MARYLAND COOPERATIVE EXTENSION
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Biosolids Fact Sheet Series

HYPOTHETICAL BUSINESS SCENARIO FOR DEEP ROW BIOSOLID INCORPORATION FOR A HYBRID POPLAR FORESTRY OPERATION

Formerly known as “sludge,” biosolids refer to the soil-like residue of materials removed from sewage during the wastewater treatment process. They usually contain from 1-4% nitrogen and are a valuable source of fertilizer for agriculture and forest crops. The utilization of biosolids using forestry plantations of hybrid poplar trees solves many of the problems of traditional application methods and holds great promise for our region. This series of fact sheets will educate the reader about the practical application of research on this topic. More information can be found in the other *Biosolids* fact sheets of this series and at www.naturalresources.umd.edu.

BIOSOLIDS & FORESTS
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One of the major issues with agricultural use of biosolids is planting a crop that is able to take up large amounts of nitrogen and not cause odors and nutrient runoff. Hybrid poplar trees, related to native cottonwood trees, can use up to 350 lbs. N per acre each year and are capable of thriving on gravel spoils and farm fields amended with biosolids. Deep-row incorporation involves the one-time application of biosolids in a wide and shallow trench that is covered with overburden, and planted with hybrid poplar cuttings that utilize the nutrients over a 7-9 year rotation.

ERCO is a business in Waldorf, Maryland that has functioned under a research permit from the Maryland Department of Environment since 1983 to use the deep row incorporation technique. There are no other comparable operations anywhere in the world, so it is useful to understand the economics of this type of biosolid application.

Figure 1. Machines such as a backhoe and operator salary are parts of production expenses.

This fact sheet illustrates the income and expenses from such an enterprise. The development of an economic analysis required using information obtained from ERCO, but it is not representative of the ERCO operation itself. Commonly accepted machine rates per hour and production rates per person were used to determine costs based on reasonable assumptions. As application rates increased assumptions were made on equipment needs and hours required. The objective was to determine how different factors affect the profitability of this enterprise, given the present market conditions

Economic Analysis

Business resources required for this kind of biosolids application are listed in Table 1. These resources were subdivided into four headings: land and buildings, site development, equipment, and personnel. Table 2 describes the production factors. Table 3 illustrates the annual income, expenses, and net profit associated with the resources and production factors.

Production

The analysis illustrates the income generated under the different application rates that were part of the research study: 4000, 8000, and 12,000 lbs of nitrogen (N) per acre for a seven-year rotation (Table 2). The existing ERCO operation presently operates near the 4000 lbs of nitrogen rate. It is important to note that the wet tons per acre required to reach target N levels depends directly on the percent nitrogen found in the biosolids. In this case, the average was about 1.2% N (wet weight basis) using lime-stabilized biosolids that are currently available. If the percent N were to decrease, it would require more wet tons per acre to reach the same N application rate - likewise, fewer tons per acre would be necessary with a higher percent N. Based on the results from the water quality portion of this work, the nitrogen concentration is very consistent and not likely to change. However, if the process at the wastewater treatment plant were to change, then a change in the biosolids nitrogen content would be anticipated.

Field experience indicates that applying the 2351 wet tons per acres is the highest volume that can be physically applied using the deep row technique as presently done due to operational and equipment limitations.

Application rate figures (Table 1) were determined by figuring the average number of wet tons per truck (18 wet tons) times the number of loads per day possible considering personnel and equipment abilities, times the number of work days per week.

Land Requirements

An important aspect of deep row application is the land requirement. Since one application is made every rotation, there must be adequate land available during the rotation length before reapplication is needed. In our scenario we used a rotation length of seven years on a 125 acre land base. Rotation length was kept constant for this analysis until other research information provides better information.

In this hypothetical analysis, the site is 121 acres. Using a seven year rotation, biosolids will be applied to 17.3 acres per year. The only variable in this scenario is the amount applied per acre. However, if the rotation length can be reduced by improving the growth of the trees through better vegetation management, phosphorous amendments, or other means, this would reduce the rotation length, thus reducing land requirements and/or increasing application rates.

Figure 2. Bulldozer filling trench with biosolids. Greaterprofits result when more biosolids can be applied to an area.

Figure 3. Trees after harvest. Growing trees suitable for pulp production would increase profits and decrease the expense of having trees chipped on site.

Financial Projection – Income and Expenses

This project attempted to estimate annual income and expenses based on the expense factors identified and the present income structure of the industry (Table 2). The $25 per wet ton received for application of the biosolids does not include the cost of trucking to the site, which may be figured into actual contracts in a number of ways.

The main expenses that change with the higher application rates are equipment operators, and bulldozer and excavator equipment costs. Many of the other costs are not significantly impacted by higher application rates. The general trend in equipment operator needs is that an additional equipment operator is needed when increasing to the next higher application rate.

The bottom line of this analysis is the profit, calculated as annual income minus annual expenses. At the lower application rate the enterprise operates at a loss ($19,675), however, profits increase dramatically at the 8000 lbs N rate to $160,825. At the highest application rate of 12,000 lbs N, the profit more than doubles to $341,325.

What this analysis clarifies is that if the higher application rates are environmentally feasible, then the profit potential would likely attract others into the industry. It is important to note that the higher profits at the higher rates would not likely be sustained as more competitors entered the industry and market competition would likely reduce profits.

Some Highly Variable Costs

The values provided for taxes, permits & assessments, tree harvesting, and opportunity cost per year are included at their actual cost, but may be reduced as indicated below:

•Taxes – many gravel spoils are taxed as commercial properties, however, because this type of operation is considered a tree farm, it is eligible for a woodland assessment, which would reduce the taxes to about $1-2 per acre.

•Monitoring costs – though currently lacking, COMAR regulations can be developed and monitoring costs made considering the enterprise.

•Permits and assessment fees – similar comments as provided for monitoring.

•Tree harvesting – one of the objectives of the current research is to make it possible to grow a tree suitable for pulp production within the rotation time so that a commercial harvester could take the trees at a break-even cost. Presently, harvesters are paid to chip the trees on site, which is an expense.

•Opportunity cost – this is the value this land could bring if used for other purposes. This value can be changed depending upon the business operation.

Other Considerations

Presently, biosolids may be trucked long distances for application to farm fields or disposal in landfills. Sites for deep row application within 40 miles of most treatment facilities would minimize trucking and the associated pollution from emissions, wear and tear on highways, accidents, and noise associated with truck traffic. Deep row application with trees has desirable environmental benefits associated with the reclamation of gravel spoil, improved wildlife habitat, the production of forest products, carbon sequestration, improved water quality, and the general attributes of open space and working lands. These are external costs that are not incorporated into a financial analysis for any one enterprise, but are nonetheless real costs to local, state, and federal governments, that being the taxpayer.

Table 1. Resource and production figures.

Business resources

Land & Buildings	Equipment
125 acres gravel spoil	Bulldozer
Office trailer	Backhoe
Storage trailer	Pickup
	Pickup
Site development	ATV
Well	Scale
Electricity	
Telephone	**Personnel**
Geological assessment	Equipment operators
Well monitoring	Manager
Erosion and sediment control/site grading	
Permits	

Production

Nitrogen content per acre of applied biosolids

Biosolids (wet tons)	N (lbs)
855	4000
1710	8000
2565	12000

	Weekly application rates at 18 wet tons/load	Days to apply 1 acre @ 2351 tons/acre
3 loads per day	270	43.5
6 loads per day	540	26.1
9 loads per day	810	14.5

Application rate per acre	855	1710	2565
Application rate per week	270	540	810
Acres need per week	0.32	0.32	0.32
Acres needed per year	16.6	16.6	16.6
Years per rotation	7	7	7
Acres per rotation	116	116	116

Table 2. Financial projection.

Annual income

Application rate per week	270	540	810
Price/wet ton	25	25	25
Income per year (line 1 x line 2 x 52 weeks per year)	351,000	702,000	1,053,000

Forest product income

Annual expenses

Manager	60,000	70,000	80,000	
Equipment operator 1	50,000	50,000	50,000	
Equipment operator 2		50,000	50,000	
Equipment operator 3			50,000	
Office trailer, $200 month	2,400	2,400	2,400	
Storage trailer, $150 month	1,800	1,800	1,800	
Dozer $75/hour, 5 hours/day, 250 days	93,750	187,500	281,250	
Excavator $75/hour, 2 hours/day, 250 days	12,500	25,000	37,500	
Service vehicles 40,000 miles/year, $0.35/mile	14,000	14,000	14,000	
ATV	1,500	1,500	1,500	
Taxes, residential assessment, $75/acre, 125 acres	9,375	9,375	9,375	*
Utilities, $100/month	1,200	1,200	1,200	
Insurance	15,000	15,000	15,000	
Monitoring, 4/year	6,000	6,000	6,000	*
Wells, cost recovery # Years	500	500	500	
Permits & assessment	4,000	4,000	4,000	*
Professional improvement	2,000	2,000	2,000	
Tree planting, 17 acres/year, $600/acre includes cuttings	10,200	10,200	10,200	
Tree harvesting, 17 acres/year, $1,000/acre	17,000	17,000	17,000	*
Lime 5 ton/acre, 18 acres, $30/ton	2,700	2,700	2,700	
Opportunity cost of land, $500/acre/year	62,500	62,500	62,500	*
Total expenses	366,425	532,675	698,925	
Net profit (income - expenses)	-15,425	169,325	354,075	

* indicates costs that may be highly variable depending location & circumstances

Other considerations

Trucking costs $1/mile	Biosolid sustainability
Trucking emission reduction	Forest renewable resources
Carbon sequestration	Reclamation
Open space/working land	Noise, truck traffic
Wildlife habitat	Water quality

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