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An Assessment of Economic Feasibility for Energy-Enhanced Roughage as Cattle Feed

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Hawaii's cattle industry has undergone a major change in the past three decades. Hawaii's share of the local beef market has continued to decrease from the 28% reported in 1983 (Garrod et al. 1985). Currently, 70–80% percent of Hawaii's cattle are being exported live, according to the Hawaii Agricultural Statistic Service, while the number of ranches, slaughter facilities, and feedlots has slowly decreased, as reported by the Hawaii Department of Business, Economic Development and Tourism.

High input costs in the state have been the major contributor to the decline of Hawaii's market share. Feed, in particular, has become relatively expensive for local producers as the cost of imported grain to finish cattle has increased. If an economical alternative to imported grain could be found for finishing cattle in Hawaii, then the industry would stand to regain some of its competitive position locally.

Researchers have been investigating an economical means of finishing cattle and feeding dairy cows in Hawaii for several years. For example, research has been done by the University of Hawaii for feed alternatives such as corn for grain and silage (Brewbaker 2002), and grazing supplements such as perennial forage peanut (Matthews et al. 2000) and kikuyugrass (Hanna et al. 2003).

The state's tropical climate is ideal for year-round production of grasses such as sugarcane, californiagrass, and guinea grass. As cattle feed, however, these grasses are not as digestible as grain. If they could be converted to a more digestible product, it could result in a more economical means of finishing cattle.

The Byproduct Enhancement Technology Corporation (BETC) has developed a feed called energy-enhanced roughage (EER). It allows low-quality tropical fodder materials to be used to fatten cattle. The product has several characteristics that indicate its potential as an alternative for finishing cattle:

- it is a naturally derived product
- it is a high-energy feed
- it produces carcass yield and grade comparable to grain
- it contains 70% digestible material, compared to 35% for the raw biomass
- the raw material can be produced locally.

At the same time, the product has some drawbacks that must be accounted for in order for EER to be economical:

- a short shelf life of a few days between production and consumption
- the product is not currently known and used in Hawaii
- only one feedlot currently exists
- only one biomass producer exists on the island of Hawaii
- a relatively costly processing facility is needed in order to develop an EER production-marketing system.

Initial research indicates that EER made from guinea grass can produce rates of gain comparable to those obtained by finishing cattle on grain (Carpenter and Sporleder, unpublished data). Cattle producers, feedlot operators, wholesalers, retailers, and other decision-makers need more information about the economic potential of EER before they can consider it as an alternative for finishing cattle. The economic analysis presented here proceeds from the assumption that EER has the ability to compete with grain with respect to rates of gain. We provide a preliminary outline for the feasibility of using EER as part of a production-marketing system to finish cattle in Hawaii by detailing the costs associated with the various components of the system.

The EER system

The production of energy-enhanced roughage requires vertical coordination or the presence of a large integrated operation from the production of biomass to the feedlot. The EER system would include several steps, including

- biomass production
- transportation of the biomass to the processing site
- processing of the biomass into EER
- distribution of the EER to the final users.

In order for such an operation to be successful, every step of the production segment needs to be synchronized and coordinated with demand to maximize input-output considerations.

A system would likely include a few large biomass producers, one processing plant, and at least one feedlot. To maximize the potential of such a system, state support is likely needed to ensure that the vertical coordination occurs. The location, size, and distribution of the system's component on an island are important variables in the success of the operation. The key assumptions on which our discussion of an EER system is based include the following:

- Land will be available for long-term lease for biomass production.
- The operation will be vertically integrated or coordinated from biomass production to EER product.
- Grain prices will continue to increase as shipping prices increase.
- The beef from cattle finished on EER is competitive with grain-fed beef in the eyes of the consumers.

Biomass production

The first step in the development of an EER system is the production of biomass. Sugarcane, californiagrass and guinea grass can be produced on the land that is currently available for this purpose. Guinea grass has already been converted successfully to EER.

Currently only one biomass producer operates in the state, on the island of Hawaii. In order for an EER system to be successful, more biomass is needed. The total acreage needed depends on the demand for the product by the local users and the plant capacity of the processor. If, for example, the number of cattle finished on the island of Hawaii was 50,000, which is roughly half of the island's inventory in 2002, an estimated 4000 acres would be needed to produce the 75,000 tons of biomass required.

The biomass production facilities can be managed in one of two ways. The first possibility is to operate them as independently owned businesses. The second way is to run the operation as a cooperative. Either way, the manager of the facility must coordinate the production of biomass with the processing and distribution centers.

An investment of $4 million is needed to start the biomass production operation, with an annual cost of $3.7 million (see Table 1). The cost per ton is estimated to be $54.40, with production costing $38.25 per ton and management costing $16.19 per ton. These costs will vary depending on the size of the operation. If the operation were smaller than 4000 acres, then the production costs would likely increase. However, the management costs may decrease if a family farm that did not require professional managers were engaged in biomass production.

Biomass transportation to processing

The biomass production areas and processing plant should be in close proximity. Ground transportation from the farming site to the processing location will utilize 20-ton trucks to haul the biomass to the processing plant. The hauling can be done by an independently owned business that uses custom hiring to haul the biomass or done as part of the processing operation. However, biomass production should be within 40 miles of the processing site or hauling costs will become too large to make the system profitable.

A total investment of about 1.5 million dollars is needed for the hauling operation. Total operating days

Table 1. Break-even analysis of biomass production for energy-enhanced roughage.

Size of operation	4000 acres
Biomass	68,000 tons
Costs ($)	
Land lease at $20 per acre annually	80,000
Fertilizer	1,440,000
Labor	
Chipper	320,000
Windrows	245,000
Racking	87,500
Maintenance	72,000
Fertilizer	94,500
Other	36,000
Total production cost	2,601,000
Management (1 person)	70,000
Office workers (2 people)	50,000
Other overhead (utilities, etc.)	15,000
Capitalization cost*	965,850
Total management cost	1,100,850
Total project cost	3,701,850
Cost per ton of biomass	
Production cost	38.25
Management cost	16.19
Break-even cost	54.44

*7% interest is used; 10 years is used for recovering the investment.

Table 2. Break-even analysis of the energy-enhanced roughage processing operation.

Operation size (EER tons)	104,615
Costs ($)	
Direct costs	
Labor	466,286
Maintenance	68,571
Direct materials	
Pretreatment liquors	1,360,000
Post-treatment liquors	1,360,000
Protein supplement	1,700,000
Steam, electricity	476,000
Raw biomass	3,701,850
Hauling cost	846.720
Storage	476,000
Total direct cost	10,437,427
Administrative overhead cost	130,000
Capitalization cost	842,125
Interest*	294,744
Total indirect cost	1,266,868
Total processing cost	11,704,295
Cost per ton	112

*7% interest is used; 10 years is used for recovering the investment.

for hauling is estimated at 200 days, with a round trip of 80 miles. The cost of hauling biomass is estimated at $12.45 per ton and is dependent on the location of both the biomass production and the processing plant. Once other marketing issues are examined, an optimal plant location can be found.

Biomass processing

Biomass is not converted to EER in a one-to-one ratio, because 1 ton of biomass produces 1.539 tons of EER. Therefore, 68,000 tons of biomass generates 104,615 tons of EER. Thus a processing plant that can produce 104,615 tons of EER is of sufficient size to process the biomass produced by 4000 acres. The processing facilities, feedlots, and biomass producers should be located within a 40-mile radius of each other. A comparative study of different locations is needed, including advantages and disadvantages.

The EER product has a short shelf life and therefore must be produced and distributed fresh each day according to a schedule. The processing plant can be franchised or it can be individually owned; it can be part of a partnership, a cooperative, or a regular corporation. However, close cooperation is needed among biomass producers, EER processors, and their consumer market.

An investment of $8–10 million on plant and equipment is needed. The estimated total cost per ton of EER production is $112. This is dependent on the size of the operation. (see Table 2).

Conclusion

Preliminary analysis of EER production costs indicates that the cost of producing biomass and converting it to EER is competitive with importing grain from the U.S. mainland. In order to compare feeding EER to feeding grain, some conversions are needed. First, the EER must be converted into dry matter using a ratio of 0.75 to 1. This means that 1 ton of EER contains 0.75 tons of dry matter. After this conversion, the cost of EER is $149 per ton (see Table 3). Then, because the substitution ratio of EER to grain is 1.5 : 1, the cost of feeding EER increases to $224 per ton (see Table 3).

While the cost of importing grain varies from week to week, a recent estimate for the cost of grain landed on the island of Hawaii is $225 per ton (Land-O-Lakes, Hawaii). The state has only one feedlot, which is located on Maui. Therefore, cattle are not grain-finished on the island, and this option is presented here only for comparison purposes.

A large majority of the cattle produced in Hawaii are shipped to areas in the western USA and finished on grain. The cost of grain on the Mainland varies, and the producers who do not sell their cattle directly to a buyer in Hawaii pay for all the grain used in finishing their cattle. If the animal was shipped to the Mainland, the cost of shipping would be $110 per head (Hawaii Cattle Producers Coop) and the cost of feeding the grain would be $140 per ton (Land-O-Lakes, Oregon). Given these two alternatives, EER is competitive with feeding imported grain and shipping cattle to the Mainland.

This preliminary analysis indicates that energy-enhanced roughage has potential as an alternative for finishing cattle in Hawaii. A return on investment has been included in the calculations, which means that the large capital costs required for an EER production and processing system will be recovered. However, the beef and dairy industries will need to work together to attract sufficient capital and ensure that the system runs smoothly. Issues to be addressed by the group include prices, terms of delivery, amount, and other market variables to ensure that the cost of inputs is competitive in the long run.

From the demand side, the marketability of the beef from cattle finished on EER will need to be examined further in order to ensure that all value added by using EER to produce a natural product is captured.

Table 3. Estimated costs ($) for finishing with EER or grain in Hawaii vs. finishing on the Mainland.

Finishing in Hawaii	
Cost per ton of EER	224
Cost per ton of grain	225
Finishing on Mainland	
Shipping to Mainland (per head)	110
Cost per ton of grain	140

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