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Small-Scale Ethanol Production: Economics and Issues*

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Small-Scale Ethanol Production: Economics and Issues

In the past two years, the Corn Belt has been alive with talk of producing fuels from agricultural products. Fermentation and distillation of grain (mainly corn) to yield ethanol has attracted most of the attention. A "still" on every farm or in every community, some argue, will help free the agricultural sector of dependence on expensive and unpredictable petroleum supplies, will reduce aggregate consumption of oil in the U.S., and will mean larger markets for grains.

Critical examination of ethanol production options and implications has lagged behind popular desires to become involved. Recently, evidence has begun to mount which permits judgements about the future of ethanol. In this paper, observations on the costs of producing ethanol from small-scale plants are reported. Possible connections between small-scale ethanol production and the organization of farming in the Corn Belt also are examined.

I. Production Prototypes

To simplify the analysis, only two small ethanol (EtOH) production options are considered in detail in this paper. These are defined in terms of output capacity and relationships to farms. The small on-farm still would produce more than enough ethanol (16,000 gals./yr.) to supply fuel for a 500 acre grain farm. The medium-size cooperative or community still would produce one million gallons per year. By comparison a large commercial plant might produce about 40 million or more gallons per year.

The on-farm and cooperative production units both require some degree of direct farmer involvement. The on-farm unit is run entirely by the farmer. The cooperative or community units is run with hired labor and management but member farmers supply grain feedstocks directly to the plant and oversee the cooperative.

In general, the on-farm ("pot") still prototype represents a farmer who produces ethanol as part of his farm operation. His equipment includes a cooker-fermenter, a distillation column, and storage tanks. It is housed in an existing building. The EtOH produced is 160-190 proof. It cannot be mixed with gasoline. Rather, it is used in suitably modified engines on farm equipment or in other on-farm applications. It is not marketed commercially. It may be stored. The high-protein[1] stillage by-product is fed to livestock on the farm in a "wet" form, i.e. a slurry consisting by weight of over 90 percent water and less than 10 percent solids. The wet stillage must be used within 24 hours (somewhat longer in cool weather) if spoilage is to be avoided.

The cooperative or community prototype is somewhat comparable in function to a local farm cooperative. Its grain feedstock would come from nearby member farmers. It might dispense EtOH to the members as well if they have a use for the pure product.[2] Most importantly, it is physically separate from farm operations. It is larger, producing perhaps 500,000-1,000,000 gallons per year.[3] It includes cooking vats, a fermenter, distillation and rectifying columns, storage tanks, and various pumps and other automation devices. It is housed in its own building. The EtOH is "dried" on-site or shipped to a large commercial facility for this final difficult, costly and hazardous step in producing pure EtOH. The stillage by-product is used in its wet state. To avoid excessive transportation of the bulky stillage, about 2,600 head of feeder cattle or 18,600 feeder pigs [USDA, 1980, Table VI-9] must be located close-by to consume the stillage.

Three general features of <u>any</u> small scale EtOH production are behind these prototypes: (1) Making fuel-quality EtOH is not a simple matter. It takes time, knowledge, and careful monitoring. Unless advanced (and expensive) automation and control equipment are available, direct labor and management are indispensable. (2) It is unlikely to be financially worthwhile for small EtOH plants to dry their stillage in order to market the solids in one or more of their dry forms. (See the paper by Berger [1980]

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[1]Corn solids remaining in the stillage contain about 27 percent protein by weight.

[2]Federal and most state fuel excise-tax exemptions are available only for "gasohol" mixtures of ethanol and gasoline, not pure ethanol [SERI, 1980, App. A]. This is a considerable disincentive to use pure ethanol for fuel.

[3]The modular unit manufactured by Agri-Stills Corp., Springfield, IL is representative of this type of facility. Each module is rated at 250,000 gallons/year. Two to four modules could be integrated to produce 500,000-1,000,000 gallons/year. The output is rated at 190 proof. Other researchers at the University of Illinois are currently studying the performance of the Agri-Stills unit.

for a discussion of these.) (3) Oil, bottled gas, or natural gas all are prohibitively expensive as sources of process heat for producing EtOH. Fuels available at lower cost, such as wood, coal, or crop residues, must be used. These are practical energy sources only if burned in a boiler to produce steam. This adds to the investment costs associated with small production units.

II. Economic Viability

Cost of Production

A number of recent studies have addressed the technologies and economics of small scale ethanol production. Among the best of these are:

U.S. Department of Agriculture. March 1980. Small Scale Fuel Alcohol Production. Washington, D.C.: U.S. Government Printing Office.

Solar Energy Research Institute. February 1980. Fuels from Farms. Washington, D.C. SERI/SP-451-519. [Available for $4.50 from the Superintendent of Government Documents, U.S. Government Printing Office, Washington, D.C. 20402. Refer to Stock No. 061-000-00372-0].

Cooperative Extension Service, University of Nebraska-Lincoln. Ethanol Production and Utilization for Fuel. January 1980.

Jantzen, Dan and Tom McKinnon. May 1980. Preliminary Energy Balance and Economics of a Farm-Scale Ethanol Plant. Golden, CO: Solar Energy Research Institute, SERI/RR-624-669R.

In analyzing production costs of small scale operations, many assumptions must be made regarding techniques used in the plants, their production efficiencies, and the prices of their inputs (grain, labor, equipment, etc.) and outputs (EtOH, high-protein stillage, and carbon dioxide[4]). A variety of assumptions can be justified. Thus, a range of conclusions about production costs and product prices are possible. Indeed, there is little consensus at present about the economic viability of small EtOH plants because there is so little agreement on the basic economic and technical assumptions.

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[4]Carbon dioxide is unlikely to be captured and marketed by small alcohol production facilities. It will not be considered further in this paper.

The most sophisticated of the recent analyses of this subject appears to be the U.S. Department of Agriculture (USDA) study (prepared with the assistance of Development Planning and Research Associates, Inc. of Manhattan, KS.) noted above. It is a "blue print" study, that is, it is based on engineering specifications rather than actual operations. Two of the cases analysed therein, the "pot still" and the "small community — wet by-product" plant, conform closely to the two prototypes identified in the previous section. In Table 1, we summarize the key assumptions of that study as they were developed for those two cases. Table 2 gives the production cost estimates resulting from those assumptions.

Several features of Table 2 are noteworthy. First, the larger plants produces more per dollar of invested capital and per unit of labor. These features reflect technical economies of a larger, technically advanced plant and the fact that it is not limited to part-time operation.

Second, feedstock costs are assumed to be higher for the community unit because costs of transportation between the farm and still are incurred. This differential will depend on the transport distance. The $0.25/bu. differential assumed in the USDA study probably overstates the transportation cost which would be incurred for a local unit serving, say a 20-mile radius. A more reasonable estimate would be $0.10-$0.15 per bushel.

Third, the by-product credit is much lower for the on-farm unit than for the small community plant. The intermittant production of a "pot" still would mean that the stillage would not be available for continuous inclusion in livestock's diet. In some instances, it might not be fed in a very fresh form. The author's of the USDA study concluded (p. VIII-7) that its feed value would more closely approach that of hay. They assumed also that "low-production livestock" would eat the stillage. These assumptions are questionable. Dairy herds or a small herd of feeder cattle would not be low in productivity. Also, intermittant inclusion in the diet, perhaps rotating with soybean meal, need not reduce the protein value of the stillage, as long as it is fed fresh.[5] Hence, depending on how it is used, stillage produced

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[5] Communication with Professor Larry Berger, Deparment of Animal Science, University of Illinois at Urbana-Champaign, September 8, 1980. However, it is possible that irregular feeding of stillage may lead to poor acceptance by animals due to the unusual taste and texture of wet stillage [USDA, 1980, p. VI-2].

Table 1. Assumed Characteristics of Two Small Ethanol Production Units

Characteristics	On-Farm ("Pot") Still with Wet Stillage	Small Community Still with Wet Stillage
Plant		
Type	Package ("off-the shelf") unit in existing building	Custom-built unit in new building
Capacity	20 gals./hr. (160-190 proof)	150 gals./hr. (200 proof)
Cost	$25,000	$1,200,000
Life	5 years	20 years
Working Capital	$3,000	$140,000
Capital Financing		
Debt/Equity Ratio (%/%)	50/50	50/50
Finance Charges on Debt, Equity (%,%)	12, 14	12, 14
Operating Characteristics		
EtOH Production	100 days/yr., 8 hrs./day 16,000 gals/yr (160-190 proof)	200 days/yr, 24 hrs/day 1,000,000 gals/yr. (200 proof)
Conversion Ratio	2.4 gals/bu	2.5 gals/bu
Stillage By-product	21.4 gals./bu. corn 16 lbs. dry-matter /bu. corn Fed on farm to livestock	15.7 gals/bu. corn[1] 16 lbs. dry-matter /bu. corn Fed to nearby livestock
Variable Inputs and Costs		
Labor	0.05 hrs./gal. @ $3.00/hr.	0.01 hrs./gal. @ $6.00/hr.

Reflects internal recycling of some water. As a result, the wet by-product contains a higher percentage per unit weight of dry matter relative to by-product from the "pot" still.

Table 1. continued

Characteristics	On-Farm ("Pot") Still with Wet Stillage	Small Community Still with Wet Stillage
Process Heat Energy[2]	43,000/BTU/gal. @ $2.315/10⁶ BTU	61,000 BTU/gal. @ $2.315/10⁶ BTU
Electricity	0.5 KWh./gal. @ $0.05/KWh.	0.5 KWh/gal. @ 0.05/KWh.
Supplies and Overhead	$0.09/gal. + [3% of Equip. Cost in yrs. 1-5; 5% of Equip. Cost in yrs. 6-]	$0.09/gal. + [3% of Equip. Cost in yrs. 1-5; of Equip. Cost in yrs. 6-]
Corn Feedstock	$2.50/bu.[3]	$2.75/bu.[4]
Other		
Taxes and Insurance	$1,000/yr.	$41,100/yr.
Administrative Cost	--	$30,000/yr.

[2]Assumes use of coal-fired boiler. Process heat for drying the ethanol to pure form more than offsets any improvements in energy use between a "pot" still and the more advanced equipment used in the small community unit.

[3]Farm gate price is the appropriate value for a farmer's best alternative use of corn.

[4]Prices offered by regional grain elevators are appropriate for a cooperative's best alternative use of corn.

SOURCE: USDA, March 1980. Small-Scale Fuel Alcohol Production. Tables VIII-3 and VIII-4.

Table 2. Production Cost Estimates for Two Small Ethanol Production Units [1979 dollars].

Cost Component	On-Farm "Pot" Still with Wet Stillage ($/gal. 160-190 proof EtOH)	Small Community Still with Wet Stillage ($/gal. 200 proof EtOH)
Fixed Costs		
Capital Charges	$ 0.36	$ 0.17
Taxes & Insurance	0.06	0.04
Administrative	-	0.03
Operating Costs		
Feedstock	1.04	1.10
Labor	0.15	0.06
Energy (heat & electrical)	0.13	0.17
Supplies & Overhead	0.14	0.12
TOTAL COST	1.88	1.69
By-Product Credit	(0.25)[1]	(0.43)[2]
NET COST	$ 1.63	$ 1.26

[1] Assumed to be fed to "low-production livestock" and to have a feed value equivalent to hay, i.e. $74/ton: $74/2000 lbs. dry matter x 16 lbs dry matter/bu. corn x 1 bu. corn/2.4 gals. EtOH = $0.25/gal. EtOH.

[2] Assumed to be fed to "high-production" livestock with a feed value equivalent to dried distillers grains plus soluables (DDGS). The DDGS analogue price of $153/ton was reduced to $135/ton to reflect possible transport cost for stillage $135/2000 lbs dry matter x 16 lbs dry matter/bu. corn x 1 bu. corn/2.5 gals. EtOH = $0.43 gal. EtOH. This computation does not agree with that in the source.

SOURCE: USDA. March 1980. Small-Scale Fuel Alcohol Production. Tables VIII-2 and VIII-5.

and used on-farm may have a value approaching $0.40/gal. EtOH. The net unit production costs would be lower accordingly.

While the on-farm still's by-product credit may be understated, the community still's credit may be overstated. Two things could lower that credit: (1) the local market might have limited demand for the by-product or abundant supplies of high-protein feeds; and (2) costs of transporting the stillage could further reduce the by-product credit.[6]

Fourth, labor costs per unit of output may be understated in both cases; they almost certainly are understated for a still using hired labor. It is unlikely that labor can be attracted at an hourly wage, including employer contributions to various benefits, of $6.00. A more likely average hourly labor bill might be in the $8.00 - $10.00 range, which would add to the community still's production cost. A much lower labor cost may be justified for a farmer-operator who is able to tend the still in his or her slack time and who need not pay any additional fringe benefit costs due to the ethanol production activity.

In support of higher labor cost, a recent study [Jantzen and McKinnon, 1980] of a 400,000 gal./yer. EtOH plant in Colorado reported labor costs of $0.20/gal. of 190 proof EtOH. The labor cost might be slightly higher yet for a plant equipped to bring ethanol to 200 proof.

Fifth, use of liquid fuels to provide process heat or to drive automated equipment will greatly increase the energy cost. The Colorado plant noted above uses diesel fuel for process heat and to load, mill, and unload the grains from storage bins to the cooker. The operation incorporates extensive recycling of waste heat. Nevertheless, at $1.10/gal. of diesel fuel, the diesel fuel alone costs about $0.18/gal. of 190 proof EtOH. Electrical energy adds another $0.05/gal. The USDA [1980, Table VIII-6] estimates that

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[6]It is estimated by the USDA [1980, p. VI-19] that each one way distance of 18 miles in the delivery trip reduces the by-product credit by 10 percent. One such trip was assumed and accounts for $15 reduction in the stillage analogue price (see note 2 of Table 2). A more-distant market would further reduce the stillage credit.

an additional \$0.06/gal. EtOH would be expended to bring the ethanol to 200 proof. Including all three elements, the total energy cost per gallon of 200 proof EtOH would be \$0.29, 70 percent above the estimate for a small community still in Table 2. Hence, the type of fuel used to produce ethanol can make a sizeable difference in the cost of production.

Sensitivity to Input Prices and Conversion Rates

The grain feedstock clearly is the largest cost item in ethanol production. Grain prices also are volatile from year to year relative to the prices of other inputs and relative to the prices of other liquid fuels.

At a conversion ratio of 2.5 gals. EtOH/bu. corn, each \$1.00 change in the price of a bushel of corn leads to a \$0.40/gal. change in the costs of producing EtOH. As corn prices rise, high protein feed prices should also rise. An estimate reported in the USDA [1980, p. VI-9] study indicates that distillers grain prices vary by about 40 percent of corn price changes. Hence, a \$1.00 rise in corn prices would increase the by-product credit by about \$0.16.[7] Net production costs would rise by \$0.24/gal. The cost sensitivity is 24 percent under the circumstances just described.

A similar analysis performed for an on-farm still that converts corn at a rage of 2.4 gals. EtOH/bu., would show a 42 percent rise in feedstock costs per gallon of EtOH for each dollar increase in the price of a bushel of corn. The impact on the by-product credit would depend on the use made of the stillage. At best, the stillage price might rise by 40 percent of the corn price increase, in which case the by-product credit would rise by 16 percent and the net sensitivity of production costs to corn price changes would be 26 percent. A higher sensitivity would result if the by-product is not used as a nutritional equivalent for DDGS.

A low conversion ratio also may have very damaging implications for ethanol economics. Preliminary analyses of several small ethanol production units indicate that conversion more typically is in the range of

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[7] $$\frac{\text{\$1.00 corn price increase/bu.}}{\text{2.5 gals. EtOH/bu.}} \times \frac{\text{\$0.40 price increase for stillage}}{\text{\$1.00 corn price increase/bu.}} = \$0.12$$

1.8 gals./bu. to 2.2 gals./bu.[8] A rate of 2.0 gals./bu. would result in per unit feedstock costs, with $2.50/bu. corn, of $1.25 gals.EtOH. This conversion ratio could not be sustained economically in any size of ethanol production facility. Thus, it appears that the economic viability of small scale ethanol production depends on a conversion rate of at least 2.4 gal./bu. Even then, other factors may force production cost above levels noted in Table 2.

Sensitivity to Tax-Breaks and Prices

It is important to remember than the on-farm ethanol plant is not likely to produce pure ethanol. This fact is partly responsible for the lower energy cost per gallon on the "pot" still. It also means that the output contains less energy per gallon than does pure ethanol. According again to the USDA study [Table VIII-1], 190 proof ethanol is worth up to $0.64/gal. as an on-farm replacement for $0.97/gal. gasoline;[9] 160 proof EtOH has a maximum value (again relative to $0.97/gal. gasoline) on-farm of $0.49/gal. These compare very unfavorably to a production cost estimate of $1.63/gal.

The same comparison for the pure EtOH is not quite as bad. Again following the USDA study, EtOH used straight or to make gasohol (90 percent gasoline, 10 percent EtOH) is worth about $0.74/gal. compared to the $0.97/gal. gasoline which it displaced. The federal excise tax exemption for gasohol adds another $0.40/gal. to its value. These additions bring ethanol's market value in gasohol to about $1.14/gal. In 16 states, exemptions from state fuel excise taxes add from $0.10/gal. (Connecticut and Maryland) to $0.95/gal. (Arkansas) of EtOH to the market value [SERI, Table A-1], leaving a final market value of from $1.24/gal. to $2.09/gal. depending on the state. Recent plant-gate ethanol prices quoted by

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[8]Revealed in conversations with Poofessors Folke Dovring and Robert Herendeen of the University of Illinois.

[9]The BTU content of pure ethanol is about two-thirds that of gasoline per unit volume. Ethanol has a 10 to 20 percent higher octane rating. Hence, a gallon of ethanol is worth about 75 percent as much as a gallon of gasoline to someone choosing between the two fuels to run a "gasoline" engine. This relationship to gasoline must be discounted for sub-200 proof ethanol. Ethanol of 190 proof has a maximum fuel value of 66 percent that of gasoline; 160 proof ethanol has a maximum fuel value only 51 percent that of gasoline.

Archer-Daniels Midland, Inc., the leading ethanol producer, have been about \$1.75/gal.[10] If these calculations hold, with considerable tax breaks, pure ethanol produced and sold by a community still might be profitable. The excise tax break would not be available to the unmixable output of an on-farm still.

Other tax incentives may further improve the financial picture for small scale EtOH production.[11] The federal Windfall Profits Tax Act included a \$0.30/gal. direct tax credit for 150-190 proof alcohol and a \$0.40/gal. credit for 200 proof alcohol. These credits are available only to the final processor of the alcohol. They are not available for alcohol derived from natural gas, LP-gas , petroleum, or coal. The value of the credit will depend on the producer's tax bracket. A farmer in the 40 percent bracket who produces 180 proof alcohol, for example, would realize tax offsets of \$.12 per gallon of ethanol produced. In effect, the after-tax cost to the farmer of each gallon of EtOH would be \$0.12 less than that shown in Table 2.

Ethanol production equipment is eligible for a total investment tax credit of 20 percent. After 1982, the equipment must utilize heat sources other than coal, oil, natural gas, or LP-gas to qualify for the full credit. The financial impact of the investment credit again depends on the owner's tax category. A farmer in the 40 percent bracket could subtract from his or her tax liability eight percent of an investment in ethanol production equipment. This could reduce slightly the capital charges reported in Table 2.

Just as ethanol economics depend on input prices and taxes, they depend on the prices of substitute fuels—especially gasoline. The higher the price of gasoline, the higher the price which ethanol can command. For example, \$1.50/gal. gasoline would increase the maximum relative worth of pure fuel ethanol to \$1.13/gal. without affecting production costs.

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[10] Conversation with Dick Burkett, Archer-Daniels Midland, September 10, 1980.

[11] See Prairie Farmer, 152 (no. 16, August 16, 1980), p. 58 for a list of provisions of the 1980 Windfall Profits Tax Act which affect fuel alcohol production.

Table 3 summarizes the preceding discussion of the sensitivity of ethanol production finances to various cost, price, and tax factors.

Markets

The above conclusion presumes that the small community still's EtOH output is marketed for prices equal to those charged for the production of a large manufacturer. In fact, marketing may be a problem for small production units. Unit transport costs are usually higher for small shipments. This may force the plant gate price for a small producer below that received by a large ethanol producer, other things equal. Of course, other things may not be equal; proximity to a gasohol mixing plant, for instance, may greatly offset any size disadvantages in transport costs.

For the community still, marketing the wet stillage also may present problems, unless a large feed lot is located next to the ethanol plant. It might then be necessary to maintain and operate tank trucks for stillage deliveries and to employ delivery personnel. These expenses reduce the by-product credit as noted earlier (see again footnote 5).

Transportation costs are not the only marketing disadvantages which the small ethanol producer may face. A small market share may limit the small producer's visibility and access to potential customers. Equivalent marketing efforts spread over fewer units of output lead to relatively high marketing costs per unit of output.

Wet stillage must be used soon after leaving the still, so timing is critical. A transportation breakdown may cause several batches of stillage to spoil before they are used. This timing problem does not occur for dried distillers grains, which can be stored. Moreover, finding nearby users of large volumes of wet stillage is not a simple matter. In 1978, only 15 feedlots of 2,000 or more head of cattle remained in Illinois [USDA, 1979, Table 55]. Feeder cattle operations are concentrated in the western Corn Belt, central and southern plains, and California. The economics of ethanol production in small units using corn are not attractive enough to induce a regional shift and decentralization of cattle production.

Swine do continue to be raised in large numbers in the Corn Belt. Few swine facilities are large enough to utilize the stillage from an ethanol

Table 3. Sensitivity of Ethanol Production Finances to Cost, Price, and Tax Factors.

Factor	Effect
1. Costs of Production	
Production Yields	Large
Plant Capacity (Investment) Rate of Use	Large
Feedstock Price	Large
Wage Rate	Small
Energy Price	Medium
Debt-Equity Mix	Small
Interest Rate	Small
Cost of Equity	Small
2. Output Prices	
Ethanol[1]	Large
Stillage By-product	Large
3. Taxes	
Excise Tax Break (Gasohol)	Large
Alcohol Tax Credit	Medium
Investment Tax Credit	Medium

[1]The price of fuel ethanol varies with the price of gasoline.

SOURCE: Adapted from USDA. March 1980. Small-Scale Fuel Alcohol Production. p. VIII - 17.

plant producing a million gallons per year. Swine utilize wet stillage less efficiently than cattle and the resulting by-product credit is lower than for cattle [USDA, 1980, Table VI-6].[12]

III. Possible Implications for Farm Organization and the Structure of Agriculture

On-Farm Production

In general, ethanol produced on farms will be very costly. Moreover, the impure ethanol produced in such a facility is not suited to mixing with gasoline, nor are most current engines adjusted to accept it. Hence, its uses are limited on most farms. As a feedstock for subsequent drying in an off-farm facility, it comes at high cost.

Only in special cases can ethanol production on-farm be justified economically. An individual who can fashion a still inexpensively, who places little value on the time devoted to ethanol production, and who has access to cheap sources of process energy might be such a case. Such circumstances hardly describe a large proportion of farms or farmers. Thus, it does not appear likely that many farmers will become involved with ethanol production on-farm.

For those who do become involved, what changes must be made in their farm operations? A farmer averaging 140 bu./acre corn production would need to devote 48 acres of corn to produce 16,000 gallons of EtOH (at 2.4 gals./bu.). This fact may influence the relative amounts of acreage devoted to different crops. The farmer must also have access to stillage-consuming livestock. Animals may be present already, or some arrangement might be worked out with neighbors who have livestock. From an economic viewpoint, on-farm ethanol production provides no financial inducement to have animals on-farm where they would not otherwise be. Hence, current on-farm ethanol technologies will not prompt a widespread return to mixed crop-livestock operations.

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[12] As determined by a linear programming analysis of optimal feed rations, 6.3 gallons of stillage per gallon of EtOH produced in a community still would have the following values for cattle and swine: calves ($0.42-$0.52), steers ($0.25), dairy cows ($0.50), and swine ($0.38).

Small Cooperative or Community Units

The economics are better for larger, specialized ethanol production plants. In fact, economies of size are available up to the 40-60 million gals./year range [Meekhof, Gill, and Tyner 1980, Table 7]. Opportunities to dispose of wet stillage locally and use the pure ethanol output nearby are the factors which may create a niche in the market for small community plants.

Such opportunities may exist, but they are unlikely to be numerous. The movement of large cattle feedlots out of the heart of the Corn Belt reduces the convenient outlets for wet stillage. Small ethanol producers must realize substantial by-product credits to be economical, so they are not likely to be able to offer feed discounts to attract new, large feedlots. Nor are there many gasohol mixing plants or refineries scattered around rural parts of the Corn Belt. In these prevailing circumstances, it becomes essential to produce ethanol cheaply such that costs of marketing it can be absorbed and to produce by-products which can be marketed widely without spoilage problems. These are capabilities not usually associated with small ethanol production units.

Where community or cooperative units are viable, they would relate to individual farmers much as small grain elevators do now; they are alternative outlets for grain. The implications for farm management relate simply to prices offered for corn (for ethanol and other uses) relative to those available for other farm products. Hence, there would be few direct impacts on the nature of farm operations.

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