Manure Management Considerations for Expanding Dairy Herds

C. D. FULHAGE
Department of Agricultural Engineering,
University of Missouri, Columbia 65211

ABSTRACT

The requirements and considerations for manure management change as dairy operations evolve to larger herds. Changes in manure production, collection, treatment, storage, transport, and utilization are nearly always necessary as herd sizes increase. Land area requirements for nutrient utilization increase as animal numbers increase and also increase because of crop type, nutrient uptake capability, potential nutrient losses, and limits for nitrogen and phosphorus. Expansion of herd size may require obtaining, updating, or revising environmental permits from regulatory agencies. Options for reducing manure loading on existing facilities to accommodate larger herds include solids separation and off-site facilities. As herds become larger, economy of scale usually improves the ratio of costs to benefits for manure systems. Economic analysis of manure systems in Missouri showed that cost of manure management was reduced by approximately 50% per unit of milk produced as herd size increased from 100 to 500 cows. As systems for manure management become larger and more complex, engineering design inputs and requirements become more extensive. Traditional sources of engineering design and assistance, such as Cooperative Extension and Natural Resource Conservation Service, may no longer be adequate. Identification and utilization of alternate resources, such as private sector engineers, may be necessary. Retention of legal counsel who are familiar with the regulatory aspects of manure management may be advisable as herd size increases.
(**Key words**: manure, management, expansion)

INTRODUCTION

Dairy farms that are characterized by a high degree of production efficiency find that increasing herd size is a viable means of maintaining profitability and ensuring their position in the marketplace. However, a larger herd size introduces new, and sometimes unforeseen, environmental considerations and requirements. Concerns about the negative effect of losses in manure nutrients on ground and surface water increase as herd sizes become larger (17). Requirements for manure management are unique to each farm, depending upon the natural resources available, the existing and planned facilities, and the goal of the operation (9); in addition, these requirements sometimes are subject to major change as animal numbers increase.

New equipment requirements for the handling and management of manure are often an obvious and necessary change as herd size expands. Old, more traditional equipment may not have the capacity that is needed to handle the new volumes of manure generated. Labor requirements for managing manure are also a major concern for herds that are increasing in size. Generally, as operations become larger, the substitution of capital for labor in handling and managing manure is preferred on most farms. As new manure management systems are developed and implemented on expanding operations, management requirements become more important. Knowledge of how equipment is operated and maintained and how nutrients are managed to prevent contamination of natural resource requires the education of workers and employees, who may be unfamiliar with dairy manure management systems. Dairy manure management systems include some or all of six major components or characteristics that may be subject to major change as herd size increases: 1) manure production and characterization, 2) manure collection methods and equipment required, 3) manure movement or transport mechanisms, 4) manure storage requirements, 5) manure treatment requirements, and 6) manure utilization and nutrient management requirements. These components, taken together, describe a type of manure management system that is unique to the particular farm for which it is developed.

In addition, other considerations should be addressed as an increase in herd size is contemplated. Land area requirements or a suitable option that does not require land for development and implementation

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of a viable plan for nutrient management is critical to the success of larger dairy operations. In some cases, increasing animal numbers may require obtaining an environmental or regulatory permit or updating and revising an existing permit. Regulatory requirements for monitoring certain parameters in a manure management system may increase as herd size increases or as type of required permit changes. Also, as manure management systems become more complex, assistance with detailed engineering design and construction is needed to ensure that the systems comply with environmental and regulatory requirements. Traditional sources of assistance, such as Cooperative Extension or Natural Resources Conservation Service, may not be adequate to address the needs of an expanding operation. Finally, interpretation of state and federal regulations addressing concentrated animal feeding operations can be a frustrating and arduous task for those who are not experienced in such matters or not inclined to study them. Experience has shown that the possibility of litigation between producers and other land owners, producers, and government entities (townships, county, state) becomes more likely as herds become larger. Hence, owners of expanding operations might consider identification or retention of legal counsel who are familiar with environmental regulations and requirements, agricultural production and manure management, and nuisance litigation that may be encountered as part of the expansion process.

MANURE SYSTEM TYPE AND COMPONENTS

Changes in System Type

As production levels and animal numbers increase, more manure is produced; these larger volumes may or may not require an overall change in the type of manure management system that is utilized on a dairy farm. Manure management systems are usually classified as solid, slurry, or dilute. In solid manure systems, the manure is handled at dry matter contents of >20%, which usually requires some natural drying or the addition of bedding. In slurry systems, the manure is handled at dry matter contents from 5 to 15%, and, in dilute systems, manure is handled at dry matter contents of <5%. Solid systems require the handling of manure with mechanical equipment and, thus, usually have higher labor requirements per unit of manure handled. As herds expand and more manure is handled, consideration is usually given to systems that allow hydraulic handling of a portion or all of the manure. Manure in fluid form (either slurry or dilute) can be handled via pumps, pipelines, irrigation equipment, and other appropriate equipment; therefore, hydraulic systems usually require less labor.

Manure Treatment

The management of the larger volumes of manure that are associated with larger herd size may require consideration of new or different methods of manure treatment or processing. Odors are an increasing concern for most livestock enterprises, and the expansion of a dairy herd may cause a real or perceived rise in odor levels in the surrounding area. Hence, treatment processes that reduce odors may need to be part of an expansion plan. Aeration of manure has long been recognized as a means of reducing odor for storage and land application (10). Anaerobic digestion of dairy manure under controlled conditions with gas collection (15) minimizes odor release and provides a higher degree of waste stabilization than do traditional manure treatments. The digestion process also presents the potential for collecting and utilizing energy in the form of methane, which evolves as bacteria degrade the manure. Biochemicals and additives that are based on enzymes or bacteria are marketed as being effective in reducing odors in manure management systems. However, these products do not seem to be uniformly effective and can be quite expensive (18). More research and experience are needed in the area of additives for odor control to document effectiveness and cost.

Some processes for manure treatment result in increased losses of nitrogen to the atmosphere through ammonia volatilization as bacteria degrade and stabilize the manure. As much as 80 to 90% of nitrogen that is excreted may be lost to the atmosphere in a manure system with an anaerobic lagoon for storage and treatment (11). If nutrient availability of fertilizer is a secondary concern compared with the need for land application of manure for regulatory compliance, then such a loss of nitrogen may be attractive as a dairy herd expands. Nitrogen losses to the atmosphere may translate into less land needed for manure utilization and less labor and management required for land application. If and when environmental concerns focus more specifically on atmospheric emissions (17), such losses may no longer be acceptable, and significant changes in the design of manure management systems may be necessary.

Solids separation is a treatment process that may offer benefits to an expanding dairy herd. If manure is to be handled by irrigation equipment, separation of solids may reduce problems in pumping and plug-

ging. Separated solids might be further processed and used as bedding, composted for potting soil, or used as a soil amendment or fertilizer if such a use or market exists. Also, solids separation may allow the continued use of an existing storage facility (such as a lagoon) without overloading the facility because of increased animal numbers.

Livestock manure is usually managed under the "no-discharge" concept (no discharge to streams or waters of the state), and a high degree of treatment is not necessary because there is no requirement to meet a discharge standard for land application. Hence, advanced treatment schemes are usually not considered unless there is some specific need for them.

Manure Collection

Dairy operations are unique among most livestock production enterprises in that manure collection and cleanup activities are required more than once per day. Because of this intensive requirement, dairy operators seek methods of reducing the time spent cleaning facilities and collecting manure as herd size increases. Methods that utilize automatic or hydraulic cleaning and collection of manure are usually selected to replace traditional means, such as hand cleaning or tractor-scraper. Electrically powered automatic scrapers and barn cleaners are utilized to reduce effectively the labor requirements for manure collection from feeding and loafing areas. Such devices are compatible with management of manure slurries.

Manure collection by flushing has emerged as a preferred method of cleanup by many expanding operations (5). With this method, an appropriate quantity of water is released at an appropriate rate into the area to be cleaned. The target area may be milking parlor, free-stall alley, or any other concrete area on which manure is deposited. Areas to be flushed should be properly sloped (4), and curbs should direct flush water and ensure cleaning of the area. Recycled water from a lagoon or holding pond is usually used to flush all areas except the milking parlor. Most states require the use of fresh water for flushing inside the milk parlor. With flushing, the labor required for cleanup may be reduced from several hours (as required with traditional mechanical scraping) to the few minutes that are required to release flush water in a properly designed flushing system. Use of fresh water (versus recycled lagoon water) for flushing should be minimized.

Manure Storage

Dairy herd expansion usually requires increasing manure storage volume because of the increased manure production. About 32 m^3 of manure is produced annually per thousand kilograms of live weight in a dairy herd (1), and this volume may be higher for high producing cows. Hence, any increase in herd size causes a corresponding linear increase in the volume of manure produced. Expansion of a dairy herd often includes implementation of facilities or practices that introduce additional water into the manure management system. Added exercise lots, unroofed alleys, or loafing areas increase the amount of contaminated runoff resulting from rainfall. Storage is required for this runoff under the no-discharge concept. Flushing may be desired in a new or expanded parlor and would be an additional source of fresh water added to the manure management system. Other practices such as udder preparation or cooling via sprinklers can add significant amounts of fresh water to the system. All of these additions must be taken into account to anticipate size requirements for storage for herds undergoing expansion.

Alternatives to increasing storage. Site restrictions may prohibit construction or expansion of the storage facilities. However, some alternatives may allow continued use of existing facilities as cow numbers increase. Manure storage facilities are often designed with a combined treatment volume and storage volume. The treatment volume provides the dilution that is necessary to establish desirable bacterial populations for degradation of the manure. The storage volume is simply the volume that is necessary to accumulate manure, runoff, rainfall, washwater, and any other source that must be contained. The separation of solids from the manure stream offers the possibility of reducing the treatment volume significantly (up to 50%) and reducing the storage volume to lesser extent. Hence, in some cases, implementation of solids separation may allow continued use of an existing (unmodified) manure storage structure with increased cow numbers. However, management of the separated solids must be in an environmentally sound manner.

Another alternative to increasing on-site storage with an expanded herd is to develop another storage facility that is remote from the production area. With proper equipment and management procedures, manure slurries can be pumped long distances (14); additional manure storage facilities can be located as far as 3 km from the production area. When land application operations are initiated, a remote ("satellite") manure storage facility may be located near the manure utilization area to reduce significantly the hauling or pumping distance and time. In such a

scenario, the costs of pumping to the remote storage facility are partially offset by the reduced costs of hauling or pumping for land application. Odor or other aesthetic and sensitivity factors may also influence the decision to develop additional manure storage away from the production area.

Manure Transport

The movement or transport of manure from production areas to storage occurs at least daily on modern dairy farms. The magnitude of this task increases as manure and wastewater volumes increase with expanding herds. Operators who are planning to expand usually consider methods and equipment that may reduce the time and labor that are involved in transporting manure. Traditional methods of moving manure, such as tractor-scrape or hand-washing, are labor intensive and may not be compatible with increased numbers of cows. Hydraulic or mechanized means of transporting manure are often selected with expansion because capital can be substituted for labor. Barn cleaners, automatic alley scrapers, and piston pumps for solids handling are examples of mechanical equipment that may reduce labor requirements for transporting manure. Properly designed hydraulic flush systems can accomplish both manure collection and transport to storage with very little labor input required.

MANURE UTILIZATION—THE NUTRIENT MANAGEMENT PLAN

The utilization and management of potentially contaminating manure nutrients are of paramount importance for all dairy operations, especially when the enterprise is becoming larger. Public awareness, scrutiny, and concern for protecting both surface and ground water resources suggest that the dairy industry manage manure nutrients in an environmentally sound manner. Often requirements for manure management for expansion are well-planned in the production area, but may not be properly accounted for in the area of final utilization and nutrient management. Primary considerations in land application for larger herds include equipment needs and requirements, additional land area requirements, and the nutrient management plan involving crop types and rotation with nutrient uptake capabilities.

Equipment Requirements

The equipment that is required for manure utilization includes the equipment that is needed to move manure from storage to the land application area and to apply the manure to the land. The same equipment may or may not accomplish both functions. In either case, the equipment used must be compatible with the volume of manure to be handled. Manure and washwater (not including flush water) accumulation amounts to about 100 L/d per cow in modern dairies (3); removal of this waste requires about 180 trips annually from storage to field for land application with an 11-m^3 tank wagon serving a 60-cow dairy. The time required for this activity (assuming 40 min for each round trip) would be 12 d of 10 h each. An increase in herd size to 200 cows would correspondingly increase the time that is required to haul and spread manure to 40 d/yr. The 40-d requirement might not be acceptable for time and labor and likely would not fit the window of opportunity that is available for land application of manure in concert with cropping schedules and climate restrictions. Alternatives to reduce time requirements in such a scenario include utilizing separate, dedicated vehicles for hauling and applying manure to cropland. Systems comprising 23- to 26-m^3 tanker vehicles serving dedicated applicators at the land application area have proved to be effective in reducing the time required for hauling manure (14).

Batch Versus Continuous Flow

When a dairy operation expands, consideration may be given to a continuous flow method of handling manure for land application in contrast to the more traditional batch hauling in manure spreaders or tank wagons. This choice may be influenced further by the desire to handle manure hydraulically at the production area by flushing or similar means. In continuous flow systems, manure is handled by pumps, pipelines, and moving irrigators or applicators in the field. The advantage of continuous flow is illustrated by the example of an 11-m^3 tank wagon that is operated 10 h/d at 40 min per round trip, which can apply about 170 m^3/d to land. By comparison, a typical continuous flow system that is operated at a 2000 L/min would apply 1200 m^3/d, or seven times the volume of manure in the same time period.

Previously, suitable equipment for continuous flow handling of the wide variety of materials that are common in dairy manure has not been widely available. However, manufacturers have made great strides in product development in recent years, and many more choices are available to the operator who wants to apply manure hydraulically to land. Selection of choppers, pumps, agitators, pipes and pipeline materials, and applicators that are appropriate for the desired application is important.

The manner in which manure is deposited on land utilization areas is being viewed more critically as public awareness and environmental concerns are heightened. The use of injection systems for the subsurface application of manure reduces odor and minimizes the possibility of contaminant runoff from the land area. Hence, an operator expanding in a sensitive area may minimize exposure by utilizing this application method.

TABLE 1. Minimum area required by regulation for land application of manure from dairy operations in Missouri.[1]

Manure system	Land area[2]
Lagoon	8.1
Slurry	40.0

[1]Adapted from Missouri Department of Natural Resources Manual 121 (13).

[2]Based on 112 kg of nitrogen/ha per yr for 100 cows.

Land Area Requirements

The no-discharge concept for the management of livestock manure is based on the premise that manure nutrients can be utilized in the soil-plant complex in a manner that prevents contamination of water resources. Hence, the availability of appropriate land areas for manure application is important, especially when a dairy herd is expanding. Required land area is usually based upon the amount of nutrients (nitrogen or phosphorus) that will be generated in the livestock enterprise and the cropping plan to be used. With modern standards of feeding and production, a dairy cow produces about 90 kg of nitrogen and 40 kg of phosphorus (as P_2O_5) or more annually (11). The portion of these nutrients that are available for plant growth depends upon losses that occur between the time the manure is voided by the animal and the final uptake in the plant root zone. Losses of volatile components, such as ammonia, begin occurring as soon as manure is excreted. Losses also occur somewhat in proportion to the interval between excretion and collection for storage. Losses tend to be greater when manure is deposited on open dirt lots than when it is deposited on concrete alleys or feeding areas. The type of manure storage facility used also affects nutrient losses. Generally, manure stored in more closed facilities (e.g., concrete or glass-lined steel tanks) shows fewer nutrient losses than manure stored in earthen impoundments such as lagoons or holding ponds. Storage facilities with a high degree of biological activity (such as lagoons) generally have the highest losses of nitrogen because of volatilization of ammonia. Finally, additional nutrient losses occur when manure is spread on the land. These losses depend upon the manner in which manure is spread, climatic conditions at the time of spreading, and the timing of the application in relation to the crop growing season (16). The ammonia fraction of manure nitrogen is subject to immediate loss to the atmosphere by volatilization if the manure is not incorporated or injected into the soil at the time of spreading. Up to 40% of the nitrogen in dairy manure slurry may exist in the form of ammonia (7) and is thus subject to volatilization loss if not incorporated into the soil.

A final determination of land area requirements takes into account all nutrient losses (including field losses) and the nutrient uptake capability of the crop being grown. Land area requirements are usually based on either nitrogen or phosphorus as a limiting nutrient. If soil test levels of phosphorus are below a certain value, nitrogen is usually taken as the limiting nutrient (excess phosphorus may be applied). If soil phosphorus is above a certain value, phosphorus may be the limiting nutrient, and land area is based on phosphorus uptake by the crop being grown (nitrogen will be deficient). There is not complete agreement on the target level for phosphorus in the soil.

Regulatory requirements. Some states may have regulations requiring certain minimum land areas for a given size operation and manure system type. The regulation may or may not be totally compatible with a crop fertility program utilizing manure as the primary source of plant nutrients. Table 1 shows the land area that is required by regulation for dairy systems in Missouri (13).

Alternatives for land availability. Expansion of a dairy herd may result in the production of excess nutrients for the land base and the practices associated with the operation. In these cases, identification and use of additional land or more intensive use of available land is necessary. Agreements with neighbors may be a viable means of utilizing unowned land for manure application. Benefits can be mutual in that the neighbor has a source of plant nutrients available (usually at a cost less than commercial fertilizer), and the dairy operation can expand without owning additional land for manure spreading. Spreading agreements should be legally binding, reasonably long-term, and renewable because land availability is critical to continued operation of the dairy. Regulatory agencies may require that spreading agreements be executed as legal easements, duly recorded, and transferable with land deeds.

Another alternative for land availability may be off-site utilization of either owned or nonowned land (unowned land would require a spreading agreement). In such a scheme, manure is transported to a utilization area that may be several kilometers away from the production facility. This scenario is usually most applicable in areas where land availability has been locally exhausted and manure must be dispersed on a more regional basis.

A third alternative for an expanding dairy herd might be the development of a cropping plan that more intensively utilizes plant nutrients in manure, which may reduce purchased feed (nutrients). For example, a corn silage crop removes significantly more nutrients from the soil than corn grown just for grain (6). Similarly, a double-cropping scheme, such as corn silage followed by a winter crop such as wheat (which could be ensiled or used as haylage), would be effective in utilizing more nutrients than a traditional cropping plan.

REGULATORY CONSIDERATIONS

Regulations that are applicable to a dairy herd may change as the size of the herd increases. A thorough knowledge of state and federal regulations is important to the long-term viability of a dairy operation. The future is limited for those who cannot, or will not, conduct their operations in compliance with regulation, even though regulations may differ from state to state.

Permits

Some states have developed programs whereby required or voluntary permits are issued to livestock operations that have properly designed and certified systems for manure management. Requirements for such permits are often based on herd size; hence, expansion of a dairy herd may require a permit when none was required previously. Increasing animal numbers may require the producer to update or change an existing permit. In some cases, increased animal numbers may change the provisions and requirements in existing permits. In any event, it is the responsibility of the producer to be aware of the permit requirements and to ensure that his or her operation is in full compliance.

Permit type and applicability. In most cases, the requirement to obtain a permit depends upon animal numbers (herd size). Further, the number of animals involved may determine which type of permit is required. Hence, expansion of a dairy herd should be accompanied by a close examination of permit regulations to ensure that all applicable permits are obtained. Table 2 shows permit classifications, animal numbers, and type of permit applicable to each classification in Missouri.

TABLE 2. Permit classifications, animal numbers, and permit types for dairy operation in Missouri.[1]

Class	Mature cows	Permit
	(no.)	
1A	>4900	Site specific
1B	700 to 4899	General
II	200 to 699	Letter of approval (voluntary)
III	1 to 199	No permit is required

[1]Adapted from the publication of Missouri Department of Natural Resources (12) on concentrated animal feeding operations.

Location considerations. In addition to considerations of herd size, the necessity of obtaining a permit may also depend upon the location of the operation. Local, as opposed to state, requirements, codes, or zoning ordinances may dictate the need for a permit. Geological considerations or special considerations of water quality in some areas may necessitate obtaining a permit. For example, Missouri has special permit requirements for livestock operations located in a sensitive watershed. A sensitive watershed (12) is defined as a watershed that is used as a lake supplying public drinking water or that is associated with outstanding national resource waters, outstanding state resource waters, or losing streams. Losing streams have both surface and underground flow. Any operation located in a watershed, as just defined, must obtain a waste management permit if the operation is >200 animal units (143 mature milk cows) in size. An additional requirement is that nitrogen in the form of manure cannot be applied to land at rates >112 kg/ha per yr in these watersheds, even though commercial fertilizer is not regulated. Owners who expand dairy herds must be cognizant of these types of requirements.

Permit applications. In addition to permit type and applicability, a dairy operator contemplating expansion must be aware of the time that is required for preparing, processing, and obtaining the permit as well as any restrictions that may apply to activities prior to obtaining the permit. When expansion is being considered, in the rush to start construction and minimize nonproductive time, operators often fail to plan for the time required to develop the permit application (which may require inclusion of plans, specifications, and soils or geologic investigations and reports). In Missouri, regulations require that applications for construction permits be submitted to the

regulatory agency 180 d before construction begins. Applications for operating permits must be submitted 30 d before new or expanded facilities are placed in operation. In Missouri, detailed engineering reports, construction plans and specifications, and soils and geologic investigations by qualified professionals must be submitted with the permit application. Hence, these activities must be completed prior to the 180-d permit processing period preceding the target construction date. Missouri producers must begin the planning and design phase of an expansion at least 1 yr prior to the intended time to initiate construction. The Missouri example illustrates the importance of operator awareness of time requirements involving permits when expansion is being considered.

Special permit requirements. Expansion to a larger herd may cause new or different permit requirements to be in effect. Operators who plan to expand should be aware of new provisions that may be encountered in the expanded mode. In Missouri, special provisions that are applicable to Class IA permitted operations include the following:

1. Permit applications must be accompanied by names and addresses of all adjacent property owners and applicable planning and zoning agencies.
2. A licensed engineer must monitor construction of, and certify, earthen impoundment seal construction and compaction tests.
3. Barrel tests must be performed on earthen impoundments to determine leakage rates, and the certified results must be submitted to the permitting agency by a licensed engineer.
4. Design plans and specifications as well as an operating management plan must be developed and submitted to the permitting agency by a licensed engineer.

Expanded operations may also be subject to new operating provisions as a result of increased herd size. Such provisions typically involve environmental monitoring and record keeping to ensure that the management plan is being followed. Following are environmental monitoring requirements that must be reported to the permitting agency by Class IA operations in Missouri: 1) nutrients levels in land-applied manure and wastewater; 2) dates and rates of application; 3) field locations and slopes; 4) crops grown, yield goals, and yield harvested; 5) rainfall, soil moisture, and water levels in lagoons or holding ponds; 6) nitrogen and phosphorus levels in soils, 7) wastewater discharges, if any, to water of the state, 8) monitor and test stormwater runoff, and 9) monitor and test in-stream waters of the state. As noted by the Missouri example, a herd expansion can involve many new considerations regarding environmental regulations, and the operator must be aware of such requirements.

Other provisions. In addition to environmental considerations, expansion to a new permit category may cause certain other provisions to take effect. For example, in Missouri, applications for a Class IA permit must include a financial instrument that provides for closure of the facility in the event of bankruptcy or other circumstances of financial distress. The financial instrument or bond is held in escrow by the permit agency in an amount sufficient to provide proper closure of the facility should such closure be required.

PROFESSIONAL ASSISTANCE

Manure management systems for expanded dairy herds may require detailed calculations of the engineering design, development of construction plans and specifications, bid documents, environmental impact analysis, permit applications, soils and geologic investigations, and other professional services. Expansion of an operation may increase exposure to possible litigation involving odors or other environmental issues. Hence, there may be need for legal counsel and services from individuals who are familiar with such issues and the permit process in general. Although some of these services have typically been provided by agencies such as Cooperative Extension or Natural Resource Conservation Service (formerly Soil Conservation Service) in the past, the availability of these resources is likely to be limited in the future. Hence, operations that need these services because of expansion should become aware of methods of identifying, evaluating, and working with purveyors of professional services (8).

ECONOMICS

The costs of owning and operating manure management systems should be recognized and included in financial analyses and projections for herd expansion to ensure long-term viability of the operation. Although total costs for manure management almost certainly increase as herd size increases, economy of scale may reduce costs on a per unit (kilogram of milk produced) basis. An economic study of lagoon systems in Missouri (2) showed that costs for manure management were reduced 37% (per unit of milk produced) when herd size was increased from 100 to 500 cows (Table 3) (2).

TABLE 3. Costs of owning and operating lagoon and slurry systems for manure management for various size herds.[1]

Manure system	Cost by herd size				
	100 cows	200 cows	300 cows	500 cows	1000 cows
	($/45.4 kg of milk produced)				
Lagoon	0.43	0.34	0.31	0.27	0.24
Slurry	1.04	0.58	0.54	0.42	0.39

[1]Adapted from Missouri Extension Bulletin MP666 (2).

CONCLUSIONS

Expansion of dairy herds requires careful consideration of many factors related to development and operation of the new manure management system. Primary considerations are 1) the change in the type of manure systems and operating components that are required by the expansion; 2) the utilization and assimilation of increased manure nutrients into the nutrient management plan; 3) the regulatory requirements, permits, and environmental monitoring that might be dictated by increased animal numbers; 4) the identification of the type of professional assistance that may be required in developing and obtaining permits for the manure management system; and 5) the costs of owning and operating the manure management system when cow numbers increase.

Increasing environmental concerns and regulatory activity give rise to many issues that must be addressed by dairy operations contemplating expansion. However, with careful attention to detail, such an expansion can be accomplished in a manner that will strengthen the long-term viability of the enterprise and improve its position in the marketplace.

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