COMPOSTING THROUGH CONSORTIUMS

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INTRODUCTION

In many agricultural states throughout the country, such as Iowa, Texas, and North Carolina, the increase of livestock production has created huge quantities of nutrient rich manure to manage. Often, accepted agricultural waste management practices (i.e., land application) have been mismanaged causing both public relations and environmental challenges. For this reason, innovative practices for managing agricultural by-products have been considered, but often are not implemented on a large-scale basis for economic reasons. In many cases, individual farmers do not have the financial resources or expertise to address specific challenges. One viable option to remove or minimize these barriers is by forming consortiums of interested parties. One such group has been formed in northeast Iowa to proactively address farm odors and water quality issues caused by on going land application of manure.

BACKGROUND

The Fayorganite Group was organized through efforts of the Fayette County Economic Development Commission (FCEDC) and the State of Iowa's Rural Action Program. The group was started in January 1995 and has been evaluating the management of farm manure through the development of a composting facility. Both dairy and hog farms are prevalent in Fayette County and it is estimated that approximately 196,000 dairy cows are being raised in Northeastern Iowa. The Fayorganite program was jump started when grant funds were obtained to complete an economic and technical feasibility study as well as a composting pilot project.

At the completion of the pilot project, a cost analysis was performed which included capital, operations and maintenance (O&M), and revenues for the anticipated compost products. The estimated capital costs included access roads, equipment, pads, and utilities. Estimated O&M costs included labor, bulking agents, fuel, maintenance, and utilities. An analysis of potential revenue streams was also completed including tip fees for yard waste/wood waste, tip fees for manure, and revenue from product sales. Two market opportunities for the finished compost were investigated. They were the landscape/nursery industry for use in various horticultural/agronomic applications and local dairy farmers for use as animal bedding. Data relevant to product value was used in the economic analysis. Total annual costs and annual costs per ton of manure for the entire facility were developed as were a conceptual site layout, process flow, and economic analysis.

PILOT STUDY

The pilot composting study was conducted at the Chensvold & Rovang Sanitation recycling facility in West Union, Iowa. It is assumed that the large scale composting facility would be located in West Union because an estimated 12,450 farms are located within 50 miles of West Union. The pilot study was undertaken to determine the most efficient and economical composting technology to utilize as well to evaluate potential bulking agents. The aerated turned window (ATW), unaerated turned windrow (UTW) and aerated static pile (ASP)composting methods were studied with various manure and bulking agent blends.

Pile 1 was a UTW consisting of a 4:1 blend (by weight) of separated dairy manure and shredded paper on half of the pile and a 4:1 blend of separated dairy manure and cornstalks. Pile 2 was an ATW consisting of a 1:1 blend of manure and leaves (by volume). Pile 3 was an ATW consisting of 100% manure. Pile 4 was an ASP consisting of manure and cornstalks. Pile 5 was an UTW consisting of a 7:3 blend of manure and leaves (by volume). Pile 6 was an UTW consisting of 100% manure on one side and a 4:1 blend of manure and cornstalks (by

weight). As a general summary, the piles containing the bulking agents generated heat faster and maintained temperatures longer. Also, piles under aeration dried out faster.

FEASIBILITY STUDY

The Fayorganite project was unique in that the proposed program began as a cooperative effort between livestock managers, the Cooperative Extension Service and the Fayette County Economic Development Commission. It later took shape as a private venture which would benefit both the livestock managers and the facility owner. Ultimately, the facility meets the needs of all parties involved in the Fayorganite program. The overall concept of the program changed when a local garbage hauler became interested in operating the composting pilot study. Because of the interest of a company outside the agricultural sector and because of the potential economic benefits of an integrated composting facility, various conceptual designs were considered. To best consider a wide variety of potential design and economic scenarios, a strictly agricultural type facility and a more commercial type facility were compared.

The commercial facility would receive and process 15,000 tons of wood waste to use as a bulking agent for the manure. The wood would also provide a source of substantial revenue to the facility. The UTW composting method was utilized because of the porous nature of the mix, its drier nature and because turning the pile would improve the physical breakdown of the feedstock (e.g., wood, paper). Manure would be received in 20 cubic yard roll-off containers and placed on an asphalt pad. Wood waste will be delivered and also placed on the open asphalt pad awaiting grinding through a tub grinder or horizontal grinder. The site will also be equipped to receive food waste and unrecyclable paper. The paper would be off loaded by haulers into a three sided building. Mixing of the feedstocks would be performed with a front-end loader and volumetric measurements of the materials will be measured with the front- end loader bucket. The mix ratio will provide a C:N ratio of 30-40:1 and a solids content of 35-50%. In this scenario, the goal is to maximize the use of the wood waste because it provides a tipping fee to the facility, and the manure does not. The mix will be placed into 12 feet (width) by 5 feet (height) windrows and the front-end loader will be used to shape the windrows. Daily temperatures will be taken until PFRP is achieved and the piles will be turned at least five times during a 15 day period in which the pile temperatures are at 131 degrees F. Following active composting, the product will cured for 30 days. The facility will provide three months capacity for curing and storage on the open pad. Within the three sided building, aerated curing for one months capacity of product will be provided to provide enhanced drying of the bedding product. Final screening will be completed on a quarterly basis with a leased screen.

The agricultural facility would primarily receive and compost separated manure supplied by the livestock farmers involved in the consortium. The facility will compost 15,000 tons of manure using the ASP composting method. This method will be used because it can enhance drying of the mix which will possess a higher initial moisture content. Separated manure will again be delivered in 20 yard roll-off containers onto an open asphalt pad. Pre-ground wood and yard waste will be placed on the asphalt pad for storage. Sixty days of storage will be provided, and feedstock blending and pile formation will be performed using a front-end loader. The mix ratio will provide a C:N ratio of 20-30:1 and a solids content of 35-50%. In this scenario, the goal is to maximize the use of the manure because the facility is primarily a manure management facility for the farmers. The mix will be placed over perforated high-density polyethylene pipe, then covered with a one foot layer of coarse wood chips. A six feet layer of mix will be placed over the wood chips and insulated with a one foot layer of unscreened compost. An extended ASP will be created by placing the new mix directly against the face of the previous days pile. Temperatures will be measured until PFRP is met (131 degrees F for 72 hours). The mix will be actively composted for four weeks, then cured in a static pile for an additional month prior to screening. Three months of curing and product storage will be provided on an open pad and screening will be done quarterly using a leased screener.

MARKET RESEARCH

To provide economic data necessary for the economic study, a preliminary market assessment was performed in Northeast Iowa to determine the marketability and value of the manure compost. Two marketing opportunities were investigated, marketing the compost as an animal bedding to the dairy industry and marketing

the product to the landscape/nursery as a soil amendment. Data collection identified research which illustrated the potential usage of compost as animal bedding. Market related data was obtained from various sources and uniform data collection was completed by using standardized surveys. Surveying was completed by telephone and the followed up with face to face visits.

Animal bedding markets were evaluated by obtaining information from the Cooperative Extension Service, the University of Iowa and by surveying dairy farmers and dairy supply companies. Bedding is used in free stall operations as a means to manage the animal's urine and excrement. The majority of farmers use dried sawdust, wood shavings or chopped straw as bedding. The typical price of dried sawdust and wood shavings was identified as $27.00 - $40.00 per ton, with typical prices being $35.00 per ton and above. While some dairymen apply thick layers of bedding, infrequently, many now use rubber mats, then apply a ¼ to ½ inch layer of bedding over the mat. In this type of operation, the mats are frequently cleaned and bedding reapplied. Aside from requiring a product which is absorbent and non-abrasive to the cows, dairymen require a product which will not cause the spread of mastitus. The product must also be somewhat dry, but not dusty. Limited research has shown and many experts know that although compost supports bacterial growth, there is no evidence supporting the belief that the bacteria are transmitted to the cow causing mastitus. Product samples were distributed to local dairymen for evaluation, and overall, the product was deemed acceptable.

The landscape/nursery industry in Northeast Iowa has had little experience with compost. Being a rural area, the industry itself is not well developed. The landscape/nursery industry includes landscapers, garden centers, nurseries, golf courses, etc. Only one-third of the individuals contacted had used or resold compost. Unfortunately, two of the firms trying yard debris compost had poor results; because of unstable compost. Although there was little compost-related experience, interest did exist. Some had evaluated mushroom compost from a regional landscape supply company. Soil conditions vary from rocky to heavy clay and professionals seemed to understand the need to improve the soil. The current local landscape/nursery market is small, but could grow to be substantial. Often, rural markets are not large enough to allow typical commercial landscape/nursery suppliers to spend the time to develop them. However, for a small to medium sized compost facility, they could be developed into a substantial market.

Using standard animal bedding utilization estimates obtained by industry experts and other farm management assumptions, it was estimated that between approximately 116,000 and 143,000 tons of animal bedding are used in the Northeast Iowa dairy industry on an annual basis. For this reason, and the fact that dairymen will be supplying the composting facility with manure, the short-term market focus should be as animal bedding marketed to dairymen. Field testing of the product will be necessary as will the production of a somewhat fine, dry product which is moisture absorbent. Further product development research will be required. Whereas a fully stabilized compost may not be required for an animal bedding application, it will be required for a soil amendment. The landscape, topsoil and garden center markets should also be approached to allow for the development of higher value markets. Because of the lack of compost experience, and some negative prior experience, educating the landscape/nursery industry will be necessary to develop these markets.

ECONOMICS

The capital, and operational and maintenance (O&M) costs of the commercial and agricultural composting facilities are outlined Tables 1-2, attached. The estimated annualized costs of the facilities are $374,100 and $163,550 for the commercial and agricultural composting facilities, respectively (Table 3). Using conservative tipping fees for wood waste brought to the commercial composting facility and conservative compost values of $5.00 per ton for an animal bedding and $14.00 per ton for a soil amendment, the commercial facility shows a net profit of $26,700, while the agricultural facility shows a net loss of $105,200 (Table 4). Profit could be increased at the commercial facility by increasing tipping fees for the wood waste, introducing food waste at a higher tipping, or by increasing the price of compost. The capital construction and O&M costs of the agricultural facility outweigh the revenues generated through compost sales. However, the $11.00 per ton cost to compost manure can be offset through product marketing or by having the cooperating farmers utilize the product, thus reducing the cost associated with purchasing animal bedding. To improve the economic feasibility of the agricultural facility, grants may be obtained to offset capital costs or additional revenue sources should be sought to offset O&M costs. In both cases, the cost of separating (dewatering) the manure must be borne by the farmer.

CONCLUSIONS

The development of consortiums or regional facilities can provide excellent economic development and business opportunities as well as the opportunity for public-private partnerships. Scaling up a composting facility to accept larger volumes improves the overall economics of a facility and can provide excellent environmental benefits. The creativity of such programs will allow for the management of farm by-products in a more sustainable means, while improving economic opportunity for rural communities.

The success of the commercial facility depends on the ability to obtain wood waste at a reasonable tip fee and to market the resultant product. Indications suggest that this appears feasible in West Union. The estimated revenues could be significantly increased by increasing the sales price of the product and by introducing food waste as an additional nitrogen source. The agricultural facility will require a tip fee of $7.50 per ton of manure unless grant funds are obtained to reduce capital costs or existing equipment or land is used. The willingness of the cooperating farmers to utilize the compost as animal bedding on their farms is also important as is developing higher paying horticultural markets. However, it should be understood that although current manure management costs cannot currently offset the cost of composting in this specific scenario, stricter nutrient management regulations will increase over time. This will result in increased manure management costs, thus making composting more economically feasible on a wide scale basis.

TABLE 1

CAPITAL COST SUMMARY

Facility Type	Capital Cost
Commercial - UTW	$1,150,600
Agricultural - ASP	$316,400

TABLE 2

OPERATIONS AND MAINTENANCE COST SUMMARY

	Commercial - UTW	Agricultural - ASP
Labor	$103,100	$63,100
Bulking Agent[1]	$0	$14,100
Maintenance[2]	$32,500	$9,300
Fuel[3]	$18,300	$5,800
Utilities[4]	$12,000	$1,150
Miscellaneous[5]	$29,700	$18,900
Annual O & M Cost	$195,600	$112,350

1 - Assumes $4/ton cost to purchase and transport ground yard waste and/or corn stalks to the site
2 - Includes equipment and site maintenance costs
3 - Based on estimated usage and $.80 per gallon for fuel
4 - Based on estimated usage and $.10 per kilowatt-hour
5 - Includes utilities, insurance, licensing, laboratory analysis of product, product marketing costs, and engineering consulting fees

TABLE 3

FAYORGANITE COMPOSTING FACILITY

ESTIMATED ANNUALIZED COSTS

	Commercial (UTW)	Agricultural (ASP)
Amortized Capital[1]	$178,500	$51,200
Annual O & M Cost	$195,600	$112,350
Total Annualized Cost	$374,100	$163,550

1 - Capital amortized at 8%. Includes land, utilities, engineering, and sitework at 20 years, and equipment at 7 years.

TABLE 4

ESTIMATED FACILITY NET PROFIT (LOSS)

	Commercial - UTW	Agricultural - ASP
Total Annual Cost	$374,100	$158,200
Wood Waste Tip Fee Revenue	$275,000	$0
Compost Sales to Horticultural Market	$41,600	$17,500
Compost Sales to Agricultural Market (bedding)	$84,200	$35,500
Facility Net Profit (Loss)	$26,700	($105,200)