CHAPTER 5a

LAND APPLICATION OF SWINE MANURE

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Land application of swine manure to crop and forest land is an effective way of recycling the nutrients back to the land. There are four key steps to utilizing manure in an environmentally and economically sound manner:

- know the available nutrient content of the manure
- know the nutrient needs of the soil and the crop, and apply the manure at the correct rate and time to provide the nutrients
- adjust the use of supplemental fertilizer to compensate for the nutrients applied in the manure
- use application and conservation practices that minimize movement of the nutrients from the field

NUTRIENT CONTENT

Applications of manure as a crop nutrient source may provide a portion, or all of the plant nutrient requirement, dependent on the rate of application and the relative content of the nutrients. Application rate decisions are usually based on either the nitrogen or the phosphorus content of the manure and environmental concerns are typically based on the amount of nitrogen, phosphorus, zinc, or copper added to the soil. Average nutrient contents of different types of swine manure are listed in Chapter 3. Knowing the nutrient content of swine manure is critical to using it as a crop nutrient source. Not knowing the nutrient content of the manure to be applied can result in large errors in application rate -- either too much or too little.

NITROGEN-BASED APPLICATION RATES

Manure utilization area requirements are outlined by DHEC in **Part 100.100.**

The Department (DHEC) shall approve an Animal Facility Management Plan that establishes an application rate for each manure utilization area based on the agronomic application rate of the specific crop(s) being grown. The application rate shall also be based on the limiting constituent (either a nutrient or other constituent as given in item 100.100.B).

The Department may establish permit conditions to require that swine manure and other swine by-products application rates remain consistent with the lime and fertilizer requirements for the *cover, feed, food, and fiber crops based on land grant universities (in the southeast) published lime and fertilizer recommendations (such as the Lime and Fertilizer Recommendations, Clemson Extension Services, Circular 476).* **Part 100.100.E.**

Swine manure additions are most often based on the nitrogen requirement of the crop and the available nitrogen content of the swine manure. Crops that require and remove a lot of nitrogen are favored for receiving swine manure because more manure can be applied to less land. This approach reduces the hauling costs of implementing a manure management plan, but often results in a large accumulation of phosphorus and other nutrients in the soil. Soil analysis should be used to ensure that soil pH and nutrient conditions are at optimum levels even when manure is applied based on nitrogen. (See Chapter 7d and **Part 100.000.9** of the Regulations).

Manure application shall not exceed the agronomic rate of application for plant available nitrogen (PAN) for the intended crop(s) on an annual basis. For those years that fertilizer is land applied, manure in combination with the fertilizer shall not be used so as to exceed the agronomic rate of nutrient utilization of the intended crop(s). **Part 100.100.B.h.**

Nitrogen fertilizer recommendations for commonly grown crops are listed in Table 5.a.1. These rates are suggested as the most profitable rate over a period of years with good management. Ranges in nitrogen rate recommendations reflect differences in yield and management potential. For instance, nitrogen recommendations for dryland corn are 100 lb N/acre for 80 bu/acre or less, 120 lb N/acre for expected yields of 80 to 130 bu/acre, and 150 lb N/acre for productive soils where yields in excess of 130 bu/acre are often obtained. For well managed irrigated corn recommended nitrogen fertilization rates are 180 to 220 lb N/acre for yields of 150 to 200 bu/acre. A good rule of thumb for corn is about 1.0 to 1.25 pounds of nitrogen per bushel of expected grain yield. Similarly for bermudagrass, 240 lb N/acre should be sufficient to produce 4 to 5 tons hay/acre and 400 lb N/acre should produce 6 to 7 tons hay/acre with normal rainfall. Recommended nitrogen rates are reduced 20 lb N/acre for crops grown after a legume (typically soybeans or peanuts).

Nitrogen Application Timing

Swine manure shall not be applied to cropland more than 30 days before planting or during dormant periods for perennial species, unless otherwise approved by the Department in an emergency situation. **Part 100.100.B.16.**

The release of nitrogen from manure should coincide with crop nitrogen accumulation. If the crop is not actively accumulating nitrogen then nitrate-nitrogen in the soil will be subject to loss via leaching. Annual crops such as corn, cotton, and wheat have high nitrogen requirements for short time periods. For example, corn accumulates 67% of its nitrogen from the knee high stage to tasseling. Adequate nitrogen must be available during this time period if optimum yields are to be obtained. Pasture and hay crops have more moderate nitrogen requirements over longer periods of time and are not very sensitive to short-term deficits in nitrogen availability. Periods of nitrogen accumulation and nitrogen application windows for crops commonly grown in South Carolina are presented in Table 5.a.2.

Table 5.a.1. Nitrogen fertilizer recommendations for commonly grown crops in South Carolina.	
Crop	Nitrogen, pound/acre
Corn, dryland	100 - 150
Corn, irrigated	about 200
Cotton	80 - 100
Soybean	150 *
Wheat	80 - 100
Bermuda grass hay	240 - 400
Bermuda grass pasture	about 150
Fescue pasture	about 100
Annual rye for grazing	about 120
* Recently conducted research by Camberato, Albrecht, and Adams has shown little excess nitrogen in the soil profile when soybeans are fertilized with up to 150 pounds nitrogen per acre.	

The type of swine manure available is another factor that determines when it can be applied. Application of solids is most effective when incorporated into the soil due to potential for volatile loss of nitrogen and effects of moisture on organic nitrogen mineralization. Manure applications to row crops, therefore, are typically made preplant and incorporated into the soil. Most of the organic nitrogen is released in 3 to 4 weeks when temperature and moisture are favorable for nitrogen mineralization. Topdress or sidedress applications can be made, but determining when and how much nitrogen will become available is difficult. This limits the time period that applications of high-solids manure can be made.

Liquid manure applications can be made from planting through the period of effective crop accumulation as long as the liquid does not burn crop tissue too severely. Burn from liquid manure may be due to the high salt content of the manure and/or high ammonia content. Liquid applications of more than 1/4 inch move the ammonia into the soil, thereby conserving nitrogen by reducing volatile ammonia loss. Most of the nitrogen in liquid manure is in the ammonia or ammonium forms, not in the organic form.

Table 5.a.2. Swine manure application windows for crops commonly grown in South Carolina. Months with cross-hatch or darkened indicate approximate times that swine manure applications providing nitrogen can be made to that particular crop. Darkened months indicate times of peak nitrogen accumulation. Adapted from similar by Dr. Virgil Quisenberry.

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Corn												
Cotton												
Soybean												
Wheat												
Bermudagrass												
Fescue												
Rye												
Bermudagrass/Rye												

PHOSPHORUS AND POTASSIUM BASED MANURE APPLICATIONS

Nitrogen-based applications typically over-apply all other essential plant nutrients, especially phosphorus (P_2O_5) and potassium (K_2O). Although most manure management plans base application rates on plant-available nitrogen, applying swine manure based on its P_2O_5 or K_2O content may be more economical or necessary to protect surface waters from phosphorus pollution.

The availability of P_2O_5 and K_2O in manures is similar to that of fertilizer sources, so basing application rates on the manure's content of P_2O_5 and K_2O should be adequate. Recommended rates of P_2O_5 or K_2O are based on soil analysis, soil type, and crop to be grown and are provided with a routine soil test. These recommendations can also be obtained from your County Agent or Clemson University Extension Circular 476. On soils testing high in P_2O_5 and K_2O, when these nutrients are not recommended by soil test, consider using the manure on other fields requiring P_2O_5 and K_2O. Manure nutrients are much more valuable when applied to low fertility fields. See section, Determining the Value of Manure Nutrients, for further explanation.

CONTROLLING PHOSPHORUS MOVEMENT FROM THE FIELD

All new manure utilization areas shall be evaluated using the NRCS-CPS to determine the suitability for application and the limiting nutrient (nitrogen or phosphorus). However, fields that are high in phosphorus may also be required to incorporate additional runoff control or soil conservation features as directed by the Department. **Part 100.100.B.9.**

The Natural Resources Conservation Service Phosphorus Index (specifically NRCS-PI of the NRCS-CPS) is an evaluation system for determining the potential for phosphorus movement from the field to surface waters. Phosphorus movement from the land into surface waters, such as lakes and streams, is considered pollution. Phosphorus movement occurs by erosion and runoff. Erosion is the movement of soil or particles of manure from the field. Runoff is water movement over the surface of a field containing little sediment. In South Carolina, erosion and runoff occur primarily from heavy rainfall or excessive irrigation. Phosphorus in erosion and runoff can be bound to the soil, contained in soil organic matter and manure particles, or dissolved in the water.

Many factors affect the amount of phosphorus that moves from the field to the water. These factors include:

- slope of the land
- soil type
- distance to the water
- rainfall and irrigation intensity and duration
- method of manure application
- soil phosphorus level
- presence of conservation practices-filter strips, contour planting, riparian zones

Manure application on sloped land is subject to greater loss via runoff and erosion than applications made on flat land. The greater the distance between the application area and the surface water the lower the chance of phosphorus movement into the water. Hence, the rationale for application setbacks from ditches, streams, ponds, and lakes. On tilled soils, incorporated manure results in less phosphorus runoff and erosion then when the manure is left on the soil surface. High soil phosphorus is another factor that increases the potential for phosphorus pollution of surface waters. The higher the level of phosphorus at the soil surface the greater the concentration of phosphorus in the runoff water and erosion sediments. When soil test phosphorus is high at the soil surface, application of manure to other fields should be considered. An alternative practice in some instances may be deep plowing to mix the high phosphorus surface soil with low phosphorus subsurface soil. Installation of conservation practices that reduce runoff and erosion are also beneficial to reducing phosphorus pollution of surface waters.

In most soils with moderate phosphorus application rates phosphorus remains in the soil where it is placed with little downward movement. Phosphorus added to the soil is bound by clay particles so that only a portion remains available to the crop. This process reduces the amount of dissolved phosphorus in runoff water, but does not affect the loss of phosphorus in erosion sediments. Soils have finite capacities to absorb phosphorus. When the capacity is exceeded, the majority of any additional phosphorus remains dissolved in the soil water and can be leached downward. Leaching of phosphorus can occur on coarse sandy soils with high application rates of phosphorus and on high organic matter soils commonly occurring in Carolina Bays. In these soils, phosphorus leaching into the water table and lateral movement of ground water can move phosphorus to the stream or lake. However, in soils with clay subsoils the leaching of phosphorus through the soil profile is slow since these soil layers have a substantially greater capacity to absorb phosphorus than surface soils. The potential for phosphorus leaching and subsequent lateral movement to surface waters is a component of the NRCS-PI to determine the suitability of the field for manure application and the nutrient determining the application rate (either nitrogen or phosphorus). Lateral flow of soil water containing phosphorus can occur in the absence of tile drains, but is accelerated by artificial drainage.

CROP NUTRIENT ACCUMULATION

Swine manure applications may be based on crop removal of phosphorus to prevent further increases in soil phosphorus when the NRCS-PI rating suggests the potential for phosphorus movement to surface waters is high. Phosphorus removal for crops commonly grown in South Carolina are listed in Table 5.a.3. Row crops remove about 30 lb P_2O_5/acre at typical yield levels and hay crops remove more than 50 lb P_2O_5/acre. A more extensive list of crops and a computer based calculation of crop removal can be found at http://npk.nrcs.usda.gov/nutrient_body.html.

Crop accumulation of nutrients from the soil and removal from the field determines the efficiency of crop nutrient utilization (Table 5.a.3). Nutrient utilization is routinely less than 100% due to inefficiencies in nutrient uptake by the crop, soil reactions that render the nutrient unavailable, and loss of the nutrient from the soil by leaching, erosion or volatilization. Only a portion of the nutrients in the crop will come from that year's application of animal manure or fertilizer. The remainder of nutrient accumulation will have come from nutrients already present in the soil. Nutrients in the crop parts that remain in the field, such as corn or wheat stover, will be recycled to the soil and available to the next crop. Nitrogen has been the plant nutrient most studied. Accumulation efficiency from fertilizer is typically around 60% of the nitrogen added and removal efficiency is about 50%. These efficiencies are determined by accounting for the amount of nitrogen that came from the soil without added fertilizer. Nitrogen efficiency from manures is usually less than that from fertilizer.

ZINC AND COPPER REGULATIONS AFFECTING LAND APPLICATION

South Carolina regulates swine manure applications by the concentration of zinc (Zn) and copper (Cu) in the manure or by the amount of Zn and Cu that can be applied on a cumulative basis (See **Part 100.100.9B** and Chapter 3). Good record-keeping of the amounts of manure applied to a field and the concentration of Zn and Cu in the manure is necessary to meet the conditions of the regulations.

Zinc and Cu are present in swine manure in varying amounts (see Table 3.3) and are essential crop nutrients. However, long-term use of swine manure based on providing the total N requirement of the crop provides more Zn and Cu than the crop requires, and these nutrients can accumulate to high levels in the soil. Crop toxicities may occur in certain situations. Crop removal of Zn and Cu from the field is quite small, around 0.03 pounds of Cu per acre per year and about 0.11 pounds of Zn per acre per year (see Table 5.a.3) and no leaching of these nutrients occurs. Therefore, once applied to the soil they remain there. The toxicity of high soil Zn and Cu is reduced by increasing soil pH, however, increased soil pH will not completely eliminate Zn and Cu toxicity in some instances. If soil pH is increased too much, deficiencies of other micronutrients may be induced by the high pH.

Table 5.a.3. Nutrient accumulation and removal by crops commonly grown in South Carolina.

Crop	Yield level	Plant part	N	P_2O_5	K_2O	Cu	Zn
			---- pounds of nutrient per acre ------				
Corn	100 bu/acre	grain	75	44	29	0.02	0.10
		stover	58	14	105	------	------
		total	133	58	134	------	------
Cotton	1,000 lb lint/acre	lint, seed	63	25	29		
		stalks	57	17	55	------	------
		total	120	42	84	------	------
Oats	80 bu/acre	grain	48	20	12	------	------
Peanuts	3,000 lb nuts/acre	nuts	105	17	26	0.04	0.10
		vines	75	13	113	------	------
		total	180	30	139	------	------
Soybean	30 bu/acre	grain	120	24	42	0.03	0.10
		stover	42	8	29	------	------
		total	162	32	71	------	------
Tobacco	2,000 pounds/acre	leaves	57	10	104	0.04	0.13
		stalks	27	7	68	------	------
		total	84	17	172	------	------
Wheat	50 bu/acre	grain	60	28	17	0.02	0.13
		stover	26	6	84	------	------
		total	86	34	101	------	------
Hay and Silage Crops							
Bermudagrass	6 tons/acre	hay	300	84	252	------	0.12
Fescue	3 tons/acre	hay	116	56	159	------	------
Annual ryegrass	3 tons/acre	hay	129	51	144	------	------
Corn	10 tons/acre	silage	71	24	72	------	------
Sorghum	5 tons/acre	silage	74	28	141	------	------

CROP PRODUCTION PROBLEM FROM HIGH SOIL ZINC

Reduced growth and yield of peanuts, soybeans, and cotton due to Zn toxicity have occurred in South Carolina fields. Peanuts are extremely sensitive to soil Zn and have been studied more extensively than the other crops with respect to Zn toxicity. Soil Zn levels and pH levels at which toxicities occur in peanuts are listed in Table 5.a.4. Note that toxicities may occur with as little as 10 lb Zn per acre with soil pH less 6.0. Raising soil pH to high levels cannot completely eliminate Zn toxicities in some cases, because the high pH may cause manganese deficiencies in subsequent crops such as soybeans, cotton, and wheat.

Zinc toxicities occur in crops other than peanuts, but at somewhat higher levels of Zn. Yield of soybeans grown on a sandy Coastal Plain soil was reduced by Zn toxicity when soil pH was 5.4 and soil test Zn was 26 pounds per acre. When soil pH was increased to 6.6, Zn toxicity was eliminated. Growth of cotton on a sandy Coastal Plain soil was reduced by Zn toxicity at a pH of 5.3 and soil test Zn of 45 pounds per acre. The toxicity was reduced when soil pH was raised above 6.0. Maintaining soil pH greater than 6.0 is needed to reduce the incidence of Zn toxicity when soil test Zn levels are high.

Table 5.a.4. Minimum soil pH necessary to avoid Zn toxicity in peanuts at different levels of soil test Zn. From Jessica Davis-Carter, 1993.

Soil test Zn, lb/acre	Minimum soil pH
<1	5.7
1 - 4	5.8
5 - 10	5.9
11 - 20	6.0
21 - 30	6.1
31 - 40	6.2
41 - 50	6.3
51 - 60	6.4
61 - 70	6.5

APPLY THE CORRECT AMOUNT OF SWINE MANURE UNIFORMLY

Applying the proper amount of animal waste to the field in uniform fashion is the next step in effectively utilizing animal waste. Spreaders and irrigation systems must be calibrated to apply the proper rate and be adjusted for uniform application.

Utilization of swine manure on nitrogen sensitive crops like cotton and tobacco is difficult because of difficulty predicting nitrogen availability, calibrating delivery equipment, and making uniform applications. Herbicide application timing, insecticide effectiveness, growth regulator applications, and defoliation decisions are all impacted by the amount of cotton growth which is highly dependent on nitrogen. Variability in height and growth within the row complicate these management practices. Too little nitrogen on tobacco reduces yield, and too much can delay harvest and reduce quality. Harvesting and curing of non-uniform tobacco may also be a problem. If swine manure is applied at the correct rate to a grain crop there should be no problems growing cotton or tobacco in the field the next year.

REDUCE FERTILIZER APPLICATIONS ACCORDINGLY

When swine manure is used as the primary nitrogen source for crops, supplemental phosphorus, potassium, and micronutrient applications are usually not needed. Eliminating unnecessary fertilizer applications is a benefit both economically and environmentally. For nutrients other than nitrogen, traditional manure, soil testing, and plant tissue analysis methods are adequate for determining if further additions of these nutrients are required.

WATER TABLE, ENVIRONMENTAL, AND SETBACK RESTRICTIONS ON LAND APPLICATION OF SWINE MANURE

Water table and environmental restrictions

Swine manure and other swine by-products shall not be placed directly in groundwater. **Part 100.100B.4.**

Swine manure and other swine by-products shall not be applied to or discharged onto a land surface when the vertical separation between the ground surface and the water table is less than 1.5 feet at the time of application, unless approved by the Department on a case by case basis. **Part 100.100B.8.**

Manure shall not be spread in the floodplain if there is danger of a major runoff event, unless the manure is incorporated during application or immediately after application. **Part 100.100.B.20.**

Swine manure and other swine by-products shall not be applied to land that is saturated from recent precipitation, flooded, frozen, or snow-covered. Swine manure and other swine by-products shall not be applied during inclement weather or when a significant rain event is forecasted to occur *within 48 hours, unless approved by the Department in an emergency situation.* **Part 100.100B.3.**

Manure (solid or liquid) shall only be applied when weather and soil conditions are favorable and when prevailing winds are blowing away from nearby dwellings. Animal manure should not be applied to land when the soil is saturated, flooded, during rain events, or when a significant rain event is forecasted to occur within 48 hours, unless otherwise approved by the Department in an emergency situation. **Part 100.100.B.19.**

Setbacks for manure utilization areas

This section is intended as a summary of selected setbacks between manure utilization areas associated with swine facilities of different sizes and residences, property lines and various water features (Table 5.a.5 and 5.a.6). Note the setbacks differ dependent on the size of the swine operation. Consult the Regulations for more specific information. **Part 100.100.C.** Additional setbacks for any size swine farm may be required by DHEC. **Part 100.100.C.5.**

Table 5.a.5. Setbacks between manure utilization areas associated with swine facilities with less than 1,000,000 pounds normal production live weight and various features. Part 100.100.C.1&2.

Feature	Application type	Minimum distance	Waivable
Residence	Spray	300'	Yes
Residence	Incorporate or injection	None	----
Property line without residence within 300' of line	All	None	----
Waters of the State, ditches and swales that drain directly into waters of the State	Not specified	100'	No
Ephemeral and intermittent streams	Spray	100'	No
	Incorporation	75'	No
	Incorporation within 24 hours	50'	No
	Injection	50'	No
Ditches and swales that drain directly into ephemeral and intermittent streams	Not specified	50'	No
Public and private drinking water wells	Not specified	200'	No

Table 5.a.6. Setbacks between manure utilization areas associated with swine facilities with more than 1,000,000 pounds normal production live weight and various features. Part 100.100.C.3.			
Feature	Application type	Minimum distance	Waivable
Real property owned by another person	Not specified	200'	No
Occupied residence	Not specified	750'	No
Waters of the State, ditches and swales that drain directly into waters of the State	Not specified	150'	No
Ephemeral and intermittent streams	Not specified	100'	No
Public and private drinking water wells	Not specified	200'	No

DETERMINING THE VALUE OF MANURE NUTRIENTS

Major Nutrients

The value of manure nutrients is dependent on soil fertility level, crop nutrient needs, manure nutrient content, and the cost of purchased nutrients and manure application.

Manure has the greatest nutrient value when applied to low-fertility fields and the least value when used on the same field year after year. When soil fertility status is low, high nutrient application rates of phosphorus and potassium are recommended in addition to the standard nitrogen application. In this situation the crop will benefit from the addition of phosphorus and potassium and the application of these nutrients in the manure is valuable. However, most manures when applied based on the crop's nitrogen requirement provide more phosphorus and potassium than is required and these nutrients accumulate in the soil. When soil fertility status becomes high, supplemental nutrients are not required, and the application of phosphorus and potassium is not recommended. In this situation the phosphorus and potassium in the manure does not have any value in that year. If manure is continually applied to the same field, then the main benefit derived is the nitrogen content of the manure. No benefit is derived from the continual application of excess phosphorus and potassium and the potential for phosphorus runoff polluting lakes, rivers, and streams is greatly increased. Applying manure to low-fertility fields first and having enough land to use manure every second or third growing season are good ways to maximize the nutrient value of the manure and minimize the potential for polluting.

This point is illustrated in Table 5.a.7. A producer applies 33,333 gallons of lagoon water per acre to three fields varying in soil fertility level to provide 120 lb N/acre in anticipation of growing a 100 bu/acre corn crop. The lagoon water also applies 93 lb P_2O_5/acre, 203 lb K_2O/acre, and 10 lb S/acre. One field has a low phosphorus and potassium level and 80 lb/acre P_2O_5 and K_2O are recommended, therefore, a significant amount of the potassium and phosphorus in the lagoon water has value. In this low soil fertility situation, the nutrient content of the 33,333 gallons per acre is worth $64.80 or $1.94 per 1,000 gallons. Only an extra 13 lb P_2O_5/acre was applied. However, when soil test phosphorus and potassium is medium, less P_2O_5 and K_2O is recommended and the lagoon water is worth less, $52.20 per acre or $1.57 per 1,000 gallons. At medium soil fertility levels an extra 43 lb P_2O_5/acre was applied. At high soil test phosphorus and potassium, no P_2O_5 or K_2O is recommended, and the nutrients in the lagoon water are worth only $31.20 per acre or $0.94 per 1,000 gallons. Ninety-three lb P_2O_5/acre, valued at $23.25, was wastefully applied to the high fertility soil.

Excess crop nutrients are not necessarily lost from the soil and without value for the next growing season. In most soils some of the excess phosphorus added in one year will be available to future crops over several years. If phosphorus applications in future years are reduced or eliminated by the initial manure application, then some of the excess phosphorus provided in the initial year has value. Excess potassium will also be available to some extent in future years in clayey Piedmont soils and Coastal Plain soils with clayey subsoils within 15 inches of the soil surface. In coarse sandy soils with deep subsoils, however, much of the potassium may be lost between the first and second cropping season and that value will be lost. Even though some of the value of manure nutrients is captured after the first year, fertilizing one year for several years is generally not recommended because some of the phosphorus and potassium will be wasted and the phosphorus may pollute surface waters.

The key to getting the most value from manure nutrients after the initial growing season is not to apply any more phosphorus and potassium when soil test in subsequent years indicates those nutrients are adequate.

Micronutrients

The example referred to above and in Table 5.a.7 did not consider the value of micronutrients (zinc, copper, manganese, etc.) because soil testing and plant analysis has shown that micronutrient levels in most fields are adequate most of the time. However, when soil testing or plant analysis identifies micronutrient deficiencies and recommend micronutrient additions, the value of the micronutrient application in the manure should also be considered. Calculate the value of the micronutrient by multiplying the recommended application rate by the fertilizer cost of the nutrient. Micronutrients are typically much more expensive than nitrogen, phosphorus, and potassium, so when needed their value is significant to the overall benefit of the manure.

Table 5.a.7. Nutrient value of swine lagoon water containing 3.6 pounds available nitrogen, 2.8 pounds of phosphorus (as P_2O_5), 6.1 pounds of potassium (as K_2O), and 0.3 pounds of sulfur per 1000 gallons. The lagoon water was applied to the field at a rate of 33,333 gallons per acre in anticipation of growing a 100 bushel corn crop. The value of the manure nutrients changes dependent on the soil fertility status of the field.					
Fertility status	**Nutrient**	**Recommended application**	**Amount applied with manure**	**Value**	**Excess nutrients applied**
		pounds per acre		$ per application	lb/acre
LOW	N	120	120	120 x 24¢ = $28.80	0
	P_2O_5	80	93	80 x 24¢ = $19.20	13
	K_2O	80	203	80 x 18¢ = $14.40	123
	S	10	10	10 x 24¢ = $2.40	0
MEDIUM	N	120	120	120 x 24¢ = $28.80	0
	P_2O_5	50	93	50 x 24¢ = $12.00	43
	K_2O	50	203	50 x 18¢ = $9.00	153
	S	10	10	10 x 24¢ = $2.40	0
HIGH	N	120	120	120 x 24¢ = $28.80	0
	P_2O_5	0	93	0 x 24¢ = 0	93
	K_20	0	203	0 x 18¢ = 0	203
	S	10	10	10 x 24¢ = $2.40	0

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