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MANURE MANAGEMENT UNDER THE SUSTAINABLE GROUNDWATER MANAGEMENT ACT

Confined Animal Feeding Operations (CAFOs) need to take a comprehensive approach to manure management as they face limitations of farmland and irrigation water supply. As the Sustainable Groundwater Management Act (SGMA) is being implemented at an increasing rate with the ongoing drought, the traditional manure manage system of agronomically applying manure to fields with irrigation water will be restrictive and costly. CAFO facilities should evaluate each step of manure management to find solutions to these complex challenges. Nitrogen and/or salts are often the limiting factor of manure management, and these elements should be tracked from the time they are brought to the facility to the time they are exported or applied back to the field. Each CAFO facility is unique, so each step of a CAFO's management should be evaluated with the management team and trusted partners to find solutions that work for each operation. Now, more than ever, it is important to be proactive in addressing the significant challenges that SGMA will have on your dairy or feedlot operation.

This article evaluates the different stages that a CAFO producer can use in the management of manure under SGMA.

I. We will look at the management of manure generation.
II. Assess the different methodology of capturing manure in a liquid or solid form.
III. Evaluate how liquid manure can be managed on the facility.
IV. Evaluate how solid manure can be managed.
V. Discuss how to maximize the use of wastewater and solid manure for crop production.
VI. Explore ways to increase exports of manure.
VII. Measure what is important.
VIII. Discuss why collaboration is so important.

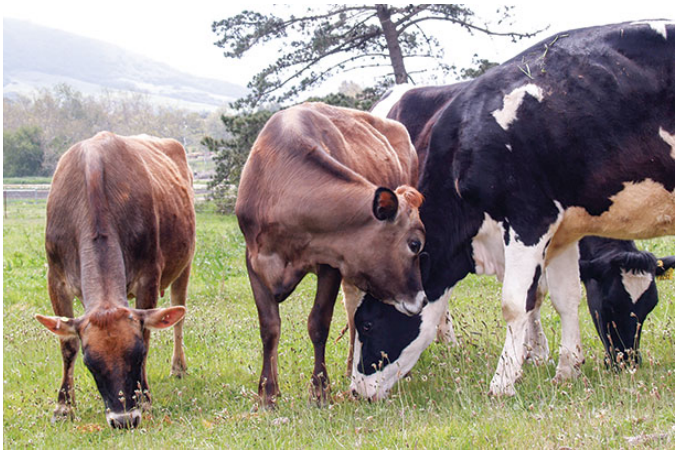
Finally, a summary of these complex challenges is provided. There are many steps that producers can take when applying manure to crops, especially when irrigation water is limited. While no single step will likely overcome the challenges of SGMA and manure management, a comprehensive approach will likely provide the solutions needed to not only survive but thrive.

I. Manure Generation.

CAFO facilities generate waste, and there are many factors that affect how much and what types of waste are generated. While the easiest answer to reducing the amount of manure generated is to reduce the herd size, there are many other factors to consider. Some producers have changed the type of animals they raise that generate less manure. For instance, there is around a 40 percent reduction of size of the animal and waste generated between a Holstein milk cow and a Jersey milk cow.

CAFO producers can also choose what age of animal to house at their facilities. Today more than ever, we are seeing the young stock of dairy facilities being raised off-site at various calf facilities and heifer facilities. To meet manure management goals, it may be time to consider raising support stock off-site.

How animals are raised at each facility affects the amount of manure that is generated at your CAFO facility. While most dairy facilities use artificial insemination to breed heifers and cows, some still use breeding bulls. These breeding bulls take significant amounts of feed and also generate significant amounts of manure. Whether it's through artificial insemination or breeding bulls, the management of lactating animals is critical to the profitability of dairy facilities and manure generation. The extra month a heifer or cow is not bred is an extra month of feed consumed and manure generated. For your manure management under SGMA, be sure to maximize the efficiency your breeding program.



The increased feed cost and the challenges of SGMA will also place increased pressure to cull a herd for optimum management. Culling a low producing milk cow or selling a steer at the optimum weight will also reduce the amount of manure generated.

Another area that has a significant effect on the amount of manure generated at CAFO is the types of feed that are used. Ruminant animals will intake high amounts of dry matter with varying amounts of salts and protein. Protein has a direct relationship to nitrogen, and nitrogen is often the limiting factor of manure management systems. By working closely with a nutritionist, feed can be maximized to meet the milk production or weight gain needed while managing the amount and type of manure generated.

One of the first steps a CAFO facility should take in manure management is evaluate the manure generation. With the proper herd numbers, feeding/production information, the amount of manure and related Nitrogen, Phosphorus, Potassium and salts produced can be estimated on a daily or yearly basis. As noted, there are many management opportunities that will affect the type and amount of manure generated. The many management improvements that have increased the production of beef or milk in the United States agriculture has also improved manure management by increasing the amount of product generated per amount of manure produced. While CAFOs have made great improvements, it is important to keep making improvements as we face the challenges of SGMA.

II. Manure Capture Options.

Manure from a bovine animal has a higher water content than many other animals, such as goats, sheep, and horses. As such, many bovine housing and animal processing systems utilize a liquid flushing or cleaning system to collect and process manure. The ease of use a flush system offers, as opposed to the high management and cost of a mechanical scraping system, greatly reduces the manure management

cost on many CAFO facilities. When this manure is moved to a liquid state, this wastewater takes on different management challenges than solid manure. As CAFO facilities face challenges under SGMA, they need to manage their collection systems to match their ability to manage manure in both liquid and solid forms of manure.

While a flush or wash system may make it easier to manage and move the manure on the CAFO facility, the manure will still need to be removed from the facility. There are additional restrictions related to wastewater as opposed to solid manure. Wastewater has a high concentration of ammoniacal nitrogen, that has a propensity to volatilize and/or convert to nitrate nitrogen that is leachable though the soil. A wastewater agreement is often required before a CAFO can export to another entity. These wastewater agreements must meet regulatory requirements and be on record with the various agencies. There are storage limitations to the amount of wastewater that can be stored on-site, while there are not the same limitations to solid manure. For most circumstances, there are significant advantages to collecting manure in a solid form and limit the amount of wastewater collected.

There are several management practices that CAFOs can use to increase the amount of manure collected in a solid form rather than a liquid form. Flushed lane facilities can be managed or converted to a scrape facility to allow manure to be moved to open corrals for drying and processing. Similarly, milk barns can reduce the amount of time and water used to clean cows that will reduce the capture of manure in the liquid form. Animal cooling systems can be managed and altered to prevent or reduce the capture of manure in wastewater. Windbreak can be used for air quality mitigation rather than sprinkler systems in animal housing that will increase the collection of manure in a liquid form. Animals can also be encouraged to defecate in open corrals, as opposed to being locked in a free stall housing system without exercise pens.

In addition to the ease of facility management, there are other reason why CAFO facilities will collect manure in a liquid/flushed form. Many air quality objectives are met by flushing manure as opposed to scrapping. Over the past few years, and for years to come, we will see the utilization of methane digesters on CAFO facilities. These digesters collect manure in a liquid form, and often incentivize CAFO producers to place increased amounts of manure in a liquid form. When there is the proper storage, distribution system, land allocation and irrigation water allocation, there can be significant advantages in managing manure in a liquid form for the agronomic production of crop. Liquid manure has readily available nitrogen and other nutrients that can help maximize crop production. With the right management in place, liquid manure can maximize profitability for many CAFO facilities.

CAFO facilities should evaluate their capacity to manage both the liquid and solid manure on their available farmland. The capacity to apply manure to crops is dependent on the amount of irrigation water available, so it is important to budget based on the water availability. With this information, CAFOs need to decrease the amount of manure collected in a liquid form to move the manure from the facility.

III. Liquid Manure Management.

Once manure is collected in liquid form, there are various management options CAFO producers should consider when facing water limitation under SGMA. A significant amount of water is needed for every pound of nitrogen or salt that is in wastewater, so the more nitrogen and salts that can be removed from wastewater, the less water is needed to agronomically apply the wastewater. The key to removing nitrogen and salts from wastewater is to remove it quickly while these elements are still attached to the solid organic matter within the wastewater.

There are various solid separating systems in use: separating pits, slope screen separators, filters, centrifuge systems, and weeping walls systems provide varying levels of separation, cost, and maintenance. Solid separation has been documented in a range of 10 to 60 percent efficiency in removing solids from wastewater. This variability in solid separation provides a management opportunity to choose the right system. Another key component of these solid separating systems is that they require significant maintenance and upkeep, so it is important that CAFO producers manage these systems at their designed capacity.

Another aspect to consider is that consistently there are new wastewater treatment technologies being evaluated by producers, industry groups, and universities that will play an important role in the years to come. Dissolved Air Flotation (DAF systems), worm farms, algae farms, reverse osmosis, aeration, plasma treatment are just a few technologies may help you meet the needs of manure management with the challenges of SGMA. Take time to evaluate these emerging opportunities as they may prove to be a valued investment.

As noted earlier, a high percentage of the nitrogen in wastewater is an ammoniacal state (NH3 or NH4). This nitrogen is not stable, and the more time wastewater is stored or exposed to the atmosphere, the greater the loss of nitrogen to the volatilization of NH3. Carefully evaluate your storage system and manage this volatilization within your manure management systems. Aeration system, pH, additives, biological components, and flushing system will all have an impact to the volatilization of ammonia from your wastewater system that can be managed to enhance your manure management systems.

IV. Solid Manure Management.

It is important to understand and manage the different types of solid manure. Solid manure can vary between the types of animals, feeding programs, separating systems and housing types. Beef cows on a heavy grain diet will create a different manure than heifers on a high forage diet. With these differences, it is important to manage, test and use these different manures for the best use.

While grooming corrals is an important management tool for fly pest control, it is also important to create a dry and consistent solid manure product. By grooming corrals, manure is dried out and large clumps are broken up. Low moisture manure is preferred, as there is additional cost to haul the water in the high moisture content manure. Additionally, the large clumps of manure pose a challenge in the distribution of manure on field applications.

Separated solids, or manure that is removed from a wastewater system, often has a high fiber content, and works well for bedding in a Freestall housing system. Like other types of solid manure, separated solids should be dried quickly and stored in uniform piles for use on the dairy.

Solids that are removed from separating pits or wastewater ponds will also vary between each storage system. Solids that are removed from wastewater ponds can rarely be dried to a low moisture content when directly applied to field, but these solids can be process in a corral to remove the moisture before hauling off-site. As with each type of solid manure, the consistency or uniformity of the product is an important management step to the end use of the solid manure.

When evaluating how SGMA will affect manure management systems, we can look at where land and water are limited in other areas of the state of the western United States. There are numerous dairies that are operating in metropolitan areas that have very little land available for their manure and very little water. While many of these dairies are selling their manure, most are adding value to the manure by composting the manure to open the product up to more markets and increase the value.

While CAFO producers can take steps to make a consistent and dry solid manure product, steps can also be made to add value to the manure by creating compost from the solid manure. Composting is a biological and chemical process that addresses many food safety related concerns of the manure and fixates the carbon to nitrogen ration for soil health qualities. To be consider compost, the compost must be processed in accordance with federal guidelines that specify the temperature the compost is

maintained for a set period. Composting is a biological process and requires regular aeration of the pile. There are numerous regulatory requirements that a CAFO must meet before they can commercially create and sell compost. With the restrictions of SGMA, many CAFO facilities should consider the investment in acquiring these permits and commercially producing the value-added compost.

In summary, solid manure can be managed to increase its value and markets within the challenges all farmers will face with SGMA. Providing a consistent and uniform product with low moisture content is preferred in nearly all markets. Compost will add value and be open to more markets. To meet these markets, many CAFO facilities will need to change how they manage manure on their facilitates.

V. Maximize Manure for Crop Production.

Most dairies and feedlots are regulated in California by the Regional Water Quality Control Board, (RWQCB) which limits manure applications to a 1.4 ratio of nitrogen applied to nitrogen removed by the crop harvested. With these regulations, extra efforts should be in place to increase yields and increase the nitrogen (protein) content of the crops produced. This will allow higher rates of manure to be utilized on site.

A comprehensive approach needs to be implemented utilizing manure for crop production, especially when faced with the changing and difficult dynamics of SGMA. There are significant variations in the nitrogen removal rates between crops as wells as the water use between crops. The first step in maximizing the manure management on land application areas is to choose the type of crop for each field.

Cereal grains for silage, like wheat and triticale, use less water than summer crops per ton of dry matter produced. Similarly, cereal grains have a higher protein content and remove higher amounts of nitrogen per ton of dry matter. Another important consideration of cereal grains is they are a winter crop that can utilize manure applications around the winter months, which is needed to ensure the storage capacity in the wastewater storage ponds is not exceeded.

Corn silage is a preferred feed from many bovine operations, as the corn can increase the amount of milk produced. Corn has been a surprisingly good option to consider for manure management, even though it uses more water than numerous crops. The per ton of dry matter produced per acre foot of water used by the corn crop is similar to that of a cereal grain.

Sorghum silage has a significantly lower utilization of manure per acre foot of water applied but may be a viable option under certain soil conditions. And while alfalfa can utilize high amounts of nutrient found in manure, the high-water use of alfalfa hay will restrict its utilization under most CAFO facilities with restriction of irrigation water.

When considering how to apply manure to each of these crops, it is important to work with a team who know and understand each specific farming and distribution system. A Professional Agronomist should provide a Nutrient Management Plan that follows the 4Rs of nutrient management: The Right Source, the Right Time, the Right Placement, and the Right Amount. With these principles in place, commercial fertilizer is limited, and manure use is maximized while meeting the regulatory 1.4 nitrogen ratio requirement.

SGMA will make a significant impact and CAFO facilities should plan, especially those that will need to fallow fields because of water restrictions. When fields need to be fallowed or reduced cropping systems, focus your capital improvements on the fields that will receive water and limit investment in fields that will not receive water. Leveling of a field, amendments, pipelines, and irrigation systems will provide little or no return on fallow fields.

The majority of manure from CAFO facilities are utilized in the land application to feed crops and as such, the management of crop production systems will be critical to manure management under SGMA. Choose the best cropping system with the water that is available and then make the most of both the manure and water on those crops.

VI. Increase Exports of Manure.

Most CAFO facilities have been utilizing their land for the recycling of manure for crop production, and when SGMA limits crop production there will be an increased need to export manure. There are a variety of steps that CAFO facilities can take to increase the amount of manure they export each year.

To increase the exports of wastewater, evaluate the lands that are adjacent to or close by the facility. These landowners or managers' circumstances may have changed with SGMA or various markets where they now can utilize manure from your facility. Before you send wastewater to a neighbor, a wastewater agreement will need to be established in accordance with the RWQCB regulations. Next, the appropriate infrastructure is needed to deliver and measure the wastewater exported. Wastewater not only includes many valuable nutrients needed for most crop production, but it also increases its value. Wastewater agreements should be updated regularly, as aging agreements are often disputed when not updated or understood.

Any solid manure exports need to be recorded using the RWQCB's Manure Manifest Form. On this form, the CAFO operator and the Hauler need to complete the information of the quantity of manure, the moisture content, and the location of delivery. This form needs to be signed by both the CAFO operator

and the hauler. This documentation is critical, as CAFO producers are required to account for all the manure generated at their facility.

To help facilitate the demand for a CAFO's manure, take time to share the value of the manure. Commercial synthetic fertilizer prices have skyrocketed in recent months. Manure has high amounts of Nitrogen, Phosphorus and Potassium that are needed for most crop productions systems. Micronutrients are also found in manure that can greatly improve plant health and yield. Similarly, manure and compost are rich in biodiversity that help the microbial health of your soils. Manure and compost both have a high carbon content that will increase the organic matter of your soil. This organic matter from manure can buffer the negative effects of salts and increase the water holding capacity of the soil. The use of manure and increase carbon content of the soil may also open the door for farming operations to receive carbon credits.

As discussed earlier, creating compost from the solid manure will open the door for more uses and increase the value of manure. With all the recent changes to the farming system, now is a good time to explore not only how to export more manure, but to be paid for that manure.

VII. Measure what is important.

SGMA is a significant challenge for local Groundwater Sustainable Agencies (GSAs) to implement. These agencies are looking for measurable data to make their decisions to meet the State's mandates. Whether it is flow meters on wells or remote sensing of evapotranspiration, data will drive the way these mandates are implemented. Similarly, dairies and feedlots will need data to manage their facilities in this new era of farming and raising animals. Data collection and data management will be a key factor for dairies and feedlots to manage moving forward.

Tracking the number of animals, type of animals, where they are housed, what they are fed, and the amount of milk produced are all measuring tools for manure being generated. Flow meters are a great way to measure the amount of wastewater pumped. Similarly, the weight of each load of manure is great documentation of the manure you manage. Each step of the manure management process may need to

be measured to give a better understanding of the fate of the manure through the management steps. Be sure to measure how much manure is removed from your facility for each event.

Similarly, it is now more important than ever to measure the amount of water you use on your facility and farmland. Consider installing flow meter on each water source, whether it is a domestic supply, an irrigation well or surface water supply. Individual water source data is important for nutrient management, as each source is likely to have different concentrations of nitrogen and salt.

While some data is needed for regulatory reporting, take the extra steps to collect data and process it to maximize your management system. Remember the adage: "If you can measure it, you can improve it".

VIII. Collaborate.

There is no single answer to addressing the challenge we face, and it will take time and diligence to evaluate the operation of each facility. Answers to individual challenges are likely not unique, but the solutions must be uniquely crafted to each individual facility. To find the answers, it is important to collaborate with others. First, collaborate with a team who knows your facility the best. Your employees know your operations, but you can also consult many outside professionals who can help. Your agronomist, your PCA, your nutritionist, your environmental specialist, and/or your irrigation supply company should have valuable input to help your operations. Your team has a vested interest in your success and should gladly provide input and ideas of how to improve your operation to meet the challenges of SGMA and manure management.

Next, open the conversation with other dairy and feedlot operations. There are many lessons to learn from both the successes and failures of your neighbor. As we live in a global market, look at other areas of the state, nation, or world that have faced restrictions to surface water and groundwater to learn how they have met and conquered these challenges.

It is also important that dairies and feedlots engage their local Groundwater Management Agency (GSA). Each local agency will have site specific objectives and rules that need to be considered. These GSAs are newly formed public agencies, and their meetings are open to the public. There are a number of industry groups that regularly attend and speak up for agriculture. Geoff Vanden Heuvel with Milk Producers Council, (http://www.milkproducerscouncil.org/), is a respected advocate and resource to the dairy and livestock industry, as he attends many of the GSA and other related SGMA meetings. Similarly, the industry has an ally in WaterWrights, (https://waterwrights.net/), as Don Wright regularly provides updates to the meetings he attends about the issues the industry is facing regarding SGMA. Take time to read their updates and to speak to the local GSAs.

Evaluate the emerging technologies that are coming to the forefront to meet these challenges. A new technology will have lots of economic potential and the technology company may be willing to cover many costs and risks as an entry point into an emerging market. Be sure to address the liabilities of new technologies by getting the correct permits and use agreements in place before any investments are made.

Engage the federal resources in the USDA-NRCS, as they have a team of professionals dedicated to conservation. This includes a state CAFO team that have expertise in facility design and agronomy. These relationships can also open the door for funding to improve your operations.

The State of California also has a team of professionals and an increased amount of funding available to the dairy and feedlot industry to meet the goals of the state. The California Department of Food and Agriculture (CDFA) has recently implemented various programs with over $100 million available annually which includes the Dairy Digester Research and Development Program (DDRDP), the Alternative Manure Management Program (AMMP), the Healthy Soils Program (HSP), and the State Water Efficiency and Enhancement Program (SWEEP). CDFA has also initiated a compost resource website to assist producers in implementing this practice. The State also has many allies and resources through both the University of California and other teaching institutes. The UC-ANR (Agriculture and Natural Resources) and the UC-CE (Cooperative Extension), not only help many agricultural industries to become established in California, but they also help producers meet today's new challenges.

Industry groups are a great resource for information and advocacy. Dairy Cares is one that not only provides great advocacy for the industry, but they also provide great education and seminars for producers to learn more about how to face these challenges. Cattleman's Association, Milk Producers Council, local county Farm Bureaus, Western United Dairies, and other industry groups have great staff and a support network that will be able to get to know your facility and help you with the challenges you face. Utilize these allies to help you meet the challenges you face. By joining and investing in these advocacy groups, you are being part of the solution and they will help you find solutions.

IX. Summary.

The challenge of managing water supply will be a long road in California. There will not be a single solution to meet this complex issue. May we find encouragement in knowing the struggle of water supply has been on-going for a long time, and we need to follow the example of our predecessors in their pursuit of water that will help agriculture and our society flourish.

We can look to the foundations of society, where God directed Isaac to a new land to raise his family and care for his business (Genesis 26: 19-22). Groundwater rights were disputed, and new wells were installed. There were times of plenty and times of famine, but through it all we are called to follow the Lord and worship him. May we be encouraged by God's faithfulness and encourage one another.