to add quality bonuses on top of the price as well as pay differently on the total solids of components such as butterfat and solids not fat. The California producer pool price is calculated by the operations unit located within the Milk Pooling Branch of the CDFA. The price is calculated based on milk receipts and usage reports which are submitted by all milk handlers within the state and minimum class prices which are announced by the Dairy Marketing Branch. The operations unit also monitors quota in terms of transfers and how much each producer owns. Economic and research analysts are widely incorporated in order to closely monitor the pooling plan and stabilization and marketing plans for market milk (CDFA, 2012).

Quota is very important to have in the conventional dairy industry because having quota ensures producers a higher pay price for their milk than producers without quota. Quota is sold in pounds of producers but it is very common for producers to own less pounds of quota than what they are actually producing though the goal is to own enough quota to match production. Matching quota pounds with pounds of production maximizes income from milk. Quota price is determined and paid on a CWT basis. Base price is the price producers receive without quota and it runs traditionally $1.70/CWT less than quota price. Overbase is the price producers receive for the milk that surpasses their limit of milk that they are set to produce and this price is usually the same as base price (CDFA, 2008).

Within the last ten years, many strides have been made in the direction of price stabilization for producers due to the volatility of the past. In 1993, futures and options

contracts in products other than butter were added to the futures market. It has greatly helped producers with price risk management (Manchester and Blayney, 2001).

Creamery or Cooperative Milk Pricing

Pricing of each type of milk is calculated and weighted similarly, but in fact, both are not calculated the same. Both organic and conventional pricing systems pay on pounds of milk produced, pounds of fat (or butterfat) and pounds of solids not fat (SNF). Different cooperatives offer bonuses for quality and compliance of standards (some cooperatives have certain standards they try to enforce and sometimes offering a bonus is the perfect incentive). The formulated prices in both organic and conventional production systems are the same and are based on a minimum 3.5% fat and 8.7% SNF test (CDFA, 2008).

Conventional and organic producers are paid differently because of the presence or lack of quota. Conventional producers are rewarded with slightly elevated prices when they own a certain amount of pounds quota compared to the base and overbase prices. Organic producers can be paid an elevated price based on quota but that is usually determined by the creamery or cooperative in which producers ship their milk to. Some cooperatives do not acknowledge quota but they pay their producers a few more dollars per CWT of milk to make up for the fact. In the organic market, cooperatives are attempting to eliminate the presence of quota because they believe their producers should all be paid the same prices because they all produce the same type and quality of product.

In the course of my research, I have developed the goal to accurately compare pricing systems of both industries. In order to analyze and report on accurate milk pricing

models, I have obtained four copies of both organic and conventional producer pricing information from different dairy producers whose identities will remain anonymous. Each pricing model that is provided is authentic. The reports indicate each individual production level, quality of milk, pounds of fat, pounds of SNF, and prices based on quota, base and overbase. The producers I was able to obtain information from shipped their milk to two organic and two conventional cooperatives, respectively: Organic Valley, Sierra Organics, Safeway-Lucerne and Dairy Farmers of America.

First, conventional milk pricing will be evaluated and compared between cooperatives and creameries. Then organic milk pricing will be evaluated. Following both separate evaluations, a comparison will be made.

A milk receipt from a Dairy Farmers of America (DFA) producer was obtained for pricing comparison in terms of what the cooperative was offering in terms of components, quality and other factors. Figure 2 shows the pricing invoice for this producer. All of the producer information has been removed. This receipt was for milk produced in July of 2012. A Lucerne-Safeway milk shipper also provided the following milk receipt for the month of January 2011 which is shown in Figure 3. All producer information has been removed as well.

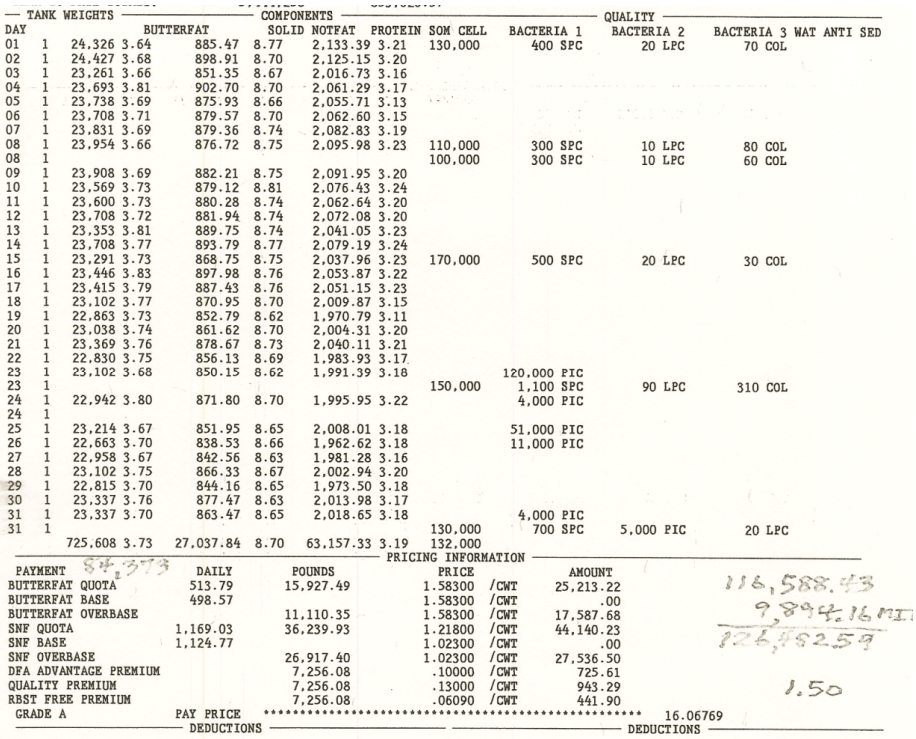
All of the prices listed and specified are the price of each category based on pounds of milk that contribute to the overall price per hundred weight.

Overall DFA offers more premiums for producers on top of their payment of pounds of fat and SNF. They offer a quality bonus of producers of $0.1300 as well as a rBST Free premium of $0.0609 and a DFA advantage premium of $0.100. Lucerne does

not offer as many added on bonuses for producers. They only offer a quality bonus of $0.1000 and a compliance allowance premium of $0.4000. In 2012, DFA quoted producers a lower price for pounds of butterfat than did Lucerne in 2011. This can be attributed to a trend in the market prices and demand during each year or it could be because Lucerne offers higher prices for producer components in order to maximize producers utilization of high components testing.

Lucerne barely bypasses DFA's price of $16.06769/CWT with $16.6285/CWT for both of these given producers but this can be attributed to the fact that the Lucerne producer also had a higher average SNF test for the month than did the DFA producer. Overall, this pricing method is variable and CWT of milk can vary month by month based on season and feeding practices which directly affect components testing.

Figure 1. DFA producer milk receipt for July 2012.



— TANK WEIGHTS — — COMPONENTS — — QUALITY —

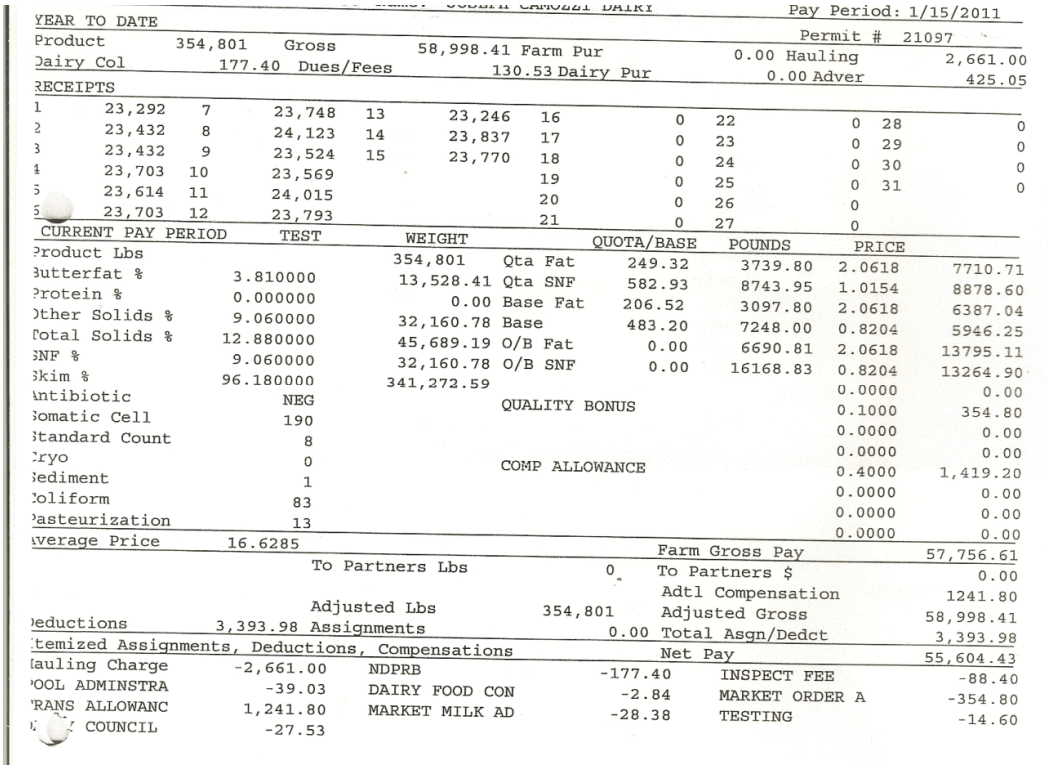
DAY		BUTTERFAT		SOLID NOTFAT		PROTEIN	SOM CELL	BACTERIA 1	BACTERIA 2	BACTERIA 3 WAT ANTI SED
01	1	24,326	3.64	885.47	8.77	2,133.39 3.21	130,000	400 SPC	20 LPC	70 COL
02	1	24,427	3.68	898.91	8.70	2,125.15 3.20				
03	1	23,261	3.66	851.35	8.67	2,016.73 3.16				
04	1	23,693	3.81	902.70	8.70	2,061.29 3.17				
05	1	23,738	3.69	875.93	8.66	2,055.71 3.13				
06	1	23,708	3.71	879.57	8.70	2,062.60 3.15				
07	1	23,831	3.69	879.36	8.74	2,082.83 3.19				
08	1	23,954	3.66	876.72	8.75	2,095.98 3.23	110,000	300 SPC	10 LPC	80 COL
08	1						100,000	300 SPC	10 LPC	60 COL
09	1	23,908	3.69	882.21	8.75	2,091.95 3.20				
10	1	23,569	3.73	879.12	8.81	2,076.43 3.24				
11	1	23,600	3.73	880.28	8.74	2,062.64 3.20				
12	1	23,708	3.72	881.94	8.74	2,072.08 3.20				
13	1	23,353	3.81	889.75	8.74	2,041.05 3.23				
14	1	23,708	3.77	893.79	8.77	2,079.19 3.24				
15	1	23,291	3.73	868.75	8.75	2,037.96 3.23	170,000	500 SPC	20 LPC	30 COL
16	1	23,446	3.83	897.98	8.76	2,053.87 3.22				
17	1	23,415	3.79	887.43	8.76	2,051.15 3.23				
18	1	23,102	3.77	870.95	8.70	2,009.87 3.15				
19	1	22,863	3.73	852.79	8.62	1,970.79 3.11				
20	1	23,038	3.74	861.62	8.70	2,004.31 3.20				
21	1	23,369	3.76	878.67	8.73	2,040.11 3.21				
22	1	22,830	3.75	856.13	8.69	1,983.93 3.17				
23	1	23,102	3.68	850.15	8.62	1,991.39 3.18		120,000 PIC		
23	1						150,000	1,100 SPC	90 LPC	310 COL
24	1	22,942	3.80	871.80	8.70	1,995.95 3.22		4,000 PIC		
24	1									
25	1	23,214	3.67	851.95	8.65	2,008.01 3.18		51,000 PIC		
26	1	22,663	3.70	838.53	8.66	1,962.62 3.18		11,000 PIC		
27	1	22,958	3.67	842.56	8.63	1,981.28 3.16				
28	1	23,102	3.75	866.33	8.67	2,002.94 3.20				
29	1	22,815	3.70	844.16	8.65	1,973.50 3.18				
30	1	23,337	3.76	877.47	8.63	2,013.98 3.17				
31	1	23,337	3.70	863.47	8.65	2,018.65 3.18		4,000 PIC		
31	1						130,000	700 SPC	5,000 PIC	20 LPC
		725,608	3.73	27,037.84	8.70	63,157.33 3.19	132,000			

— PRICING INFORMATION —

PAYMENT	DAILY	POUNDS	PRICE		AMOUNT
BUTTERFAT QUOTA	513.79	15,927.49	1.58300	/CWT	25,213.22
BUTTERFAT BASE	498.57		1.58300	/CWT	.00
BUTTERFAT OVERBASE		11,110.35	1.58300	/CWT	17,587.68
SNF QUOTA	1,169.03	36,239.93	1.21800	/CWT	44,140.23
SNF BASE	1,124.77		1.02300	/CWT	.00
SNF OVERBASE		26,917.40	1.02300	/CWT	27,536.50
DFA ADVANTAGE PREMIUM		7,256.08	.10000	/CWT	725.61
QUALITY PREMIUM		7,256.08	.13000	/CWT	943.29
RBST FREE PREMIUM		7,256.08	.06090	/CWT	441.90
GRADE A	PAY PRICE	**********			16.06769

— DEDUCTIONS — — DEDUCTIONS —

Figure 2. Lucerne-Safeway producer milk receipt from January 2011.



YEAR TO DATE										Pay Period: 1/15/2011	
Product	354,801	Gross		58,998.41	Farm Pur					Permit # 21097	
Dairy Col	177.40	Dues/Fees		130.53	Dairy Pur			0.00	Hauling		2,661.00
RECEIPTS								0.00	Adver		425.05
1	23,292	7	23,748	13	23,246	16	0	22	0	28	0
2	23,432	8	24,123	14	23,837	17	0	23	0	29	0
3	23,432	9	23,524	15	23,770	18	0	24	0	30	0
4	23,703	10	23,569			19	0	25	0	31	0
5	23,614	11	24,015			20	0	26	0		
6	23,703	12	23,793			21	0	27	0		

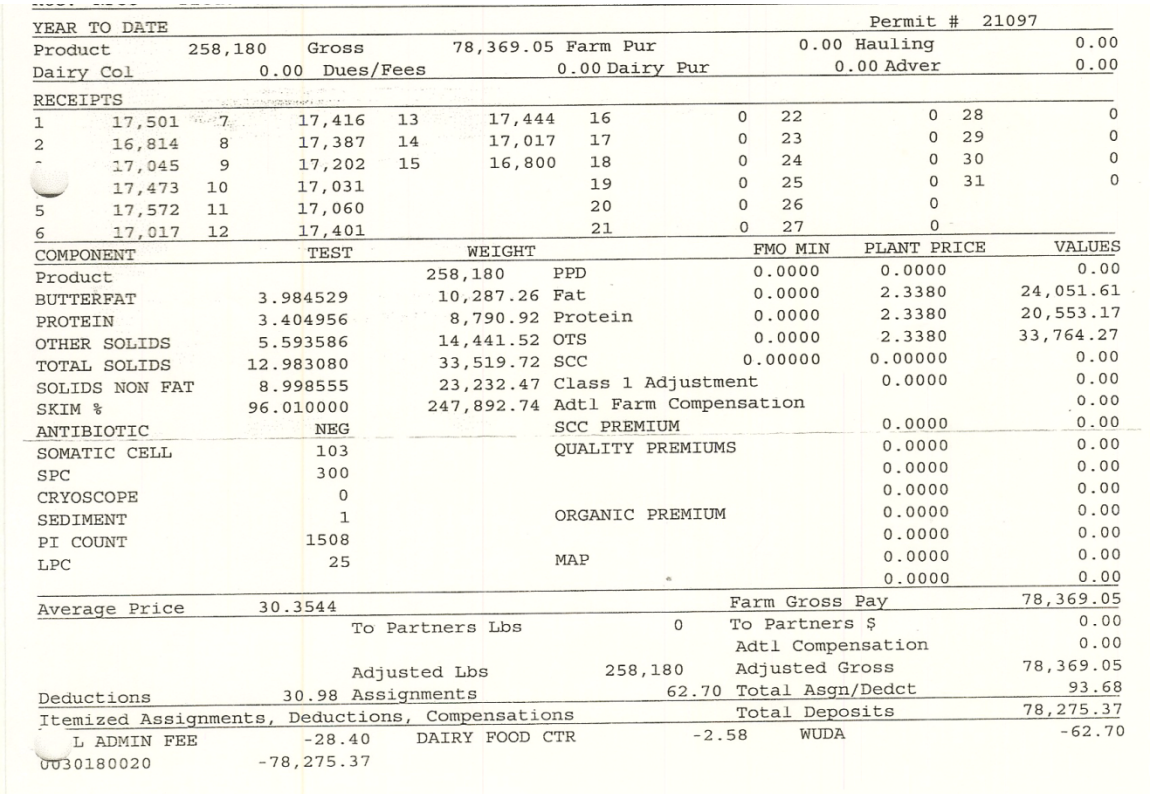
CURRENT PAY PERIOD	TEST	WEIGHT		QUOTA/BASE	POUNDS	PRICE	
Product Lbs		354,801	Qta Fat	249.32	3739.80	2.0618	7710.71
Butterfat %	3.810000	13,528.41	Qta SNF	582.93	8743.95	1.0154	8878.60
Protein %	0.000000	0.00	Base Fat	206.52	3097.80	2.0618	6387.04
Other Solids %	9.060000	32,160.78	Base	483.20	7248.00	0.8204	5946.25
Total Solids %	12.880000	45,689.19	O/B Fat	0.00	6690.81	2.0618	13795.11
SNF %	9.060000	32,160.78	O/B SNF	0.00	16168.83	0.8204	13264.90
Skim %	96.180000	341,272.59				0.0000	0.00
Antibiotic	NEG		QUALITY BONUS			0.1000	354.80
Somatic Cell	190					0.0000	0.00
Standard Count	8					0.0000	0.00
Cryo	0		COMP ALLOWANCE			0.4000	1,419.20
Sediment	1					0.0000	0.00
Coliform	83					0.0000	0.00
Pasteurization	13					0.0000	0.00
Average Price	16.6285				Farm Gross Pay		57,756.61
		To Partners Lbs		0	To Partners $		0.00
					Adtl Compensation		1241.80
		Adjusted Lbs		354,801	Adjusted Gross		58,998.41
Deductions	3,393.98	Assignments		0.00	Total Asgn/Dedct		3,393.98
Itemized Assignments, Deductions, Compensations					Net Pay		55,604.43
Hauling Charge	-2,661.00	NDPRB		-177.40	INSPECT FEE		-88.40
POOL ADMINSTRA	-39.03	DAIRY FOOD CON		-2.84	MARKET ORDER A		-354.80
TRANS ALLOWANC	1,241.80	MARKET MILK AD		-28.38	TESTING		-14.60
[illegible] COUNCIL	-27.53						

Next organic milk receipts will be compared for Organic Valley and Sierra Organics. Organic Valley is a national cooperative and has producers across the country mainly in the mid west and the east coast. In the last five years, Organic Valley has picked up multiple producers in Northern California and in the Central Valley. Sierra Organics is a California based cooperative, out of Chino and only have dairies in California at this time.

An Organic Valley milk receipt was obtained from the month of December 2012, shown in Figures 4, 5 and 6 and the Sierra Organics milk receipt, shown in Figure 7, was obtained for the month of January 2013. Producer information has also been removed to

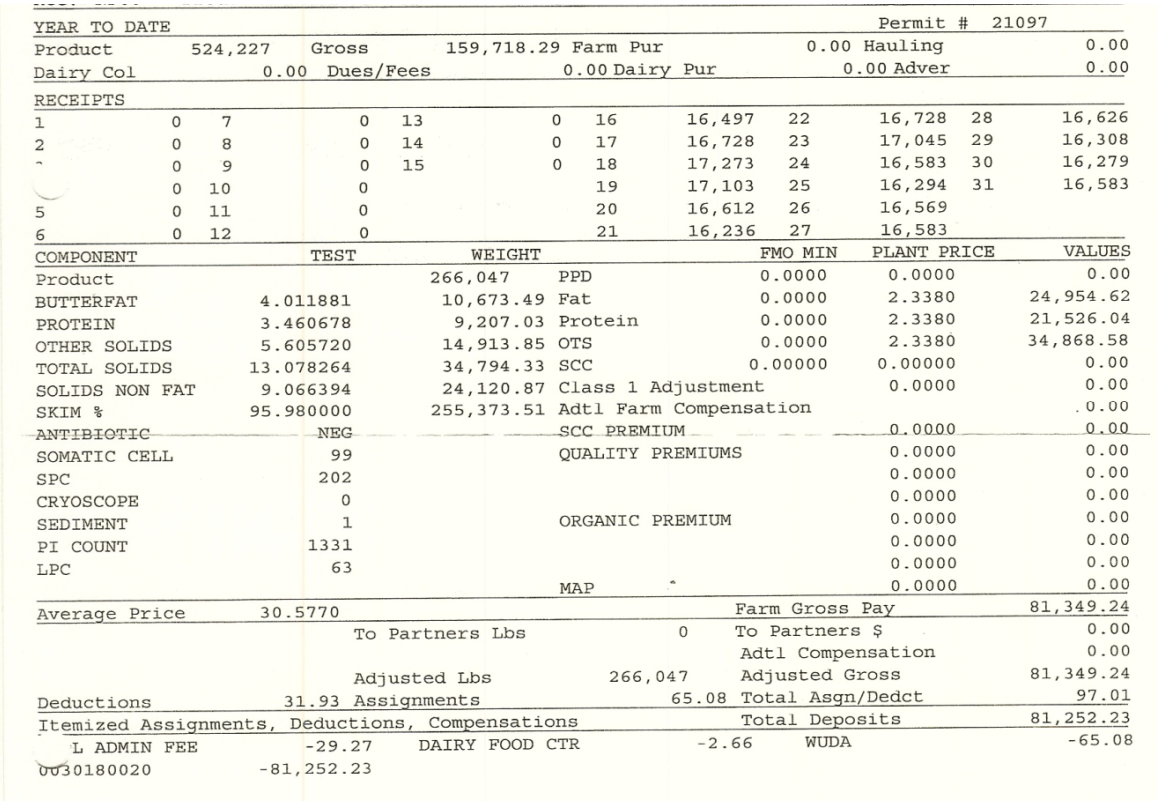
keep the anonymity of the producer. Organic Valley sends out three reports and pays producers in three checks per month. All three milk receipts are shown here in order of how producers receive them. The last check sent out is significantly smaller than the first two because it only pays out the premiums the producer received for the month.

Figure 3. Organic Valley producer milk receipt for pay period through December 15, 2012.



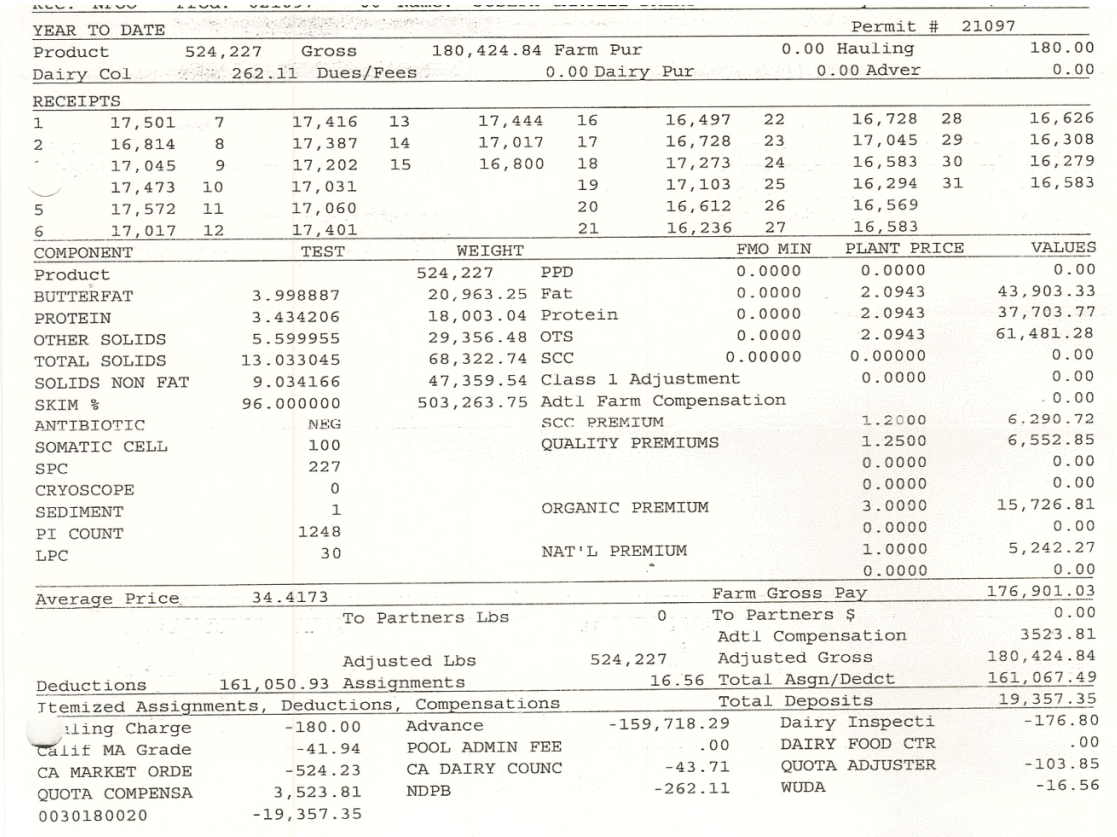
YEAR TO DATE											Permit #	21097	
Product	258,180	Gross		78,369.05	Farm Pur			0.00	Hauling				0.00
Dairy Col		0.00	Dues/Fees		0.00	Dairy Pur			0.00	Adver			0.00
RECEIPTS													
1	17,501	7	17,416	13	17,444	16	0	22	0	28	0		
2	16,814	8	17,387	14	17,017	17	0	23	0	29	0		
[illegible]	17,045	9	17,202	15	16,800	18	0	24	0	30	0		
	17,473	10	17,031			19	0	25	0	31	0		
5	17,572	11	17,060			20	0	26	0				
6	17,017	12	17,401			21	0	27	0				
COMPONENT		TEST		WEIGHT			FMO MIN		PLANT PRICE			VALUES	
Product				258,180	PPD		0.0000		0.0000			0.00	
BUTTERFAT		3.984529		10,287.26	Fat		0.0000		2.3380			24,051.61	
PROTEIN		3.404956		8,790.92	Protein		0.0000		2.3380			20,553.17	
OTHER SOLIDS		5.593586		14,441.52	OTS		0.0000		2.3380			33,764.27	
TOTAL SOLIDS		12.983080		33,519.72	SCC		0.00000		0.00000			0.00	
SOLIDS NON FAT		8.998555		23,232.47	Class 1 Adjustment				0.0000			0.00	
SKIM %		96.010000		247,892.74	Adtl Farm Compensation							0.00	
ANTIBIOTIC		NEG			SCC PREMIUM				0.0000			0.00	
SOMATIC CELL		103			QUALITY PREMIUMS				0.0000			0.00	
SPC		300							0.0000			0.00	
CRYOSCOPE		0							0.0000			0.00	
SEDIMENT		1			ORGANIC PREMIUM				0.0000			0.00	
PI COUNT		1508							0.0000			0.00	
LPC		25			MAP				0.0000			0.00	
									0.0000			0.00	
Average Price		30.3544							Farm Gross Pay			78,369.05	
			To Partners Lbs			0			To Partners $			0.00	
									Adtl Compensation			0.00	
			Adjusted Lbs			258,180			Adjusted Gross			78,369.05	
Deductions		30.98	Assignments			62.70			Total Asgn/Dedct			93.68	
Itemized Assignments, Deductions, Compensations									Total Deposits			78,275.37	
L ADMIN FEE		-28.40	DAIRY FOOD CTR			-2.58			WUDA			-62.70	
0030180020		-78,275.37											

Figure 4. Organic Valley producer milk receipt for pay period of December 15, 2012 through December 31, 2012.



YEAR TO DATE												Permit #	21097
Product	524,227	Gross	159,718.29	Farm Pur				0.00	Hauling				0.00
Dairy Col	0.00	Dues/Fees	0.00	Dairy Pur				0.00	Adver				0.00
RECEIPTS													
1	0 7	0	13	0	16	16,497	22	16,728	28	16,626			
2	0 8	0	14	0	17	16,728	23	17,045	29	16,308			
[illegible]	0 9	0	15	0	18	17,273	24	16,583	30	16,279			
	0 10	0			19	17,103	25	16,294	31	16,583			
5	0 11	0			20	16,612	26	16,569					
6	0 12	0			21	16,236	27	16,583					
COMPONENT	TEST	WEIGHT					FMO MIN	PLANT PRICE	VALUES				
Product		266,047	PPD				0.0000	0.0000	0.00				
BUTTERFAT	4.011881	10,673.49	Fat				0.0000	2.3380	24,954.62				
PROTEIN	3.460678	9,207.03	Protein				0.0000	2.3380	21,526.04				
OTHER SOLIDS	5.605720	14,913.85	OTS				0.0000	2.3380	34,868.58				
TOTAL SOLIDS	13.078264	34,794.33	SCC				0.00000	0.00000	0.00				
SOLIDS NON FAT	9.066394	24,120.87	Class 1 Adjustment					0.0000	0.00				
SKIM %	95.980000	255,373.51	Adtl Farm Compensation						0.00				
ANTIBIOTIC	NEG		SCC PREMIUM					0.0000	0.00				
SOMATIC CELL	99		QUALITY PREMIUMS					0.0000	0.00				
SPC	202							0.0000	0.00				
CRYOSCOPE	0							0.0000	0.00				
SEDIMENT	1		ORGANIC PREMIUM					0.0000	0.00				
PI COUNT	1331							0.0000	0.00				
LPC	63							0.0000	0.00				
			MAP					0.0000	0.00				
Average Price	30.5770						Farm Gross Pay		81,349.24				
	To Partners Lbs		0				To Partners $		0.00				
							Adtl Compensation		0.00				
	Adjusted Lbs		266,047				Adjusted Gross		81,349.24				
Deductions	31.93	Assignments	65.08				Total Asgn/Dedct		97.01				
Itemized Assignments, Deductions, Compensations							Total Deposits		81,252.23				
L ADMIN FEE	-29.27	DAIRY FOOD CTR	-2.66				WUDA		-65.08				
0030180020	-81,252.23												

Figure 5. Organic Valley producer milk premium and bonus receipt for pay period of December 2012.



YEAR TO DATE — Permit # 21097

Product	524,227	Gross	180,424.84	Farm Pur	0.00	Hauling	180.00				
Dairy Col	262.11	Dues/Fees	0.00	Dairy Pur	0.00	Adver	0.00				

RECEIPTS

1	17,501	7	17,416	13	17,444	16	16,497	22	16,728	28	16,626
2	16,814	8	17,387	14	17,017	17	16,728	23	17,045	29	16,308
	17,045	9	17,202	15	16,800	18	17,273	24	16,583	30	16,279
	17,473	10	17,031			19	17,103	25	16,294	31	16,583
5	17,572	11	17,060			20	16,612	26	16,569		
6	17,017	12	17,401			21	16,236	27	16,583		

COMPONENT	TEST	WEIGHT		FMO MIN	PLANT PRICE	VALUES
Product		524,227	PPD	0.0000	0.0000	0.00
BUTTERFAT	3.998887	20,963.25	Fat	0.0000	2.0943	43,903.33
PROTEIN	3.434206	18,003.04	Protein	0.0000	2.0943	37,703.77
OTHER SOLIDS	5.599955	29,356.48	OTS	0.0000	2.0943	61,481.28
TOTAL SOLIDS	13.033045	68,322.74	SCC	0.00000	0.00000	0.00
SOLIDS NON FAT	9.034166	47,359.54	Class 1 Adjustment		0.0000	0.00
SKIM %	96.000000	503,263.75	Adtl Farm Compensation			0.00
ANTIBIOTIC	NEG		SCC PREMIUM		1.2000	6,290.72
SOMATIC CELL	100		QUALITY PREMIUMS		1.2500	6,552.85
SPC	227				0.0000	0.00
CRYOSCOPE	0				0.0000	0.00
SEDIMENT	1		ORGANIC PREMIUM		3.0000	15,726.81
PI COUNT	1248				0.0000	0.00
LPC	30		NAT'L PREMIUM		1.0000	5,242.27
					0.0000	0.00

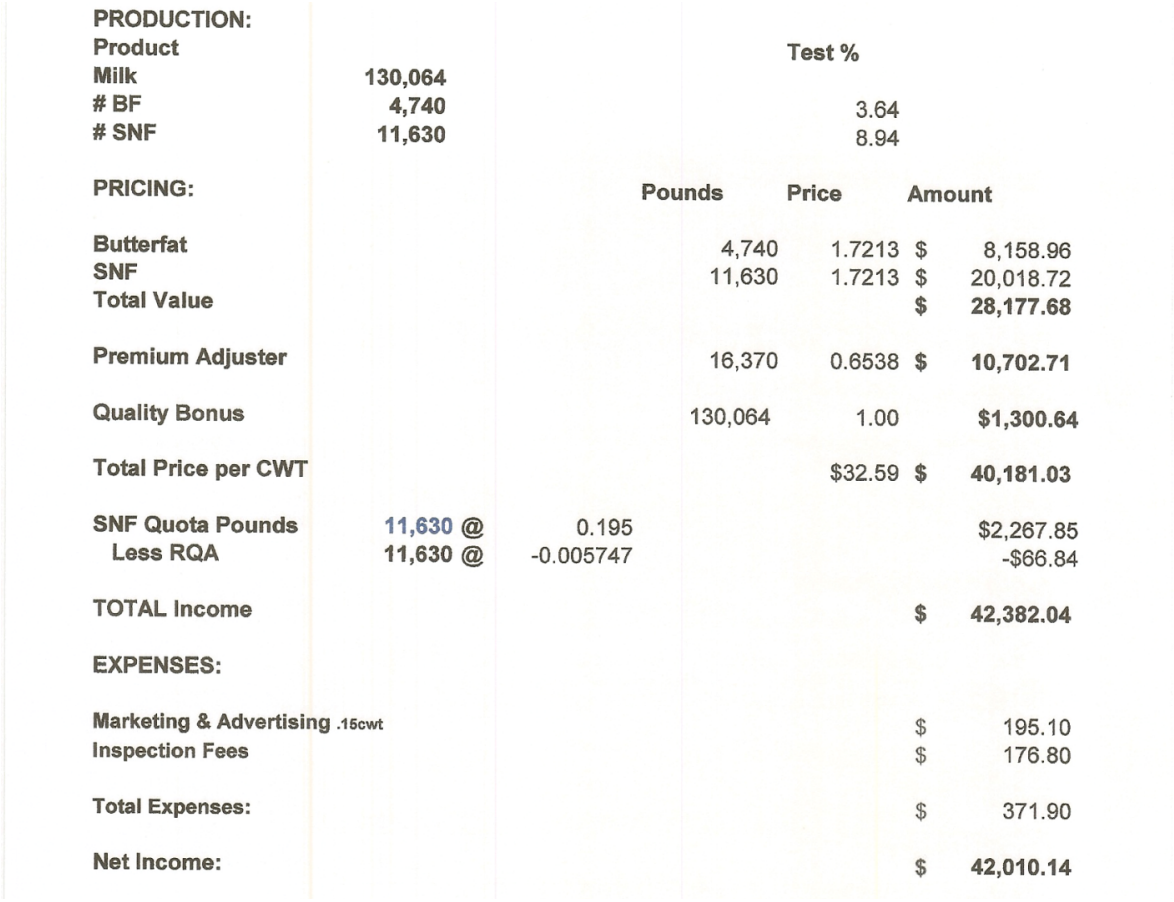
Average Price	34.4173			Farm Gross Pay	176,901.03
	To Partners Lbs	0		To Partners $	0.00
				Adtl Compensation	3523.81
	Adjusted Lbs	524,227		Adjusted Gross	180,424.84
Deductions	161,050.93	Assignments	16.56	Total Asgn/Dedct	161,067.49
				Total Deposits	19,357.35

Itemized Assignments, Deductions, Compensations

...ling Charge	-180.00	Advance	-159,718.29	Dairy Inspecti	-176.80
Calif MA Grade	-41.94	POOL ADMIN FEE	.00	DAIRY FOOD CTR	.00
CA MARKET ORDE	-524.23	CA DAIRY COUNC	-43.71	QUOTA ADJUSTER	-103.85
QUOTA COMPENSA	3,523.81	NDPB	-262.11	WUDA	-16.56
0030180020	-19,357.35				

Organic Valley is an example of an organic cooperative that has eliminated the use of quota and instead, has implemented an organic premium of $3.00 higher when compared to other organic cooperatives like Sierra Organics. They also offer a low SCC premium of $1.20 on top of their quality bonus which is $1.25. This gives producers the opportunity to really make some extra income by striving for high milk quality. Overall, this Organic Valley producer was able to walk away with $34.4173/CWT for their organic milk.

Figure 6. Sierra producer milk receipt.



PRODUCTION:						
Product				**Test %**		
Milk	130,064					
# BF	4,740			3.64		
# SNF	11,630			8.94		
PRICING:			**Pounds**	**Price**		**Amount**
Butterfat			4,740	1.7213	$	8,158.96
SNF			11,630	1.7213	$	20,018.72
Total Value					$	**28,177.68**
Premium Adjuster			16,370	0.6538	$	**10,702.71**
Quality Bonus			130,064	1.00		**$1,300.64**
Total Price per CWT				$32.59	$	**40,181.03**
SNF Quota Pounds	11,630 @	0.195				$2,267.85
Less RQA	11,630 @	-0.005747				-$66.84
TOTAL Income					$	**42,382.04**
EXPENSES:						
Marketing & Advertising .15cwt					$	195.10
Inspection Fees					$	176.80
Total Expenses:					$	371.90
Net Income:					$	**42,010.14**

Sierra Organics is an example of an organic cooperative that pays producers based on pounds of quota SNF that they have which is usually left over from when they were producing in the conventional dairy industry. Sierra Organics only offers a premium adjuster of $0.6538 and a quality bonus of $1.00 for their producers. With fat and SNF tests, the total price per CWT for this Sierra Organic milk producer caps off at around $32.59/CWT.

Organic milk prices have a trend of being higher because in formulating these prices, production costs are taken into account. In the organic agriculture industry,

organic commodities run at a drastically higher price than do conventional commodities. Because of the high expenses in feed costs, organic producers try and limit their rations to only a few types of concentrates and forages to keep production costs down. In this next section, the production costs of organic and conventional dairy farming will be explored in greater detail, specifically in the area of feed costs.

Feed Costs and Prices

The intensive grazing practices organic dairy production calls for results in less feed per cow and therefore results in higher income over feed costs in the long run. This main difference economically is the large reduction in cost of production that organic dairy farmers have over conventional dairy farmers. Based on the rations that were formulated and discussed earlier in *Nutrition*, it is very clear that conventional producers utilize more concentrates and additives in the diets of their cows which show up very prominently in their production costs.

Commodity prices have had a very volatile past since the economic crash at the end of 2008. Record high prices were issued in the areas of corn, soybeans as well as other commodities used in the dairy industry. This has left producers that are still in business today with a lot of unpaid debt to feed companies and commodity distributors.

Traditionally, organic commodities are significantly more expensive than conventional commodities because of the difficulties farmers encounter in raising them. They too have to be organically certified through an agency in order to grow and distribute commodities into other branches of organic agriculture. This takes a lot of time and money because section § 205.202 Land requirements under the NOP requires a three

year transition or holding period in which farmers must wait upon certification to start planting and harvesting crops for organic use (United States Government Printing Office, 2013). Organic commodity producers also cannot use any synthetic pesticides as well as numerous other compounds, as specified clearly in section "§ 205.602 Nonsynthetic substances prohibited for use in organic crop production" of the NOP, in the production and harvest of any given crop that is intended for further organic usage (United States Government Printing Office, 2013). They too must also submit paperwork and organic systems planning in order to become a certified operation. Because of all of these demands and obstacles, like organic milk producers, organic commodity producers are able to charge and receive a higher price for their commodities produced.

Along with the milk receipts that were obtained from producers (shown above), two dairy producers, one organic and one conventional, shared their feed costs. Figure 7 shows the pricing between the two operations. All producer information was removed to create anonymity.

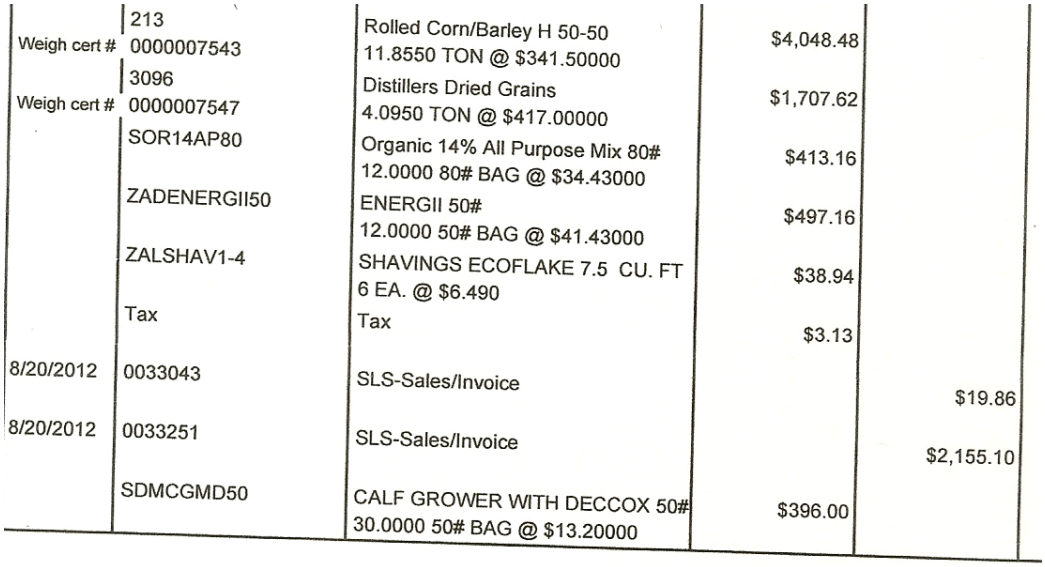
Organic prices for corn grain mixed fed in this operation were charged to producers at $658.87 per ton. This producer administered corn to cows in the form of a mixed grain that was made for this producer. "Organic Sp Dairy Mix" consists of the following: corn, barley, soybean meal, wheat mill run, wheat, wheat-ground limestone, sodium bicarbonate, salt, zinc sulfate, mangenous sulfate, magnesium oxide, calcium chloride, vitamin E supplement, copper sulfate, sodium selenite, vitamin A, iron sulfate, vitamin D3, ethylenediamine dihydroidide and coba carbonate. All of these ingredients are allowed for use in organic ruminant animals.

Figure 7. Organic feed invoice.

Date	Document Number / Item Number	Description	Extended Price	Amount Due
12/31/2012		BBF-Balance Brought Forward		$90,583.25
1/7/2013	0050431	SLS-Sales/Invoice		$2,691.52
	1410	Organic Sp Dairy Mix (1410)	$2,691.52	
Weigh cert #	0000012706	4.0850 TON @ $658.87882		
1/7/2013	0050461	SLS-Sales/Invoice		$2,314.40
	SORCSM80	ORGANIC CALF STARTER MIX 80# 14.0000 80# BAG @ $38.95000	$545.30	
	ZALSHAV1-4	SHAVINGS ECOFLAKE 7.5 CU. FT 36 EA. @ $5.500	$198.00	
	ZOFHYLM50	HYDRATED LIME 50# (50/Pallet) 2 EA. @ $10.240	$20.48	
	SORCSM80	ORGANIC CALF STARTER MIX 80# 21.0000 80# BAG @ $38.95000	$817.95	
	SOR14AP80	Organic 14% All Purpose Mix 80# 16.0000 80# BAG @ $37.17000	$594.72	
	ZTPDCS50	TRI PRO DOG 50# (ADULT) 1 EA. @ $23.750	$23.75	
	HAULFB2	HAULING @$35 PER TON 5,382.0000 LBS. @ $0.01750	$94.19	
	Tax	Tax	$20.01	
1/8/2013	0050405	SLS-Sales/Invoice		$39.76
1/11/2013	0051147	SLS-Sales/Invoice		$5,353.40
	1410	Organic Sp Dairy Mix (1410)	$5,353.40	
Weigh cert #	0000012918	8.1250 TON @ $658.88000		

CONTINUED

Figure 8. Part of a conventional feed invoice.



	213	Rolled Corn/Barley H 50-50	$4,048.48	
Weigh cert #	0000007543	11.8550 TON @ $341.50000		
	3096	Distillers Dried Grains	$1,707.62	
Weigh cert #	0000007547	4.0950 TON @ $417.00000		
	SOR14AP80	Organic 14% All Purpose Mix 80#	$413.16	
		12.0000 80# BAG @ $34.43000		
	ZADENERGII50	ENERGII 50#	$497.16	
		12.0000 50# BAG @ $41.43000		
	ZALSHAV1-4	SHAVINGS ECOFLAKE 7.5 CU. FT	$38.94	
		6 EA. @ $6.490		
	Tax	Tax	$3.13	
8/20/2012	0033043	SLS-Sales/Invoice		$19.86
8/20/2012	0033251	SLS-Sales/Invoice		$2,155.10
	SDMCGMD50	CALF GROWER WITH DECCOX 50#	$396.00	
		30.0000 50# BAG @ $13.20000		

***Please disregard the Organic 14% All Purpose Mix; this producer was in the middle of transition during the month of August 2012*

Only four months earlier, in August of 2012, this conventional producer paid $341.50 per ton of rolled corn and barley, almost exactly half of what organic producers pay.

Overall, production costs in terms of feed are much higher for organic producers but large scale conventional producers can surpass these organic producers because they have such diversified rations as shown in Figure 9.

When prices rise, conventional producers have the potential to be hit twice as hard by raised commodity prices because they are using twice the amount of commodities than are organic producers. Feed contracting is a constructive way to eliminate variability and volatility of prices.

A study conducted by Winsten et al. (2010) supports this producer data which insinuates that pasture based (sometimes organic) operations have lower production costs across the board than do conventional producers. This study was conducted by issuing surveys to dairy farmers in the Northeastern region of the United States. Overall the study had 1,026 respondents that were classified in one of three production system categories: rotational grazing or management-intensive grazing, large modern confinement or traditional (incorporates pasture in a less intensive manner and has not specialized into either of the preceding groups). Overall it was determined that the rotational grazing and large confinement production systems had an overall greater satisfaction with the financial progress of their operation during the past five years when compared to traditional production systems. This can be attributed to the main difference of all together lower operating costs in rotational grazing systems and successfully capturing economies of scale with new production technologies like rBST and different crop management (Winsten et al. 2010).

This source helps reinforce the fact that both industries have the potential to maximize producer satisfaction in terms of financial progress. Organic or rotational grazing operations have an advantage of lower operating costs in the areas of veterinary, feed, fuel and utility expenses which helps contribute to their profitability and sustainability. Conventional operations that operate in large confinement facilities have the potential to maximize profits through feeding total mixed balanced rations, administering rBST, growing crops of corn silage or green chop, utilizing feeding supplements and antimicrobial treatments for the treatment of disease. Though conventional producers will have a much higher production cost because of the list of

previous items, they will also better the operations efficiency especially in milk production.

Future Predictions for the Industry

The dairy industry has a very volatile past especially in the last five years since the economic downturn and surplus of milk the industry experience in late 2008 and in 2009. Producers are still affected today by the catastrophic events that were common at that time, for example record high feed prices and all time low milk prices. Luckily, producers have had resources be made available to them in order to decrease the risk of being taken advantage of by dips and peaks within the markets. Producers have been able to rely on the futures and options contracts in commodities like butter, cheese and nonfat dry milk in order to reinforce prices and receive a contracted milk price. The futures market also allows them to follow price trends and obtain contracts within the different areas of production costs like oil, corn, wheat, soybean, cotton and numerous other commodities. Through this option of forward pricing, producer risk is not completely eliminated but it does rule out uncertainty and it removes pressure on producers when trying to make decisions about their future.

Conclusion

What can be concluded from this review of literature is that both of these industries manage to fill the needs of producers across the state of California and across our nation. Through this review, an organic production system would be more appropriately implemented in areas that pasture is common. In California, these areas are in the Northern part of the state. The central valley possesses the other necessary components for running and maintaining a conventional production system because they are in an area where farming and raising crops is possible. Each industry also travels different avenues of management practices in order to produce a quality product and promote animal welfare and health. Economic incentives also differ greatly across the board for each production system when considering production costs and revenue earned. Overall, both industries are profitable as shown throughout this review if management practices and production systems are maintained and implemented correctly. As a producer, deciding which route to take is solely dependent on personal opinions and access to different resources. This literature review is aimed to increase producer awareness of the wide availability of options the California dairy industry has to offer.

Throughout the investigation of organic and conventional husbandry practices, numerous differences, advantages and disadvantages between each industry have been observed and investigated through the work of numerous scholars. Because of the drastic differentiation between each industry, it is not necessary to decide which industry has an overall advantage, though it is necessary to explore the high diversification of needs each and every dairy producer has and the successes producers can potentially experience with alternative options and proper management techniques.

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