ANIMAL WASTE MANAGEMENT, A NEW ERA

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Introduction

Livestock and poultry production has changed dramatically over the past decades. These changes have been driven by a growing and much more sophisticated consuming public demanding that food be sold in a highly convenient package, that it be of the highest possible quality and that it represent value in the marketplace.During this amazing unification of our cultures has come the realization that there is no longer a Western way nor an Eastern way but there is a technology that is shared throughout the world. There is also a growing sense that we share a single interrelated world for which we are collectively responsible. As designers and managers of livestock and poultry waste handling facilities this realization adds a sense of challenge and excitement to an already dynamic field of endeavor. Today, however, we stand before a new array of challenges that have far reaching implications as to how the people of the twenty-first century will be fed, the quality of the air they will breathe, and the color of the water in the streams that flow through their communities. Success is both possible and necessary if we are to continue to maintain the quality of life to which we have come to regard as "enlightened twenty-first century".

Water is a shared resource which shall be protected for downstream users

Nearly one hundred years ago it became obvious that the indiscriminate discharge of organic matter into public waterways was causing damage both to the resource and to downstream water users. This realization drove the development of wastewater treatment technologies and the adaptation of those technologies to a great variety of organic waste sources. Anaerobic digestion, modified activated sludge and chemical coagulation of livestock waste streams arose as standard treatment technologies as we practitioners of the art borrowed from science first applied to other waste sources.

Currently, the criteria by which we judge the acceptability of waste treatment are becoming more demanding. I recall being drawn around the table as the design of the Environmental was being planned. There was no question but that the effluent from that system must surpass current criteria and open the door for even better quality effluent. Although this trend will continue, it is likely that it will prove inadequate to protect the receiving waters unless we also reduce the quantity of water being discharged per animal produced. Although reducing the quantity to be discharged complicates the treatment, it allows a reduction of the impact on receiving streams. Water reuse or recycling for manure transport is the most reasonable method of waste reduction in many locations. This form of recycling is in widespread use and although challenging in many areas is likely to be necessary in our futures. Handling less dilution water can reduce waste treatment costs, in terms of treatment tank volume and pumping capacity. In many parts of the world, zero discharge is the norm. Where near-by cropland is available for effluent utilization and nutrient recycling this is relatively easy to achieve. In much of the U.S. we are constrained, as are you, by land limitations and the need for groundwater protection.

Plant nutrients, nitrogen and phosphorus, have value

Livestock and poultry production in the U.S. and Europe developed on the assumption that manure was a valuable by-product and was to be returned to cropland as a beneficial fertilizer. This model served well so long as livestock and poultry production was viewed as an adjunct to crop production and as a mechanism to capture the value of available labor. As livestock production has become more concentrated and manure production exceeds the capacity of available land to utilize the nutrients, alternative arrangements became necessary. The advent of low cost chemical fertilizer based upon cheap energy further eroded manure utilization by making available a more convenient and more predictable nutrient supply. Much of Asia was spared this transition based upon smaller land holdings and more specialized agricultural production discouraged widespread manure utilization.

In much of the U.S. land application of manure is no longer based on the economics of a low cost nutrient source but as an acceptable site for nutrient rich wastewater disposal. Nutrient management is a frequently heard term to describe the process of applying treated or partially treated animal manure to cropland according to the nutrient uptake capabilities of the crop to be grown. Traditionally, nutrient management decisions have been based upon nitrogen. Since nitrogen is highly volatile in several of its common forms, it was possible to apply the manure from several animals per unit area. Waste management systems that allowed ammonia volatilization were common. More recently, attention is shifting from nitrogen as the sole criteria to both nitrogen and phosphorus being of concern. For many livestock producers depending upon land application for manure disposal, this understanding has the potential to raise the land required for a particular operation by a factor of two to five.

Whether based upon future escalating energy costs, limited land availability, or constraints on ammonia release, nutrient recovery is likely to be a part of future livestock production. Nutrient recovery can be for the purpose of transport beyond the farm boundary or for promoting availability at a more appropriate time. Current technologies for nitrogen and phosphorus recovery are relatively undeveloped and do not compete favorably with chemically manufactured fertilizer from a cost perspective. The extent to which the market value of the recovered nutrients can offset the recovery costs depends upon future energy costs as well as the creativity with which the challenge is pursued.

Odor control will drive waste treatment facility design

Pig production in the U.S. is being transformed by large-scale vertically integrated pig producers. Corporate pig production in which the pigs are owned by the same enterprise that also owns the slaughter facilities, the meat packing plant and the marketing organization has changed the waste treatment demands in unexpected ways.

Anaerobic lagoons are the most frequently used devices for the storage and treatment of pig manure in the U.S. Although there are differing opinions as to the odor from anaerobic pig manure lagoons, many neighboring residents find it objectionable. Large pig operations result in lagoons with a large surface area. These large anaerobic surfaces result in the release of odors that are detected at greater distances than smaller facilities and at a greater intensity. Because of the odor and the frequency of lagoon dike failures and ammonia release, there is a perceptible

move to eliminate lagoons in those areas of most intense pig production. Similar action is likely with regard to other meat and dairy animals.

Technologies are available that result in reduced odor release. Many of these technologies are currently in use throughout the world. Enclosed anaerobic digestion modified activated sludge systems and covered lagoons are all demonstrated alternatives. The challenge is in developing the criteria that establish the appropriate choice of odor control standard for individual production sites and size of operation. There is also the challenge of providing equitable treatment to individual operations located in what may prove to be very different operating environments.

The structure of the pig production industry has environmental implications

Dispersed livestock and poultry production enterprises located over a large geographical area have an opportunity to gain some benefit from this degree of dispersion. Odors tend to be diluted and wastewater discharges assimilated into the receiving waters. As operations become larger, individual air and water pollution inputs become larger with respect to the local assimilative capacity. This would imply that our wastewater management technologies would need to be responsive to those factors of scale. To date, research has done little to respond to this need other than to identify there is a relationship between desired separation distances and the size of open cattle feeding operations and confined livestock and poultry enterprises.

Large-scale livestock and poultry operations are generally few in number, are owned by a relatively few people, and are surrounded by smaller livestock operations or non-animal raising enterprises. From the perspective of odor control this introduces the problem of how to achieve the odor control expectations of surrounding landowners while at the same time, assuring the large operator that he/she is being treated equitably.

The economics of better waste treatment

No matter how effective the treatment system nor how clear the affluent, waste treatment facilities have construction, operating and maintenance costs. Whether the cost of waste treatment is “reasonable” depends upon how well that cost can be incorporated into the production cost and those costs recovered in the sale of the product. Livestock produce a high strength organic waste. The organic load from a finishing pig is typically reported to be equivalent to that from three urban dwelling adults. Clearly we have not been able to incorporate a waste treatment expense into the sale price of a market hog equivalent to eighteen months of my sewage treatment bill. There is nothing to suggest this is either necessary or desirable. There is reason; however, to acknowledge the necessity and seek the mechanism to incorporate appropriate waste treatment costs into the market price of meat, eggs and milk at the consumer level. The alternative is to have a disproportionate share of the world’s meat produced in those locations most willing to sacrifice environmental quality. We all lose under that alternative.

Where to from here

As we stand poised at the beginning of the twenty-first century we have made great progress in the humane rearing of animals. The food supply available for both domestic consumption and export is one of which we can be proud. There are, however, challenges facing our professional creativity that will stretch us just as we have been stretched in the past.