FINANCIAL FEASIBILITY OF ON SITE TRASH EXTRUSION IN MISSISSIPPI: A PRELIMINARY ANALYSIS

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Abstract

This paper presents a preliminary analysis of on site gin trash extrusion technology. Given the assumed technology costs and gin sizes, the gin trash extrusion was generally found to be profitable for producing wood substitute pellets as well as mulch and fertilizer, but was found not to be profitable for cattle feed. Further analysis of the impacts of the production of wood substitute pellets and mulch/fertilizer on the price of those products is needed.

Introduction

There are 1,196 gins in the United States producing around 17 million bales in 1999. There are 126 gins in Mississippi, producing around 1.7 million bales in 1999 (National Cotton Council). After the cotton has gone through the gin, three products are produced. The cotton lint, which is sent to textile mills, cottonseed, which is usually sent to oil mills to be crushed, and gin trash. The primary revenue for cotton gins is the sale of cottonseed. The price of seed in April of 1998 ranged from about $130 to about $150 per ton (Cotton Incorporated). Ginning is a seasonal business and almost all the workers are employed for just the ginning season. The season lasts around three months and begins around September and runs to around December. This can vary from gin to gin because of location, the amount of cotton ginned, and any major problems that might stop ginning for an extended time.

Gin Trash

Gin trash is a byproduct of the ginning process. The byproduct is basically anything that is not the seed or fiber. It is the foreign material (including cotton plan debris) that gets picked up when cotton is harvested. The byproduct comes out of each cleaner that is used for removing trash. The trash material is run through "cyclone" machines, which separates trash and dust and removes dust particles. The trash is then taken by auger or some other means to either a composting pile or trash house. Sometimes water is applied to the trash to help prevent fires and to aid in composting. There are approximately "2.5 million metric tons of by products produced by gins annually" (Thomason). Stripper cotton is grown mostly in West Texas and is harvested by a stripper, which harvest most of the cotton plant. Picker cotton is harvested with a picker that picks mostly the bolls off the cotton plant. Picker cotton produces about 75-150 lbs of trash per bale of cotton and Stripper cotton produces between 700-1,000 lbs of trash per bale (Parnell et al). Typically, gins that handle spindle picked cotton handle 500,000-1 million tons of gin trash a year. Gin trash is composed of several basic compounds. Digestible nutrients make up 42-53%, digestible proteins 3.1%, cellulose 33%, ash 8-28%, nitrogen 1% and phosphorus 0.1-0.3% (Thomason).

Problem

Currently there are several ways to dispose of gin trash. In the past gin trash was burned. After stricter air quality laws were passed this practice became illegal in many states. Another important factor in considering gin trash is the location of the gin. Some gins are located in town or city limits, which prohibits them from composting the trash at the gin site. In these cases, gins must dispose of their trash off-site immediately.

A popular method of disposing of gin trash is composting. Composted trash becomes a rich humus material with about a three percent nitrogen level (Holman). Composting can either be done on site in a pile or spread over a field. Composting can also be done either wet or dry. Dry composting can lead to chances of fire as a result of the rapid break down of materials an adequate water source must be near to combat fires. Wet composting helps eliminate the risk of fire. This process drops trash from a cyclone onto an auger containing water jets, and mixes anywhere from five to eight gallons of water per bale. This system also decreases the volume of trash because it packs tighter and composts more rapidly. Composting also helps destroy many weed seeds in the trash.

Another method of trash disposal is to spread raw cotton gin waste on fields in the fall. In a three-year test trial cotton yields increased 20% for the first two years and increased the third year by a smaller amount. The only problem with this method seems to be that there is not enough trash to supply available fields (Holman).

Feeding the trash to livestock is another method of disposing of trash. The trash has moderate protein levels and is good roughage. The disadvantages to feeding cattle gin trash are the limited availability of protein and the pesticide residue. The residue has been tested on cattle that were fed gin trash and the levels are below tolerance, but high enough to cause concern over residual effects.

The current disposition of cotton gin trash in Mississippi is shown in Table 1. As can be seen, on-site composting is the most popular form of disposal followed by field application. Feedlots and off-site composting are also used by Mississippi gins, but not as heavily as other methods. Assuming 120 pounds of trash per bale, this data suggest that about 93.6 million pounds of cotton were composted on-site during 1999, suggesting a large demand for space on gin sites simply for waste disposal.

The biggest problem with these disposal methods is cost. The cost of spreading the trash on the fields is about $10/ton (Parnell et al). The cost associated with composting is the cost of water and equipment plus the cost of land used for composting. Disposal costs are estimated to be $1.44 per ton on average (Elam). Another consideration is what new regulations the EPA and other government agencies may place on trash. Some states already have laws against composting or storing gin trash at the gin if the gin is in the city limits. Many feel that there is a need to explore productive uses for the gin trash and view gin trash as an opportunity for profit if there is a method of turning it into a usable product.

Another factor when considering making trash into a revenue source is the price of seed compared to the cost of ginning. As energy cost rise, so does the production cost for gins. In most cases the gin's revenue comes from the sale of cottonseed. Therefore, if trash could also be sold this could increase the profitability of the gin. Currently, most gins are simply disposing of the trash for as little cost as possible to the gin.

The COBY Process

Gin trash extrusion may be an alternative disposal method for gin trash. Some gins have attempted running trash through an extruder. The problem has been that the trash has been too abrasive, causing severe wear to the extruder. Using the Easiflo concept of coating the trash has demonstrated that the coated trash is less abrasive and therefore the wear on the extruder is reduced. The process has been named COBY (COtton BYproducts).

The Easiflo system coats the gin trash with a gelatinous cornstarch. To make the starch, cornstarch and water are mixed and heated to a temperature of approximately 230 degrees Fahrenheit. The starch is then sprayed onto the gin trash and the mixture is run through an extruder that chops and grinds the trash. The COBY product is then run through a belt conveyer to reduce the moisture content. The finish product looks like grass clippings, and can be used as feed, fertilizer/mulch or pelletized to burn in pellet stoves. Figure 2 shows a comparison of the raw trash and the COBY product. After discussion with Greg Holt, the Engineer testing this project, at the USDA Research Lab it was concluded that two kettles are needed. One kettle could be used, but if there are two one can act as the working kettle and the other the cooking kettle therefore making the process continuous. The process does not change the bulk density of the trash.

The feed is fed to beef cattle as roughage. Cotton gin trash is well suited for this because trash from picker cotton is about 12% protein. Gin trash also has several beneficial nutrients. The trash after being extruded can be further processed through a Pelletier if a pellet is more suited for cattle feed in a particular area. One can also add amendments such as a protein supplement to increase protein level, or add flavoring such as citrus or molasses to increase the palatability.

As a mulch/fertilizer, a herbicide may be added to kill weeds. The extruded trash can help to hold water and nutrients to the soil. The trash itself has several beneficial nutrients that can be added to the soil. Table 2 shows the nutrients in trash burs compared to that of barnyard manure. There is, also a potential of mixing grass seed with the extruded trash. This could be used by states Department of Transportation to seed roadsides. If the mulch is sold in bulk at the gin site, this would further reduce the cost to the gin by eliminating the transportation cost of disposal.

The trash can also be made into a pellet form for pellet stoves. By mixing cottonseed in with the trash, one can increase the heating capacity of the pellet because of the oil in cottonseed. Figure 3 shows what the pellet stoves look like. It has been observed that trash mixed with cottonseed burns at higher BTUs than wood pellets. The USDA-ARS Lab in Lubbock plans to study this further.

One advantage of this process is that it can be easily customized for an individual market. By just adding a different substance and or a Pelletier, the finished product is easily transformed into a whole different product. Thus, the extruded gin trash may result in several potential marketable products depending on local demand conditions.

The extruder used for this project is manufactured by Insta-Pro, a division of Triple F. The reason for using their extruder is because it is a dry extruder. Insta-Pro's extruders are specially designed for low-density, high moisture products such as gin trash. The extruders come in a range of sizes. They can handle an amount of gin byproducts at a rate of about 45% of their rated capacity. For example, a 2500 series extruder is rated for 2500 pounds of soybeans per hour. This means that it has the capacity of extruding 1125 pounds of gin trash. See figure 4 for a picture of an Insta-Pro extruder.

Objective

The objective of this paper is to analyze the financial viability of adding the extrusion process to the gin process. Others have looked at the viability of constructing a separate extrusion plant. However this paper will attempt to examine the profitability of running the cotton byproduct directly from gin through this process while the gin is running. Because this is a relatively new concept, there has not been a market developed for this product. Therefore, this paper will attempt to identify the costs and compare it to comparable goods to estimate the potential financial viability.

Data

Because of the size of the initial investment and capacities of the extruder, it was initially assumed that the COBY process would only be viable on larger gins. However data was also collected for smaller gins. The gin used for this project gins on average approximately 30 bales per hour and at least 30,000 bales per year. In Mississippi, there are four gins whose average processing fits this profile. There are, however, 31 gins that gin 22-28 bales per hour and produce an average 20,611 bales annually (Boyd and Hudson). The amount of trash produced was then figured using 120 pounds of trash per bale of cotton. This led to the assumption of 3600 pounds of trash an hour. This amount was rounded to 4000 to allow for increases in bale production and/or increases in amount of trash from each bale. This amount of trash was used to estimate the necessary size of extrusion machinery.

This process or plant is a combination of two existing type plants: the Easiflo seed plant and the small cottonseed extruding plant. For the equipment used in the Easiflo plant, James Askew at Servico Gin was contacted for a list of their equipment suppliers. Insta-Pro was contacted for the equipment used in the cottonseed extrusion plant.

The yearly revenue was estimated by multiplying the number of bales produced by 120 pounds to obtain the amount of trash produced per year. The amount of trash was then divided by 2000 pounds to obtain the amount of trash in tons. This number was then multiplied by the revenue per ton and variable cost per ton to arrive at the yearly revenue and yearly variable cost.

To get cost estimates for the equipment the amount of trash per hour was needed. Table 3 shows the equipment cost used in this analysis. One should note that all equipment costs except for the boiler are costs of new equipment. Equipment such as the cooler, kettles, and pump can easily be found used. Also, there are two types of coolers, the first type is used with a Pelletier and the second is a tumbler cooler. The pellet cooler may be able to be used for plants without a Pelletier instead of the tumbler cooler. The variable cost included labor, energy, maintenance, and starch.

The trash products were figured at 80% of their competitive goods price. Wood pellets sell for $150-190 per ton, so the cotton trash potential selling price was figured to be $130 per ton for Pelletier material. The potential for selling gin trash as cattle feed may approach $70 per ton. (Elam) Barnyard manure sells for about $58.50 per ton. The finer pine mulch sells for about $130 dollars a ton. Therefore the potential selling price for the trash as mulch was assumed to be $104 per ton.

Because this process is an addition to a gin for this project, the amount of labor can be reduced. The extruding plant will run 2 shifts each twelve hours long during gin season. The energy costs were estimated using the industry average for the past five years at $.0454/kwatt and $3.18/MMBTU. The variable cost was calculated to be $26.65 per ton for a plant with an extruder and $26.38 per ton for a plant without a Pelletier.

Financial Analysis

The net present value was used to examine the financial viability of the extrusion process. This was accomplished by subtracting the future cost from the future revenue for each of the next ten years. This yearly profit was then discounted back to the present value and compared to the initial investment. The discount rate initially used was 10% for ten years. For a plant with a Pelletier, the initial investment cost was $769,289, and the cost each year was $61,032.95. For a plant without a Pelletier the initial investment cost was $673,289, and the yearly variable cost was $59,525.45. The potential annual revenue for pellets was assumed to be $236,592. The potential annual revenue for cattle feed was $128,592, and the potential annual revenue for mulch was $189,792.

The next step was to do a sensitivity analysis. For this 81, different trials were run. Each variable (initial cost, income, variable cost) could either stay the same, rise by 10% or decrease by 10%. This gave 27 different trails. The reason for doing this is to: (1) evaluate the risk and (2) most of the data are estimations and therefore the sensitivity reduces the risk of relying solely on the estimation. The discount rate was then changed to 5% and 15% and again the same 27 trials were run.

The whole sensitivity analysis was then run for a 5-year planning horizon at the different discounts rates. This was done to examine the sensitivity of the NPV to the planning horizon.

Results

NPV

For a pelletized finished product, the base NPV was calculated to be $390,724. With a 5% discount rate over ten years the NPV was $688,216, with a 15% discount rate, the NPV was found to be $178,371. When the discount time period was changed from 10 years to 5 years, the 10% discounted rate NPV became -$53,256. With a 5% discount rate over 5 years the NPV was $48,354, and with a 15% discount rate over 5 years, the NPV became -$135,992.07 (Table 4).

For the cattle feed the results were less positive. The NPV for 10% discount rate for 10 years was calculated to be -$174,903. For 5% discount rate the NPV was $46979, and for 5% discount rate the NPV was -$266,217. When the number of years was changed to 5 the 10% discount rate was -$365,812, for the 5% discount rate the NPV was -$322,125, and for the 15% discount rate the NPV was -$401,396 (Table 5).

For the mulch calculations the result was more positive. The NPV for 10% discount rate for ten years was $201,144. At 5% discount rate the NPV was $425,591, and at 15% discount rate the NPV was $40,932. When the years were changed to 5 the result again was lower. The NPV for 10% discount rate was -$133822, at 5% -$57161, and at 15% -$196,244 (Table 6).

Figure 5 shows a comparison of all the NPV values for each good. As one can see the only finished product that has a positive NPV for all three discount rates of ten years is the pellet. One can also see by our estimations that the cattle feed shows no positive NPV. The only finished product that shows a positive NPV for a 5 year planning horizon was the pellet.

Sensitivity Analysis

When running the sensitivity analysis it was discovered that at the 10% discount rate over 10 years the NPV was positive 100% of the time, suggesting that the NPV for the Pelletier is not sensitive to changes in the underlying variables. When the discount rate was change to 5%, the NPV was also positive 100% of the time. When the discount rate was changed to 15%, the NPV was positive 92.6% of the trials. When the years were changed from 10 to 5, the percentages dropped. The 10% discount was positive 33.3% of the trials, at 5% 66.7% of the trial were positive, and at 15% discount rate 11.1% of the trial were positive.

When the sensitivity analysis was run there were only a few positive trials. 3.7% of the trials returned a positive value for the 10% 10 year NPV calculations. For the 5% over 10 years calculation 33.3% were positive. For all the other trials no positive NPV value was returned.

When running the sensitivity analysis 96.3% of the NPVs for 10 years 105 discount rate were positive. For the 5% discount rate 100% were positive, and for the 15% discount rate 15% were positive. For the 5-year anlaysis the 10% discount rate was positive 7.4% of the time. The 5% discount rate was positive 29.6% of the time and the 15% were never positive. The results for the sensitivity analysis can be seen in Table 7.

The same process was looked at for smaller gins. The cost of some equipment would be reduced. The smaller gins would have a hard time generating enough revenue to make the plant profitable, because they would not produce enough trash.

Conclusion

In conclusion, some of the results maybe increased by adding materials to the product that would make the finished product more marketable. This is process is a viable option for gin trash. The cattle feed does not seem to be a viable option under the circumstances. However the cattle feed is not a significant consideration in Mississippi since the trash at the present time should only be sold to beef cattle. Also the concentration of beef cattle in Mississippi is less than other states. To get the feed to other locations would also add a high transportation cost.

This process has the potential for higher profits if the plant could be run yearly. This project wanted to just evaluate the potential returns for running the plant on site with that gin's trash. However the potential could be maximized if in the off-season the plant processed other gin's trash. Trash can in most cases be bought from other gins for nothing and the only costs that would be associated with this idea would be variable cost and transportation cost.

Smaller gins could also look into the potential of buying other gin's trash. This concept could make the process profitable at other gins. Here again it would come down to the amount of trash that the gin could get.

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References

Askew, James. 2000. Servico Cotton Gin. Personal Communication, October.

Boyd, Shawn and Darren Hudson. 1999. Operational and Cost Characteristics of the Cotton Ginning Industry in Mississippi. Bulletin 1086, Mississippi Agricultural and Forestry Experiment Station.

Cotton Incorporated. 2000. Cottonseed Prices: The Cotton Intelligence Monthly URL: http://www.cottoninc.com/ cimarchives/,accessed July.

Holman, Shannon. 2000. Gin Trash: Is It Really Trash? Cotton Farming. March 2000. URL: http://www.cottonfarming.com /home/archive/2000_SeptemberGM.html

Holt, Greg. 2000. USDA-ARS Lubbock Research Lab. Personal Communication. July.

Kleman, LaVern. 2000. InstaPro International. Personal Communication. August.

Laird, Weldon. 2000. USDA-ARS Lubbock Research Lab. Personal Communication. July.

Middleton, Marty, Emmett Elam, 2001. Preliminary Estimates of the Cost of Extrusion Processing of Cotton Gin By-product As A Livestock Feed. Proc-Beltwide-Cotton-Prod-Res-Conf. National Cotton Council of America Memphis, Tenn.

National Cotton Council. 1999. Cotton: Profiles of a Resourceful Industry. http://www.econcentral.org/profiles/

Nesbitt, Duncan. 2000. InstaPro International. Personal Communication. February.

Parnell, C.B., E.P. Columbus, and William D. Mayfield. 1994. Abatement of Air Pollution and Disposal Of Gin Waste. USDA-ARS Cotton Ginners Handbook. 172-173 U.S. Gov. Print. Office, Washington, DC.

Thomason, J. Alex. 1990. A Review of Cotton Gin Trash Disposal and Utilization. : Proc-Beltwide-Cotton-Prod-Res-Conf. 689-705. National Cotton Council of America. Memphis, Tenn.

Table 1. Gin Trash Disposal Methods by Mississippi Gins.

Disposal Method	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
% taken directly to farmers' fields for composting	35.70	47.70	0	100
% composting on-site	45.87	49.44	0	100
% composting off-site	13.72	33.39	0	100
% taken directly to feedlots and other livestock	22.34	14.59	0	100
% used for other purposes	00.23	1.46	0	10

Source**:** Boyd and Hudson

Table 2. Chemical Comparison of Composted Gin Trash and Barnyard Manure.

Element	Cotton Burs	Barnyard Manure
Nitrogen	30 lbs. per ton	10 lbs. per ton
Phosphate	7.90 lbs. per ton	6 lbs. per ton
Potash	101.52 lbs. per ton	8 lbs. per ton

Source**:** Thomason

Table 3. Initial Cost for New Equipment.

Equipment	Cost in $
Extruder	165,000
Pelletier	85,000
Cooler	30-40,000
Belt Drier	61,300
Augers	8,000
Building	120,000
Parts Package	6,800
Kettles	15,000
Pump	3,500
Bulk Bin	1,689
Boiler	12,000
Misc./Installation	250,000

Table 4. The Net Present Value of Producing COBY Pellets.

Discount Rate	For 10 Years ($)	For 5 Years ($)
5%	688,216	48,354
10%	390,724	(53, 256)
15%	178,371	(135,992)

Table 5. The Net Present Value of Converting Gin Trash to Cattle Feed.

Discount Rate	For 10 years ($)	For 5 years ($)
5%	(46,979)	(322,125)
10%	(174,903)	(365,818)
15%	(266,217)	(401,396)

Table 6. Net Present Value of Converting Gin Trash to Mulch/Fertilizer.

Discount Rate	For 10 years ($)	For 5 years ($)
5%	425,591	(57,161)
10%	201,144	(133,822)
15%	40,932	(196,244)

Table 7. Percentage of Net Present Values Positive for All Sensitivity Analyses.

Scenario	Pellet (%)	Feed (%)	Mulch/Fertilizer (%)
10 year at 5%	100	33	100
10 year at 10%	100	4	96
10 year at 15%	93	0	63
5 year at 5%	67	0	30
5 year at 10%	33	0	7
5 year at 15%	11	0	0