INTENSIVE HOG OPERATION WASTE MANAGEMENT THROUGH IRRIGATION

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Introduction

Large intensive hog operations are being developed in Saskatchewan. These operations are sized to take advantage of economies of scale. To maximize returns operators wish to spend their management time in areas of the operation that pay high returns. Disposal of the operations waste has been seen as a yearly operational headache. Licensing requirements to date have not required that intensive livestock operations own a large landbase on which to dispose of wastes. Permitting suggests that a sufficient landbase to utilize the long-term production without the risk of nutrient overloading be available. From the manager's perspective, suitable lands adjacent to the facility are favoured due to decreased transportation cost and the time required to spread wastes. This unfortunately, can lead to overapplication and subsequent cropping problems such as lodging, uneven and delayed maturity, etc. Farmers who accept effluent are not willing to pay, even for the nutrient value of the manure, due to an inability to evenly apply the effluent using injection or volume gun application systems. The current effluent irrigation practise in this operation is to apply the liquid portion with some type of irrigation equipment and to apply the solids with conventional spreading equipment. The area currently available for disposal is 430 acres of intensively irrigated land and 390 acres of permanent pasture.

Project Objectives

The project objectives are to develop, evaluate and demonstrate the disposal of hog effluent, both liquid and solids, through conventional irrigation equipment. This will be done while attempting to maximize the nutrient value of the effluent. A secondary objective is to minimize the amount of solids that would have to be applied with conventional equipment.

Soil Benchmarking

Effluent irrigated lands were sampled for salinity determination prior to commencement of the project. An EM38 survey of the lands was also undertaken. All samples were analyzed for NO_3-N, P, K, SO_4-S and one half the samples for Total N. This analysis will be repeated again at the completion of the demonstration. In the intervening years N, P, K, and S will be determined on duplicated random samples taken in each cropping area. Bulk density and field capacity will be determined on approximately one quarter of the samples taken for detailed salinity analysis. Organic matter content of the top six inches will be determined on one-half of the holes at the beginning and end of the project. Trace metals will be determined on ten holes throughout the project at the beginning and end of the test.

Groundwater Monitoring

During the initial phase of this intensive livestock operation a number of piezometers were installed to assist with the evaluation of siting the lagoons and for the environmental impact evaluation. In the fall of 1993 Sask Water undertook further groundwater investigations on the lands slated to receive effluent. In total, sixteen piezometers located in the area are

monitored for groundwater levels and water chemistry. A sample is taken from the piezometers three times during the year corresponding to the period before effluent irrigation begins, mid season, and late fall. Samples are analyzed for major ions, N03, P, B, and both Total and Faecal colifonns.

Effluent Nutrient Analysis Monitoring

The nutrient content will be determined at several locations along the effluent stream. Samples will be analyzed for NO_3-N, SO_4-S, P, K, Total N and Ammonium N. Field and lab electrical conductivities will be determined. Samples are drawn from the effluent lagoons directly, the separator, and post injection at the pivot point or from catch cans placed in the receiving field.

Plant Analysis

There are five separate crop types that are currently being grown on the lands receiving effluent. Nutrient removal in the harvested crops will be used to determine a nutrient balance. If possible, yields will be taken by field scale yield strips. Square meter samples will be taken only if field scale strips cannot be obtained. All samples will be analyzed for N, P, K, S, Ca, Mg, Cu, Zn, Fe, Mn, and B.

Solids Management

In systems where the solids and liquid are disposed of by irrigation, the normal method is to use volume gun sprinklers. Volume guns do not allow for precise application of nutrients and have a much higher labour component compared to center pivot irrigation equipment. To effectively manage the application of nutrient in this operation the effluent will be passed through a screen separator to remove the solids too large to pass through the sprinkler nozzles. The intent is to apply as great a percentage of solids through the center pivot sprinklers as possible without plugging. In the initial year of the trial the largest screen size used, 0.75 mm, resulted in plugging of only two nozzles over the course of the season. A larger screen size is being purchased for testing in the second year. The smallest diameter of nozzle on the pivots being used is 3.0 mm. Theoretically it may be possible to go to this maximum size. However, the longitudinal orientation of screen wires may allow for materials larger than the nominal diameter to pass through which would lead to plugging. Therefore maximum screen size may be some factor less than the smallest nozzle diameter.

Lagoon System

A four cell, compacted, earthen lagoon system is utilized in this operation. The majority of solids settle in cell #1. Through agitation the solids are suspended and pumped to the screen separator. Liquid for dilution of cell #1 comes from one of the other three cells. Effluent from the fourth cell was injected directly into one of the irrigation systems.

In total 15316,155 litres of effluent were pumped during the 1994 growing season. Of this total 6,956,072 litres was cell #4 effluent which contained essentially no solids. The remaining 8360,083 litres were screened. The separation process produced 1039 tonnes

of solids which was spread on adjacent dryland. It was felt by the operators that this volume represented approximately eleven months of waste generation.

Summary

This project is planned to continue for another two field seasons. The soils monitoring data (not shown) has found N deeper in the soil profile. If this is from earlier applications of effluent before this project began is unknown. Future monitoring will continue to assist in matching application to crop utilization. A greater number of samples of effluent will have to be obtained. This will enable us to have greater reliability in calculating the volumes to apply. The type of analysis conducted on the effluent/irrigation water samples may have to be adjusted due to the dilution of the irrigation water. The values for some of the nutrients do not appear correct. This may be a problem with the way the samples were handled or analyzed and will be looked into further.