Chapter 1
INTRODUCTION

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1.1 INDEX

1.2 THE RESEARCH TEAM

Members of the Commercial Agriculture Program of the University of Missouri have authored this report. The Commercial Agriculture Program consists of teams of faculty and staff who research and educate farmers who make a living in agriculture on how to improve profitable production. Members of the crops focus and swine focus teams joined together to address manure management from a systems perspective.

The teams developed models for on-farm evaluation of manure management that included feeding management, storage structures, cropping activities and land application techniques. These integrated models allowed the analysis of "what if" scenarios so that producers learn what the land, time and economic impacts of changes in management would mean to them.

The UM Commercial Agriculture Program was contacted by the National Pork Producers to help producers understand the implications of proposed USEPA regulations of confined animal feeding operations. By interviewing pork producers in five states and modeling their current manure management practices, the team developed a database of current practices. These same farms were then subjected to various changes in manure management according to the proposed EPA CAFO rules.

This report is a summation of the results from the analysis of the 31 farms in five states.

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1.3 BACKGROUND

On January 12, 2001, the United States Environmental Protection Agency (USEPA) published proposed changes to the National Pollutant Discharge Elimination System Permit Regulation and the Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations in the Federal Register (Federal Register, p 2960-3145). These two regulations describe the approach the USEPA uses to define and regulate concentrated animal feeding operations (CAFOs) under provisions of the Clean Water Act.

The *National Pollutant Discharge Elimination System* (NPDES) provisions define which operations are CAFOs and establish the permit requirements for those operations. The existing NPDES rules used to regulate CAFOs were issued March 18, 1976. The *Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations* (ELG) establish the technology-based effluent discharge standards for CAFOs. The existing ELG for CAFOs were issued February 14, 1974.

The USEPA is considering extensive revision of the current rules governing manure management for (CAFOs) under provisions of the Clean Water Act. Their objective is to update and otherwise revise the current rules to better protect and restore water quality and address changes in the structure of the animal feeding industry (Federal Register, p 2972).

1.4 REPORT OBJECTIVES

This report addresses the feasibility and costs of two proposed revisions of the ELG on U.S. animal feeding operations. Chapters 2, 3 and 4 evaluate the feasibility and costs of implementing restrictions on nutrient applications so as to not exceed the crop and soil requirements for nutrients, particularly phosphorus, as proposed in part 412.31 (Federal Register p 3142; provision 412.31(b)(1)(iv). This provision is known as the "phosphorus rule", and is considered the best practicable control technology currently available (BPT). As a BPT, all CAFOs are expected to meet the requirements of this provision.

Chapter 2 presents the theoretical analysis used to define the challenges facing an operation changing from nitrogen-based management to rotational phosphorus-based management. Rotational phosphorus-based management is defined as the application of manure, based on crop nitrogen need, but no additional manure is applied until crops remove the excess phosphorus. Our theoretical model shows that phosphorus limits will have the largest impact on producers of crops with high nitrogen to phosphorus ratios (e.g. alfalfa and other hays) and on those farmers that produce manure types with low nitrogen to phosphorus ratios (e.g. poultry litter and other solid manure types). Phosphorus limits will increase land need from 0% to 900% depending on crop and manure characteristics. The greatest increase in land needed to appropriately distribute manure will occur in those regions of the country that have low crop productivity and that are dependent on crops having relatively high nitrogen to phosphorus ratios.

Chapter 2 also establishes that switching to a rotational phosphorus limit will cause application time for tractor-pulled spreader systems to increase due to the additional time needed to reach the additional acres required. The primary potential effect on application time for an irrigation spreader system is the additional setup time needed to reach the additional acres required to meet the phosphorus rule.

Chapter 3 demonstrates why the rotational phosphorus approach is the only feasible method for implementing phosphorus limits on many farms. Annual phosphorus limits are shown to require farmers to reduce the annual, per acre application rate of manure by up to 90%. Current slurry manure application technologies cannot apply some concentrated manures (e.g. swine pit slurry and poultry litter) at annual phosphorus rates. Those types of manure that can be applied at annual phosphorus rates will require producer investment in new or modified application equipment. Compliance with an annual phosphorus limit will reduce spreading discharge rate, increasing the time required for application of manure. Additionally, it will promote surface application of manure and require farmers to apply supplemental nitrogen to all nitrogen-requiring crops that receive manure.

Chapter 3 commends rotational phosphorus limits as allowing farmers to: 1) rotate fields receiving manure, targeting crops that need both nitrogen and phosphorus; 2) use manure to meet all fertilizer needs of the crop in the year manure is applied, eliminating the cost and time required to apply fertilizers other than manure to the crop; and 3) apply manure at rates that are able to use current equipment complements, minimizing expense and time increases that would result from a phosphorus limit. Chapter 3 also establishes that there will be little or no difference in water quality benefit from mandating an annual phosphorus rule instead of a rotational phosphorus limit.

Chapter 3 concludes by proposing that the existing wording in Federal Register, p 3142, provision 412.37 (a)(2) *i* and *ii* be replaced with the following text: “Multi-year phosphorus applications are permissible as long as they do not exceed the nitrogen limit for the current crop year. The phosphorus store should not exceed five years of crop need if there is a high or very high risk of phosphorus loss.”

Chapter 4 presents the results of a simulation analysis of 31 farms in five states switching from a nitrogen limit to a phosphorus limit. Our analysis estimates that one farm could not comply due to low productivity soils receiving manure and six of the remaining 30 farmers capable of applying manure under a phosphorus rule (20%) fall under the EPA’s definition of moderate impact to stress. All are contract producers. Five are in PA and one is in IA. All apply pit slurry with a tanker. Forty-six percent of contract producers are in the stress category. We predict that the EPA’s economic assessment of farms in the moderate to stress categories is underestimated. Table 10-6 of the Preamble (Federal Register, p 3090) reports that the EPA estimates that 20% of the hog producers will be in the moderate to stress categories. Their estimate of 20% includes the cost of attaining zero discharge. Our estimate of 20% considers only the cost of implementing a rotational phosphorus limit.

Chapter 5 addresses the technical feasibility of attaining the “zero discharge” rule on existing swine operations as proposed by USEPA (Federal Register, p 3144). The USEPA states that this standard is considered the “best available technology economically achievable (BAT).” All BATs are to be implemented on existing swine farms under the new ELG. The USEPA recommended the following three strategies for the swine industry to meet the “zero discharge” rule:

1. Improved water management,
2. Impermeable lagoon covers, and
3. Additional storage.

In Chapter 5, each of these strategies was evaluated to determine the technical feasibility of the swine industry adopting the strategies to meet the “zero discharge” rule. Improving water management by implementing water reduction methods will not reduce effluent volumes that flow into earthen manure storages and anaerobic lagoons enough to provide any appreciable increase in storage period. An increased storage period, if it existed, would help swine operations meet the “zero discharge” rule. A number of technical feasibility issues and challenges exist that significantly limit the potential for successful implementation of impermeable covers for a significant portion of the swine industry. The potential of implementing additional storage was evaluated and does have the potential to help meet the “zero discharge” rule. However, the suggested scenarios do not guarantee a “zero discharge” because the storage may overflow when a rainfall event occurs that is greater than the design storm used to size the structure. The only structures that can be assured to meet a “zero discharge” criterion due to rainfall are covered structures that do not have rainfall or runoff entering the storage structure.

Chapter 6 presents the agronomic and economic impact of mandating “zero discharge” for swine operations by implementing the use of impermeable covers for anaerobic lagoons. The initial cost of installing an impermeable cover and the annual expense of land applying manure from the covered storage was evaluated for a portion of the surveyed farms. With a covered anaerobic lagoon, a system change for the nutrient balances within the swine operation would occur. The plant available nutrient concentrations of the effluent from a covered lagoon would be more like covered pit slurry than anaerobic lagoon effluent. Since more plant available nutrients were available from covered anaerobic lagoon effluent, the amount of crop acres needed to assimilate the plant nutrients increased significantly. The added economic expenses related to implementing the use of an impermeable cover and the increased land application costs make the implementation of a “zero discharge” rule prohibitive for most anaerobic lagoon based swine production facilities.

Chapter 6 evaluates the agronomic and economic impact of alternative methods to potentially meet the “zero discharge” rule. The alternative methods included building additional second storage cells, constructing emergency storage cells, and converting to slurry storage tanks. Converting to a slurry storage tank system had very similar results as implementing impermeable covers and makes this conversion prohibitive for most anaerobic lagoon based swine production facilities. Adding a second storage cell to

expand storage capability to 18 months appears to be a feasible option for a large portion of lagoon based swine production facilities. Building an emergency storage cell provide expanded storage capability and appears to be feasible for all lagoon based swine production facilities. However, the second storage cell and the emergency storage cell options cannot meet the "zero discharge" rule as the EPA has stated. The additional storage capability does have the ability to protect the environment by reducing overflow potential. If adopted, an "upset and bypass" provision will be needed in the permit to implement either of the additional storage options, additional storage cells or emergency storage cells.

Chapter 7 presents issues related to the co-permitting options discussed in the proposed rule. With co-permitting, the EPA and associated permitting authorities would require both owners and operators of CAFOs to hold NPDES permits.

Three environmental objectives of co-permitting are:

- to improve manure management by contractors/growers via regulatory pressure on the integrators;
- to create a nutrient management system for manure that cannot be utilized on site by the CAFO owners; and
- to create an incentive for the integrator to minimize source loading of nutrients and compounds (e.g. in feed) that directly or indirectly impact the composition of the manure.

Co-permitting will result in an increase in administrative and manure management costs as well as regulatory monitoring and enforcement costs related to excess manure that had previously been transferred from CAFOs. Co-permitting will likely have a negative impact on market transactions for excess manure. The environmental objectives of co-permitting may be obtained with market mechanisms or other regulatory rules.

1.5 INTENTION OF THE "PHOSPHORUS RULE"

The proposed changes to the NPDES and ELG provide conflicting signals on the intent and scope of the proposed "phosphorus rule." The phosphorus rule states that "State approved indices, thresholds and soil test limits shall be utilized such that application does not exceed the crop and soil requirement for nutrients" (Federal Register, p 3142).

Assumptions made regarding how the phosphorus rule is imposed and to what extent it is imposed directly affect projected costs and feasibility of such a rule. The USEPA includes proposals that all land receiving manure must utilize the phosphorus standard. However, the USEPA's economic analysis of the proposed rules assumes that manure applied to uncontrolled acres (i.e. land not owned/rented by the CAFO) was applied based on the nitrogen content of the manure.

USEPA clearly intends that all land under control of the CAFO fall under the provisions of the phosphorus rule. All controlled land receiving manure is required to have a

permit nutrient plan (PNP) that includes an evaluation of the phosphorus status of the soil (Federal Register, p 3142).

The USEPA wants to ensure that manure spread on land is applied in accordance with the phosphorus rule through at least four mechanisms. First, the USEPA is proposing that CAFO operators obtain a letter from all farmers receiving manure on uncontrolled acres certifying that they are following the phosphorus rule provision (Federal Register, p 3138). The text explicitly states that people receiving manure certify that they do not apply manure "in quantities that exceed the land application rates calculated using the method specified in Federal Register, p 3142, provision 412.31(b)(1)(*iv*) …"

A second approach to ensuring a phosphorus rule is used on all acres receiving manure is through the co-permitting provisions of the proposed rule. It is the USEPA's intent that integrators would "develop and implement a program to ensure proper management and/or disposal of excess manure." Through this program, the USEPA intends for the integrator to develop innovative incentives that ensure manure applied to CAFO controlled land is done in accordance with permit limits (Federal Register, p 3025).

USEPA is also proposing that land receiving manure from CAFOs ("either from their own operations or obtained from a CAFOs") not qualify for the agricultural storm water exemption unless manure is applied in accordance with "proper agricultural practices" as defined by the PNP. Farmers receiving manure from a CAFO and applying it on their land could be cited as a point source if they failed to use the phosphorus rule to establish manure application rates (see Federal Register, p 3029-3031).

Finally, the USEPA is using a large voluntary effort by animal feeding operations to implement comprehensive nutrient management plans (CNMPs) on their farms (Federal Register, p 2966). These CNMPs, as defined by the Natural Resource Conservation Service (NRCS), will have a phosphorus assessment analogous to the phosphorus rule on all land receiving manure.

Given the oft repeated objective that manure applied both to CAFO controlled land and uncontrolled land be applied in a manner in accordance with the permit requirements of the CAFO, this report assumes that all fields receiving manure will incur the requirements of a PNP. This includes expenses for the phosphorus assessment, PNP implementation and record keeping.

It is further assumed that phosphorus-based application rates will be limited by the phosphorus removal capacity of crops produced on the land. While nitrogen-based rates may be appropriate in the short term, manure applications on *all* land receiving manure will be limited by phosphorus rate over the long term. Farmers must assume nitrogen-based rates will not be tenable on all land receiving manure under the proposed rules.

The proposed phosphorus rule states that one of three approaches will be adopted statewide at the discretion of the USEPA and the NRCS state conservationists (Federal Register, p 3056). The three approaches are the phosphorus index, the phosphorus threshold level and the soil test phosphorus level. Two of these approaches (threshold and soil test) are predicated on the concept that a soil has a finite capacity for added phosphorus (i.e. increasing soil test phosphorus will cause phosphorus limits to be imposed with these approaches). In the case of the soil test approach, many agricultural soils will already have a phosphorus level that requires manure application based on the phosphorus removal capacity of the crop grown or may even preclude manure applications. Soil test phosphorus is also a prominent component of most phosphorus indexes.

Crop farmers receiving manure from CAFOs will have a strong disincentive to allow manure applications above phosphorus crop removal rates once their soil is at the agronomic optimum phosphorus level under the proposed USEPA rules. Allowing a neighboring CAFO to apply manure and raise soil test phosphorus up to or near the "very high" level lowers the value of the farmers land for any future expansion into an animal feeding operation. A new CAFO on a farm that has no history of manure applications may have an abundance of land near the buildings available for manure application. Prudent crop farmers will choose to conserve the value of their land by requiring the CAFO to apply manure at rates that do not exceed the phosphorus removal capacity of the land.

In summary, this report assumes that long-term land needs of CAFOs for manure application must be based on the phosphorus removal capacity of the cropped land. This decision was based on:

- The USEPA's intent that a phosphorus assessment be used on all land receiving manure;
- The uncertainty on how the phosphorus rule will be implemented in each state; and
- The disincentive farmers receiving manure will have for taking manure phosphorus in excess of crop need.

It follows that the USEPA underestimates land requirements for the phosphorus rule by assuming that CAFOs can apply manure on uncontrolled acres based on the nitrogen need of the crop. Our approach also may underestimate CAFO land need because we assume that all land on controlled and uncontrolled acres can receive manure. It is likely that on some CAFOs' land the phosphorus assessment will rate "very high," triggering a ban on manure application on those acres.

1.6 REFERENCES

Federal Register, Washington, DC., January 12, 200. pages 2960-3145.