The Challenges of Treating Manure as a Fertilizer

Eric Rempel, Fiveway Pumping

Introduction

My wife and I own and manage a company called Ecolagra Inc. When we started this company in 1996, we decided the mission for our company would be to foster the efficient, effective use of manure fertilizer, thereby reducing the need for and use of chemical, fossil fertilizer. By doing this, we believed then, and believe now that we are making our small contribution to the preservation of the resources of this planet for our children and their children.

I also manage Fiveway Pumping Ltd. Fiveway Pumping is a company created by a number of hog farms in Southeastern Manitoba for the purpose of managing the manure generated at these barns. Through the course of the summer of 2000, we applied approximately 80 million gallons of manure fertilizer to crop land, hay land and pasture. By so doing, we potentially displaced approximately 1500 tonnes of chemical, fossil-based fertilizer. We estimate the value of the manure we apply annually to be $300,000 as a fertilizer. This is money that would be spent on chemical fertilizer were we not utilizing the manure efficiently.

Challenges

I will be talking about the challenges of treating manure as a fertilizer, and challenges there are, but I dare say my challenges are considerably less than those of most other manure applicators. For one thing, a significant number of the hog producers I work with are also serious grain producers. They want to reduce their fertilizer costs. Secondly, almost all of the land I apply manure to is owned by the hog producers I work with. This means that we do not need to negotiate with third parties. Thirdly, 95% of the work I do is within a half-hour drive of our base in Steinbach.

I regard manure as a resource, a by-product if you will, of livestock production. It is the farmer's option to use this resource efficiently and effectively, or to squander it. If it is used efficiently and effectively, it will enhance crop production, and will do no damage to the environment. If it is squandered, it will probably also pollute.

Our biggest challenge is dealing with the conflict between being true to our chosen mission, which is to use manure fertilizer efficiently and effectively, delivering a service to our clients that is as economical as possible and maximizing the profitability of our company. Where we apply manure to cereal crop on good crop land, our work is cost-effective by every scale. The value of commercial fertilizer we displace with our manure fertilizer, more or less offsets the cost of the manure application. Now with higher prices for nitrogen fertilizer, fertilizer savings probably outweigh application costs. Nevertheless, even in this situation, I need to continuously remind myself and my staff that shortcuts to improve our pumping efficiency at the expense of the efficient use of manure as a fertilizer, is not what we want to do. Where we are applying manure to marginal land, the economic return to the manure fertilizer is significantly less, and the challenge is even greater, notwithstanding the fact that my clients who find themselves in this situation are firmly committed to abiding by Manitoba Environment regulations.

I was first attracted to this business about six years ago. At that time, most of the liquid manure in this area was applied with a big gun. This seemed to be the best available technology. To me this seemed wasteful. We looked for more efficient technology, and were among the first to use drag hose/chisel plow injection technology in our area. This technology allows us to capture practically

all of the manure nutrients we are pumping for crop use. It is instructive to note that the first farmers to adopt this technology have been farmers who owned both the hog barns as well as good crop land surrounding the barn. In other words the owner of the manure also benefitted from fertilizer savings if the manure was used efficiently. There was an economic incentive for these farmers to adopt this technology, and working with these farmers, I began matching manure application rates to crop needs well before the new manure handling regulations were developed. These new regulations have made no practical difference to the way these farmers are handling their manure.

The biggest difficulty in working with these farmers has been the extreme seasonal nature of the work. We have a short spurt of work in the spring, prior to seeding, and then an intense eight-week period in fall between harvest and freeze-up. It is hard to keep a good crew if this is the only work you can offer them. With an increasing acreage in winter wheat, we have been able to increase the fall window to 10 weeks in some years, but the season remains short, as does the problem of keeping a good crew.

We have done some work, exploring the possibility of in-crop manure application in order to address this problem. I think there is promise in this area, but more development work is needed. Furthermore, any pursuit of this approach requires a commitment not only by the applicator, but also by the farmer.

From the point of view of managing labour, I have welcomed the increasing number of barns going up on the marginal lands southeast of Steinbach. These barns are situated on land that is best suited to hay and pasture, and the season for applying manure fertilizer to these lands complements the crop-land season very nicely. Within Fiveway Pumping we have been able to pull together a nice blend of producers wanting spring application, summer application, and fall application. Although we run with full crew only in fall, there is enough work in spring through summer to keep core crew members busy and interested.

But hay and beef producers on marginal land do not have the economic incentive to use their manure fertilizer effectively and efficiently. The incentive for these farmers to use their manure in a resource conserving way has come from a desire to be good neighbors, and/or a need to meet regulations.

A great deal of work has been done in the last few years to find ways of maximizing the benefits of manure fertilizer on pasture on marginal land. There is no doubt that such pasture responds dramatically to manure fertilizer, nevertheless the return is not as good as on good crop land. The economic incentive to use manure on pasture efficiently, is not sufficient to drive practice.

If this is the case, why then have so many barns been located on the marginal lands southeast of Steinbach in recent years? You should ask the owners of these barns this question, but it seems to me, it is because of pressure from so called environmentalists who say “No barns in my back yard.” I expect barn owners prefer to build a barn in a location where there is an economic incentive to build the barn, but if gaining the necessary permits becomes too complicated, the barn will be built where obtaining permits is easier. As I see it, the effect of opposition to hog barns has not resulted in a reduction of the number of barns built, but rather in the relocation of these barns to less populated areas — areas where the manure will be less beneficial. Globally we lose whenever a hog barn is built on marginal land rather than on prime agricultural land. The mere location of a barn on marginal land means that the manure fertilizer will not be used as effectively as if the barn is located on prime land.

The modern hog industry, built around large hog barns has really developed very quickly. It has grown in an environment where there has been little knowledge about the long-term effects of various rates of manure application, but where there has been pressure from the industry to build more barns. In this context, barns have been built with access to the minimal amount of land necessary for manure disposal, and with little understanding of the long-term implications of manure application under such conditions.

For example:

In many cases, in fact most cases, we are now applying manure to the same land every year. We are carrying out soil tests and manure tests, and optimizing N based on the NH_4 - N values in the manure. So far we have had only good years and good crops, and these crops have basically used up the N we have applied. But what if we have one or two poor years with poor crops? It is doubtful that a poor crop will use up the N we have been applying, so we ought not to be applying manure fertilizer to that land. But in many cases, there is no other land available!

We regard a manure application rate of 8,000 imperial gallons per acre as fairly average. At this application rate, a 4-million-gallon lagoon will cover about 500 acres. Doing this is quite straightforward. Recently, however, I heard of a case where the barn owners had decided to cover the lagoon with a synthetic cover. The effect of this was to retain much more of the nitrogen, so that the sample contained 25 lbs of NH_4 nitrogen per 1,000 gallons. Furthermore, based on soil tests, the land around the barn could only tolerate 50 lbs of N per acre. On this basis this land could only tolerate 50 lbs of N per acre. This means 2,000 gallons of manure per acre. On the one hand this is good, in that there is a large potential to displace chemical fertilizer, but the beneficiary of this is the land owner, not the hog producer. Yet usually the hog producer foots the bill for manure application. More of that later. But there are also several problems.

i) At normal pumping speeds, applying manure at this rate would require the tractor with chisel plow to move at 12 miles an hour. This is not practical, so the pump needs to be slowed down, thereby increasing pumping costs two to three fold.

ii) The reason the manure is even being applied close to the barn now is because the manure applicator does not have enough hose to go to more distant fields, nor have the necessary arrangements been made with the owners of more distant fields. The necessary dialogue and planning was not there between producer and applicator, largely because the high nitrogen concentration due to the artificial cover was not anticipated.

iii) Pumping costs will increase significantly. Whereas the budget may have been to pump manure at $0.008 per gallon, the barn owners may now find it is costing them twice that or more.

Manure Application

I feel good about the way we are applying manure fertilizer under good weather conditions. We apply the fertilizer evenly, bury it to minimize nitrogen losses, and the fertilizer stays where we want to use it. It very effectively displaces chemical fertilizer. However all of that changes when we have bad weather conditions. Under bad weather conditions the fields are in no condition to have anything done to them, and certainly do not need the application of more liquid, even if it is fertilizer, but the manure storages are screaming to be emptied. So we do what we can, but we certainly cannot treat manure as a resource under such circumstances.

Having said that, I still think we are in a better position to use manure as a resource than most other places of concentrated hog production in the world. There, technologies are in use that dissipate the nutrients in the manure so the manure can be applied to a smaller land base without polluting. My information is that these technologies are effective in dealing with the pollution hazards of manure disposal, but I regard the use of such technologies, although economically justifiable in some situations, to be unfortunate and wasteful. In a world of scarce resources, manure should be treated in a way that will maximize its contribution to crop growth rather than treated to dissipate potential nutrients. Furthermore, as the world price of nitrogen fertilizers goes up, as it has in the last year, inevitably will continue to, the economic advantage to those parts of the globe where manures are used as a fertilizer will be significant. We are doing well, but we could do better.

I find the use of alfalfa to remove nitrogen from soils unfortunate and wasteful. That is not to say that alfalfa does not do the job. Alfalfa effectively removes large amounts of nitrogen from the soil, but unlike grasses and cereals, it gives you nothing for it. No farmer in his right mind would apply purchased nitrogen to alfalfa, because alfalfa is quite capable of making its own nitrogen. Manure can rationally be applied to alfalfa to give it the phosphate it needs, but in that case the rates one should use are so low (around 3,000 gal./acre) that application costs are higher, and most farmers lose interest. I am never asked to apply manure to meet the phosphate requirements of the alfalfa, although I have on a few occasions been able to persuade farmers to do it with good crop results.

The move towards specialized farming does not serve us well. The hog producer regards the manures as a waste bi-product. As with all industrial bi-products, he will try to dispose of that was as economically as possible, hopefully taking into account the hazard of pollution. The neighboring grain producer, on the other hand, had not counted on the availability of this resource, and frequently does not plan for it. Probably he has mixed feeling about it. On the one hand, it is a free resource to him, and as with all free resources, he will make little effort to use it well. When weather conditions are favorable, the application of the manure will cause little inconvenience, and he is probably thankful for it. But what about a bad year? The field gets rutted, application does not occur when it is wanted, or it may be necessary to delay seeding in the spring. The grain producer will not want the manure. These problems are much easier to sort out where the hog producer owns the land.

Lagoon design

Lagoon design offers some interesting challenges. The main challenge is designing the lagoon in such a way that the solids can be suspended and removed as liquid. Our experience is that in a lagoon larger than 1-million gallons, this is hard to do. If the lagoon is larger than 1-million gallons, it becomes necessary to move the agitator, around the lagoon, but even if that is done, the effect is largely that we are moving the solids from one location to another. Using two agitators simultaneously allows us to effectively pump a much larger lagoon, but this is expensive. What works best is a multiple cell lagoon where the primary cell is 1-million gallons and liquid from the secondary cell can be brought back into this cell as needed through a back-flow valve to facilitate the suspension of the solids. The solids in a lagoon of this design can be removed quickly and economically. Where we have a lagoon of this design we only agitate for the first 25% of the pump-out. Unfortunately lagoon design engineers have been slow in listening to us. There are very few well designed lagoons out there, and many very poorly designed lagoons

Having promoted our favourite lagoon design, this lagoon design creates its own problem in terms of using manure as a resource. The phosphate and potassium component of the manure fertilizer is heavily concentrated in the solid portion of the manure. When pumping manure from a two-cell lagoon, the first 25% of the pump-out is very high in phosphate and potassium, but for the rest of the pump-out we are applying less than optimal amounts of these nutrients as we are optimizing N. The way we try to deal with that is by applying the first part of our pump-out to different parts of the field in different years, but to do this effectively requires good record keeping, something we often fall down at in our haste to get the job done.

More challenges

I am aware that there are those who are advocating the application of manure fertilizer to optimize P, supplementing the N as necessary for optimal crop growth. Technically this is sound, and may be the direction for the future. There is talk of variable rate application using GPS. I expect this is also technically sound and technically doable. But practically, we are still far from using these technologies. We do our manure application in 40-acre blocks. I would like to see farmers soil sampling by 40-acre blocks so that we can vary our nitrogen application by block and so we can know where we ought to apply our heaviest phosphate application. At this time the farmers I work with are not willing to incur that expense, and I will be surprised if farmers working with other applicators are more interested in spending this money on soil testing. Rarely do I encounter a farmer willing to do more than one soil sample per field.

Straw covers are a big challenge to manure applicators using our system — drag hose injection. Applicators using tanks do not share this problem (although they many other problems we don't have). The straw is hard to remove from the lagoon, it plugs up the pump, and it plugs up the injectors. None of the Fiveway Pumping partners use straw. Were this to change, we would have to look for ways of chopping the straw to facilitate pumping. I see more promise in the use of synthetic covers.

I welcome the regulations recently imposed by Manitoba Environment on the spreading of manure. Farmers we have been working with who have been interested in capitalizing on the fertilizer in manure, have been following these regulations in any case. They have not had to change there management practices. Others, however, who have been trying to rid themselves of manure as cheaply as possible, have had to change the way they are managing their manure, changes they would not have made were the regulations not in place. This is good.

In my view, it is the responsibility of government to regulate the handling of potential pollutants in order to minimize the danger to public health. I would give our government a passing grade in this regard. However I believe it is also the responsibility of government to regulate the use of non-renewable resources, preserving them for future generations. In this regard our government, in concert with the governments of the other countries of this world, is failing miserably. I regard it as unconscionable that our government allows the perpetuation of an agricultural industry that bases its ability to produce on a non-renewable resource — nitrogen fertilizer made from natural gas. What makes this situation even more ironic is that the farming industry is in crisis because of low commodity prices, prices depressed by over-production. And this over-production is fed by cheap nitrogen fertilizer. It may be argued that nitrogen fertilizer is not cheap; that it is expensive, but cheap and expensive is relative. Nitrogen fertilizer is cheap compared to what it would cost if we did not have access to non-renewable natural gas.

Conclusions

What makes this discussion of the farm crisis and the use of natural gas for fertilizer manufacture relevant to this paper, is that if nitrogen fertilizer were priced at its true cost, namely the cost of producing it rather than the cost of extracting it, the cost of nitrogen fertilizer would be so high that manure would be an expensive commodity. There would be no thought of wasting manure fertilizer or polluting with it. The economic benefits to using it effectively and efficiently would be overwhelming.