

Value Added Agriculture Program

Sourcing Corn for Ethanol: Impacts of Local Processing

A project of the Iowa Grain Quality Initiative

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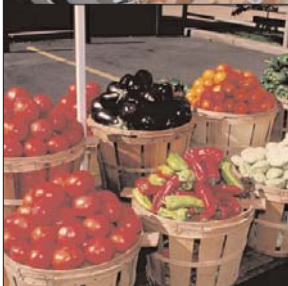
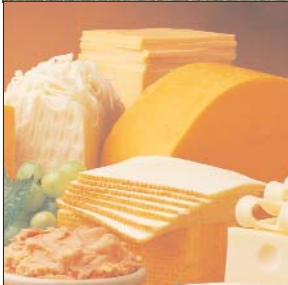
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Executive Summary

The rapid expansion of Iowa's ethanol industry has changed corn distribution patterns to support more local processing. As more corn is used locally in fuel production, less is available for export, feed applications, and other processing. This has led to changes in grain transport, on-farm grain storage, and the function of local grain elevators. This study collected data to indicate the magnitude of current and future impacts of ethanol production on Iowa agricultural logistics.

Interviews with representatives of twenty Iowa ethanol plants revealed information about sourcing corn, processing capacity, corn storage capacity, corn quality specifications, truck and rail access, and co-product storage capacity and marketing. At this time, twenty-three dry grind plants and four wet mills are expected to produce 1.5 billion gallons of ethanol in Iowa in 2006. Ten new dry grind plants, one new wet mill plant, and six expansions are under construction. In addition, dry grind plants immediately across Iowa's borders draw corn from Iowa farms. The current plants and those under construction will use 1.61 billion bushels of corn annually. Thirty-three new plants or expansions have been announced. If all announced facilities are built and operating at capacity by 2010, fuel ethanol production of 7.5 billion gallons per year in and near Iowa would consume 2.68 billion bushels of corn. Construction of all announced plants would be an aggressive projection dependent on continued favorable economic conditions; this report does not evaluate the likelihood of their construction.

Dry-grind ethanol plants also produce distillers grains feed products (DGS) in various forms. Iowa ethanol plants currently produce about 4.3 million tons of DGS, which could grow to 22.5 million tons if all announced ethanol plants come online. Distillers grains can substitute for other ingredients in cattle rations (up to 50% of ration), and can also be used in swine and poultry rations at a lower rate (up to 10%.) Ethanol plants located close to cattle feedlots are able to save energy costs by selling wet distillers grains, but on average only 25% (range 6% - 100%) of distillers grains is sold wet at an average of 56% moisture (range 50% - 65%). Nearly 60% (range 0% - 93%) of DGS is shipped by rail to users outside of Iowa and is shipped as dried distillers grains.

Ethanol plant managers recognized that new plants and existing livestock markets would compete for corn. Sixty-two percent (range 5% - 100%) of the corn currently used by ethanol plants is purchased directly from farmers. Operators expressed a desire to source corn directly from farmers. However, most had absolute limits (typical 18% moisture, 10% damage) on acceptable quality, unlike the general acceptance policies of traditional elevators. Stored grain quality will need to be maintained more closely, over a longer period, than current markets require.

Plants had onsite storage for about 5% (range 2% - 12%) of annual corn use and 2.5% (range 1.6% - 4.7%) of annual distillers grains production, which makes consistent logistics a major need. Some expressed concern about adequate rail service for both ethanol and distillers grains. The need for ongoing training for current and future ethanol plant workers was stressed by managers, pointing to Iowa's regents universities, community colleges, and Extension to take this responsibility.

Background

Rapid growth of ethanol production continues to generate many questions related to future analysis, shifts in existing businesses and policy development. In Iowa, new dry-grind ethanol processing plant construction is announced frequently, financed by either local or remote investor groups. New dry-grind ethanol plants are also being added to existing wet milling operations. As these markets develop, there will be innovation in contracts, price discovery and market information. There will also be changes to supplier interaction and service aspects as well. One of the growing concerns is the balance of corn supplies between new ethanol demand and existing feed/export demand. The logistics of more or less uniform constant use over the year are also a departure from the shipping-based export chain. Access to approximately one billion bushels of “mobile storage” in trains, barges, export elevators and river elevators is essentially cut off by the need to retain effectively the entire crop within the state, most often very near where it was produced. Processing uses require sufficient local storage to provide a steady flow through the year.

Initial discussions with dry mill ethanol plant managers have revealed shifts in corn distribution patterns as the ethanol plants establish corn supply areas and forge new relationships with individual farmers and grain handling facilities. These patterns are not consistent throughout the state and they are influenced with each new announcement of plant construction. Questions about how Iowa corn producers can support more ethanol production while maintaining livestock production and export markets are being raised by processors and shippers alike. Increased corn production through crop rotation changes with increased yield is already being done, although consistent data to make future predictions is not yet available. Research has been underway at Iowa State University to collect information about corn usage in ethanol production and in livestock feed. This data is gradually being combined with a current understanding of Iowa’s ethanol and co-product production capacities, and storage capacities, to create an overall picture of the impact of ethanol processing on Iowa agriculture.

Distillers grains, co-products of dry-grind ethanol production, are rapidly increasing, putting strain on marketing infrastructure and transportation. Co-product marketing is done by ethanol plant staff as well as by intermediary brokers. Depending on the size of local markets for wet distillers grains, plant managers decide how much of the distillers grains to dry, an important decision in terms of operating costs. Opportunities exist to change transportation and storage, and to improve uniformity in marketing standards. Expansion of dairy and beef production is encouraged to use a large portion of distillers grains, and inclusion of distillers dried grains (DDGS) in swine, poultry feed, pet food and human foods is being studied. As production of DDG increases to rival soybean meal production, shifts in prices and substitutions will occur.

The availability of well trained technical and managerial staff for new ethanol production will affect the efficiency and profitability of each plant. An assessment of training needs and a description of how ethanol plants are currently handling training will reveal new educational opportunities for Iowa’s regents universities and community colleges.

Objectives

The purpose of this study was to create an objective data set describing Iowa's ethanol processing plants that could be updated as new plants begin production. Processing and storage capacity, corn quality and consumption, and distribution of distillers grains were the main points of interest, but interview data also included plant managers' opinions about future industry needs in market development, transportation and logistics, and worker training.

Interviews

Procedure

A survey was conducted through direct interviews with ethanol plant managers to describe how existing plants originate grain into the plant and how they market the co-products. Interviews were conducted in late spring and summer 2006 with representatives for 20 existing ethanol plants within a 200-mile radius of Ames. Interview data, industry data, and mass balance calculations were used to estimate corn consumption and production amounts for the plants that were not interviewed and for the plants currently being planned or under construction.

Results

Ethanol production and corn consumption (Table 1.)

As of June 2006, twenty-one dry mill plants and four wet mill plants were producing ethanol in Iowa. Two dry mill plants have or will begin production late in 2006 or early 2007. These plants together are expected to produce nearly 1.5 billion gallons of ethanol, roughly equaling Iowa's total consumption of gasoline, 1.6 billion gallons. (Norton, 2006) The 23 dry grind plants are expected to use 506-514 million bushels of corn in 2006-2007, the range reflecting the difference between rated capacity and actual capacity. Most plants produce at 105% - 110% of rated capacity, according to interview data.

Table 1. Production statistics summary (Iowa ethanol plants)

Summary Statistics	<i>n</i>	<i>Ethanol Produced mil gal/yr</i>	<i>Corn Used mil bu/yr</i>	<i>DGS 000 tons/yr</i>
<i>Current Dry-grind Plants</i>	23	1448.0	514.3*	4386.6
<i>Plants, expansions under construction</i>	16	1509.5	524.3	4456.4
<i>Wet Mills</i>	7	1210.0	432.1	3673.2
<i>Nearby, Iowa Draw**</i>	6	402.0	143.6	1220.4
<i>Subtotal</i>		4569.5	1614.3	13721.4
<i>Announced</i>	33	2975.0	1062.5	9031.3
<i>High Estimate, 2010</i>		7544.5	2676.8	22752.7

**Operating at actual capacity, approximately 5-10% over rated capacity.*

***Plants in bordering counties of other states with 50% use assigned to Iowa corn.
High estimate assumes all announced construction will occur.*

There were 16 new plants or plant expansions in progress, and plans for 33 new dry-grind plants have been announced, with projected completion by the end of 2010. Iowa's six wet mill plants have added capacity for ethanol production and one new wet mill plant is under construction in north-central Iowa. Wet mill ethanol production is about 1.2 billion gallons of ethanol production and uses 432 million bushels of corn. Dry grind plants in neighboring states currently draw some of their corn from Iowa farms, estimated at 143 million bushels. The current plants (wet, dry and nearby states) plus the capacity under construction will use 1.61 billion bushels of corn annually. National Agricultural Statistics Service estimates Iowa's 2006 corn crop at 2.1 billion bushels.

If all announced plants are built, ethanol production of 7.5 billion gallons per year in and around Iowa would consume 2.6 billion bushels of corn by 2010. For this to happen, an economically favorable combination of grain prices, energy prices, and government policies would need to continue. If corn demand pushes prices beyond levels that would support new investment, then some announced construction may not be realized, making the 2.6 billion bushels a high end estimate. This report does not assess the probability of actual construction of announced plants. In addition to the major plant construction companies, Broin and Fagen/ICM, other companies now construct ethanol plants.

Corn origination practices and storage capacity

Iowa has 1.65 billion bushels of on-farm storage capacity (ProExporter, 2006) and 1.08 billion bushels of commercial grain storage capacity. (Wahl, 2006) Together, Iowa has storage capacity for 2.73 billion bushels. These numbers do not include approved temporary commercial storage space.

The shift in corn demand toward local processing moves more corn from farm to local processing plant, sometimes bypassing the country elevator. Some local elevators are involved with grain storage and handling for ethanol plants because of their favorable location and/or a prior arrangement with the plant. Some ethanol plants and grain elevators have shared ownership.

Among the 20 ethanol plants interviewed, there is wide variation in how much corn is sold directly to the plant. Corn storage capacity also varies among plants. On average, 62 percent of the corn is purchased directly from farmers. Four ethanol plants own or are partially owned by grain handling companies; in these situations, the ethanol plant acquires 60-95 percent of its corn from local elevators, though each plant maintains storage for at least two days of processing at the plant. Sixteen of the plants purchase more than 50 percent of the corn directly from farmers one at 100% from farmers.

Table 2. Corn storage at 23 Iowa ethanol plants

	<i>Current capacity (mil gal)</i>	<i>Corn Usage (million bu)</i>	<i>Corn Storage (thousand bu)</i>	<i>Corn Percent (storage/usage)</i>
Minimum	24.0	8.6	220.0	1.87 %
Maximum	120.0	42.9	5500.0	59.23 %
Average	64.6	22.4	1213.9	7.79 %
Std. Dev.	27.6	10.1	1107.9	12.54 %
Sum	1448.0	514.3	27920.0	n/a

Variation in corn storage capacity among plants depends on production size and whether or not the individual plant depends on a local elevator for corn storage. Table 2 shows the range of processing capacity, corn usage, and corn storage capacity at individual plants. Total storage capacity at all of the plants is 27.9 million bushels, with an average storage capacity of 1.2 million bushels and 24.9 average days of corn storage. However, two plants have three to five times the average storage capacity (3.0 million bu and 5.5 million bu). If these two plants are not included in the analysis, then the others have a total storage capacity of 19.4 million bushels, average storage capacity of 1.0 million bushels, and 14 average days of corn storage (5% of annual use.)

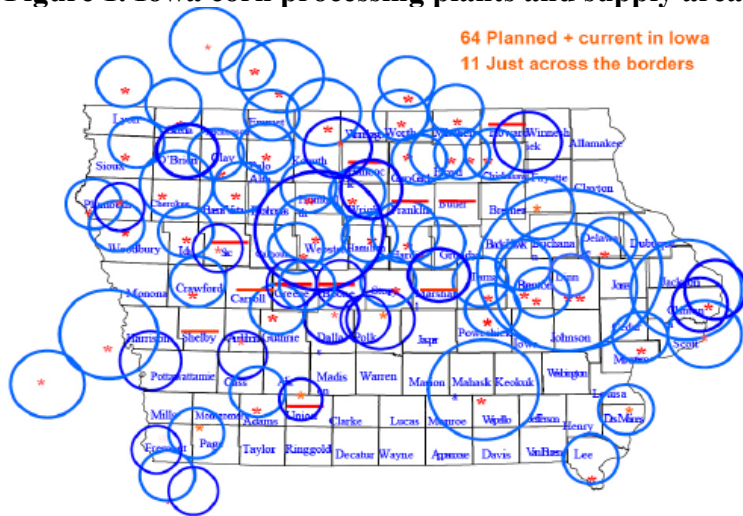
The “Corn Percent” figures shown in Table 2 are the ratios of corn storage capacity to total annual corn usage at individual plants. This ratio ranges from 1.87 percent to 59.23 percent, with an average 7.79 percent. Without the two “high storage capacity” plants included, the average is reduced to 4.38 percent. The plants with less storage might have less processing capacity, rely on local commercial storage, or plan to contract with farmers for on-farm storage. Higher corn storage capacity would be built for plants with fewer options of local commercial storage. Plants in regions with a high percentage of cash rented farmland should not expect widespread on-farm storage to be built, but instead would rely on local elevators for storage.

Of the ethanol plant managers interviewed, thirteen plan to build more storage at their plants, and one manager of an elevator that owns the nearby ethanol plant plans to add more capacity at the elevator. Five plants own or have special arrangements with local elevators for most of their corn storage. Twelve plants that rely mainly on farmer deliveries for processing maintain an average on-site storage capacity of 1.0 million bushels, typically in two concrete silos.

Most dry-grind ethanol plants do not receive inbound grain shipments by rail. This would suggest that shipments would need to be carefully scheduled to avoid long delivery lines at the ethanol plant at harvest. Three ethanol plant managers mentioned that they are offering price premium incentives for deliveries at specified times.

The rapid growth of local processing is beginning to foster competition in some areas for corn. Joining the competition is the demand from livestock feeders, some of which is offset by the availability of distillers grains, and from export customers. Figure 1 shows corn ethanol plants (current and planned) in and around Iowa that would draw corn from Iowa farms, and points out that competition will be particularly high in north central and east central Iowa. This map was created in an earlier study; some capacity has been announced since its publication, and some plans have been halted. This study attempted to reconcile several sources to form a database that can be updated periodically.

Figure 1. Iowa corn processing plants and supply areas



Iowa Corn Processing & Ethanol Plant Locations, Actual & Planned, 8/25/06

Source: Robert Wisner, Department of Economics, Iowa State University, Ames, IA 8/06

Chicago Board of Trade corn prices at harvest in 2006 were higher than prices at harvest in 2005, presumably as a result of competition for corn. In fact, prices are higher than the USDA target prices for Loan Deficiency Payments, a phenomenon that has not happened in recent years at harvest. This and related industry reports suggest that marketing corn will require different strategies for farmers. One report in *Farm Futures* predicts that the market factors of “carry” (the difference between futures contracts for the same crop year) and “basis appreciation” (the narrowing of difference between cash and futures) could be advantages to farmers who store corn on-farm. In addition, commercial storage rates are rising, which will leave farmers without on-farm storage in a bind. (Suderman, 2006). Increasing commercial storage rates would more readily give grain handlers ownership of the corn sooner, which would in turn give them more flexibility, until and unless farmers add on-farm storage.

Truck/Rail Access

All ethanol plants have truck access for inbound grain and outbound products, and all but one of the plants interviewed have rail access for outbound products. Rail transport is the most efficient way to move ethanol to the East and West coasts and to Texas, Arizona, and Mexico. Officials from Union Pacific Railroad and Burlington Northern Santa Fe Railroad (BNSF) stated in a Des Moines Register article (May 31, 2006) that ethanol shipments had more than doubled in the past year. Union Pacific is investing in track projects near several Midwest ethanol plants to help speed shipments. BNSF started its “Ethanol Express” program in response to California’s switch from MTBE to ethanol as a gasoline additive, with the intent to run 95-car unit trains to buying stations in southern California. An Iowa Department of Transportation grant and loan program has provided funding to seven Iowa ethanol plants to build tracks that provide connections to rail lines for outbound products. The rapid increase in ethanol rail traffic comes at a time when other industries are also increasing rail shipments due to increased fuel costs. This led to concern by some plant managers about rail availability and the problem of smaller plants

filling unit trains. Interview responses showed that an average of 34.7 percent of ethanol produced was shipped by truck and 65.3 percent of ethanol was shipped by rail. (Table 3)

Table 3. Transportation Patterns of Ethanol Plants

	Truck		Rail	
	Average	Range	Average	Range
Corn (in)	100%	-	0.0%	-
Ethanol	34.7%	0% - 100%	65.3%	0% - 100%
DGS	44.4%	7% - 100%	55.6%	0% - 93%

Corn Quality

Opinions about corn properties and their effect on the process were reasonably consistent and support higher levels of acceptable quality than are typical in commodity corn markets. At this time, there is high competition for corn among ethanol plants and other users, so USDA Grade #2 corn is acceptable for ethanol processing. High moisture and damage levels are discounted or rejected and the reject levels are lower than those at most elevators buying for the commodity market.

Ethanol plant operators seek clean, dry corn with little or no damage and foreign material. The USDA Corn Grades provide a basis for determining quality, and all plants are accepting USDA Grade #2 Yellow Corn as the minimum quality grade for ethanol production. Other factors such as protein, oil and starch content might influence the process or yield, and some plants are measuring these factors by near-infrared analyzers in inbound grain. At this time, no plants are paying premiums for corn with desirable levels of protein, oil or starch. Only five plant managers said they were measuring fermentable starch routinely, and none had payment policies based on starch content. Currently, the most important goal for the ethanol plants is acquiring a constant supply of corn that meets USDA Grade #2 Yellow Corn specifications.

One Iowa plant is degerming corn prior to fermentation, so the oil and protein measurements may be of some value in marketing the germ products and bran cake. Nine plants routinely use protein, starch, and oil measurements in inbound corn to correlate with feed value of the distillers grains.

Broken corn, damaged corn, low test weight and the presence of mycotoxins all have some influence on the process or end products. Though broken corn is not a major concern for ethanol production, mold damage can have a considerable effect on ethanol yield. Low test weight also is considered to reduce ethanol yield because the kernels are not as densely packed with starch. Distillers grains are used in livestock feed, and different species have varying levels of sensitivity to mold toxins. The levels of fumonisin, vomitoxin, and aflatoxin can triple in the distillers grains, which makes it possible to quickly exceed USDA mycotoxin limits for certain livestock species. New uses in human food and pet foods are being explored, too, which would require that ingredients meet the mycotoxin limits enforced by US Food and Drug Administration (i.e. 20 ppb for human and pet food uses.)

The key USDA quality factors that affect some part of the process are:

- Moisture – most plants discount above 15.5 percent with 17 percent moisture as the limit; two plants accept up to 18 percent moisture.
- Test Weight – most plants discount below 56 lb/bu; about half of the plants will not accept Test Weight less than 54 lb/bu.
- Damage – accepted up to 10 percent, but discounted above five percent.

These contrast with the typical “no reject” approach of most elevators.

Mycotoxin levels are tested at 13 plants, usually on a weekly basis on selected loads; however only two plant managers stated that they tested all inbound corn for mycotoxins. All managers said they would increase test frequency if there was a suspected problem in the current harvest year.

Co-Products

Carbon dioxide (CO₂) is one of the co-products of drymill ethanol production, produced during the fermentation stage of ethanol production. The carbon dioxide is cleaned of any residual alcohol and can be compressed and sold to other industries. Carbon dioxide is used to carbonate beverages, to manufacture dry ice, and to flash freeze meat. CO₂ is also used by paper mills and by other food processors. (American Coalition for Ethanol, 2006) At present, most plants in Iowa do not sell the CO₂, but one Iowa plant captures its CO₂ to sell to a local dry-ice manufacturer, and four other plants are negotiating with potential buyers.

Distillers Grains are currently being produced in abundance, and the industry is scrambling to find new markets or new uses within the plant for the product. Distillers grains are the spent corn solids of dry-grind ethanol processing. DGS are a high protein, high fiber feed product that may or may not contain much fat, and are usually most suitable for ruminants, primarily dairy and beef cattle. The nutrient percentage levels in distillers grains are roughly three times the levels in whole corn due to concentration during processing. Table 4 shows typical nutrient values of various DGS coproducts.

Table 4.* Nutrient Value of Selected Dry Grind Ethanol Coproducts.

	Distilled Dried Grains Solubles (most common)	Condensed Distillers Solubles	Wet Distillers Grains	Modified Distillers Grains
Moisture, %	11	55 - 75	64 - 69	49 - 54
Protein, %	31	14 - 23	32 - 36	26 - 32
Fat, %	11	15 - 24	9 - 12	11 - 16
Fiber, %	7.2	--	--	5 - 15
ADF, %	12	--	10 - 12	11 - 18
NDF, %	45	--	30 - 50	35 - 50
TDN, %	87	95 - 120	90 - 110	90 - 110
NEm, mcal/lb	0.99	1.05 - 1.15	0.9 - 1.1	.9 - 1.1
NEg, mcal/lb	0.68	0.85 - 0.93	0.7 - 0.8	.7 - .8
Ca, %	.07	0.03 - 0.17	0.02 - .05	<.10
P, %	.77	1.3 - 1.5	0.4 - 0.5	.85 - 1.4
K, %	1.00	1.75 - 2.25	0.5 - 1	1 - 1.5
Mg, %	.30	0.65 - 0.9	0.2 - 0.3	.3 - .5
Na, %	.18	.2 - .4	0.1 - 0.2	.2 - .3
S, %	.68	.9 - 1.4	.4 - .6	.4 - 1.2
Fe, ppm	127	90 - 120	70 - 180	67 - 130
Cu, ppm	6	6 - 7	6 - 7	5 - 7
Zn, ppm	62	100 - 140	40 - 80	62
Mn, ppm	19	30 - 35	8 - 16	27

*All values expressed on a dry matter basis

Source: Dan Loy, Animal Science Dept., Iowa State University in *Ethanol Co-Products for Cattle (IBC-18)*, Iowa Beef Center.

Currently, distillers grains sales represent about five percent of revenues to ethanol plants; whereas, when ethanol demand and prices were lower, distillers grains represented up to thirty-five percent of plant revenues. (Ives, 2006). Ethanol plants sell distillers grains through either in-house merchandisers or independent commodity brokers; interviews showed that merchandising efforts were evenly split between in-house marketing personnel and outside brokers. Some companies maintain tight quality specifications for their branded DDGS and also seek to maintain closer relationships to their customers, so they choose to employ their own in-house merchandisers. Though long-term booking arrangements with users (3-12 months) were less common than buying on the spot market, merchandisers stated that long term contracts were becoming more common and that they encourage long term contracts for beef cattle and dairy customers. One merchandiser stated that hog producers were more apt to buy short-term (weekly), but that they might become interested in longer term contracts if price and quality were more stable. Many plant managers stated that educational efforts need to be directed toward helping livestock feeders understand how to substitute distillers grain products for other feed ingredients.

Feeders of beef cattle generally prefer distillers grains that retain the oil (from corn that is not degermed before processing) as beef cattle need the energy value of fat to maintain acceptable rates of gain. (McMurry, 2006) However, if other feed ingredients contribute fat to the ration (such as bran cake) then a lower fat DGS is preferred. Dairy cattle feeders prefer distillers grains that are lower in fat content to avoid a decrease in feed intake and lower milk production. (Kalscheur, 2006) In DGS, sulfur and phosphorus both need to be closely monitored. Sulfur fed at high levels can cause illness and death. Phosphorus levels can be counterbalanced by maintaining sufficient calcium; however, excess phosphorus in manure is a big problem for waste disposal and is a significant consideration for large feedlots. If ethanol plants were able to reduce phosphorus levels in DGS, the resulting feed product would allow livestock feeders more flexibility in applications for cattle as well as other species, such as swine.

Together, Iowa's ethanol plants sold 25 percent of their distillers grains wet at an average moisture content of 56 percent moisture (range 50% - 65%) , and 75 percent of the DGS were sold dry at an average 10.3 (range 9% - 13%) percent moisture. This is a larger moisture range than Table 4 would indicate, which then means higher variations in "as fed" nutrient levels.

"Wet cake" distillers grains, because of the relatively high moisture content, are vulnerable to spoilage within a matter of days or a few weeks, depending on the ambient temperature, so it is important to minimize the transport distance to the user; in contrast, dried distillers grains (DDGS) can be stored for several months and therefore can be shipped long distances. Plants have storage for, on average, 5.1 days of production of wetcake and 8.4 days of production of dried grains. When compared to annual DGS production, Iowa plants had storage capacity for 2.6 percent of annual production. The ratio of storage capacity to annual production is more limiting than that for corn storage, where on-site corn storage was available for approximately 7.8 percent of total corn used by the plant.

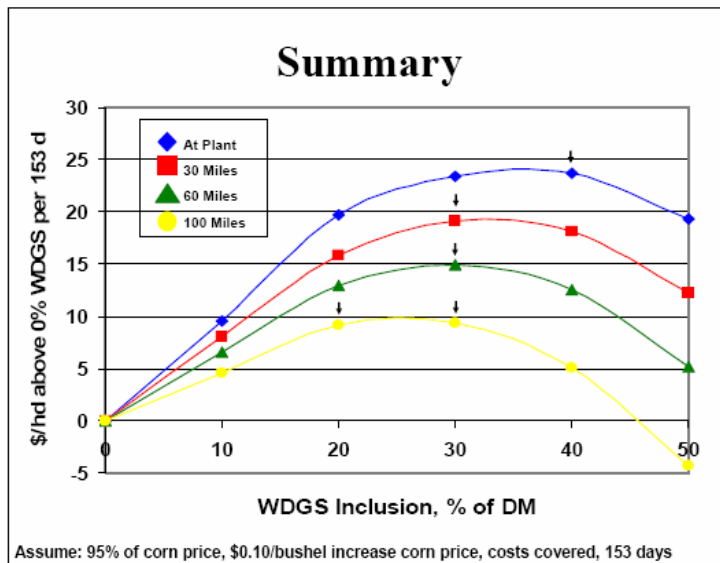
Iowa's ethanol plants have enough drying capacity to dry at least 80 percent of the distillers grains they produce. Plant managers stated that, generally, two factors influence how much of the distillers grains they choose to dry; cost of energy (usually natural gas) and available markets. Dried distillers grains are shipped mainly by rail to dairies and feedlots in California, Nebraska, Oklahoma, Arizona, Texas, and Mexico. DDGS from one company are loaded on a barge for export, and another company has an arrangement with a nearby feed mill for 80 percent of its DDGS production. Dried distillers grains can be stored and shipped to distant markets; yet, the most economical product for the ethanol plant to sell is "wet-cake" distillers grains because of the cost savings in not having to dry the product. Managers estimate that 35-40 percent of a plant's energy costs are associated with drying of distillers grains. Markets for wet-cake are usually within a 50-mile radius of the plant and they are shipped by truck.

Merchandisers seek local markets for wet-cake because it is expensive to ship and cannot be stored. For these reasons, owners of ethanol plants build limited storage for "wet cake", an average of 5.1 days of production. However, cattle feeders are rapidly adopting

“wet cake” distillers grains as the major ingredient in diets; in addition, some feeders have found it easier to get calves “on feed” using wet-cake DGS. (Couser, 2006) One Iowa ethanol plant is located adjacent to a beef cattle feedlot, thus taking advantage of the ability to sell approximately 20 percent of its distillers grains on site as wet-cake.

Figure 2 shows the relative value of feeding wet cake at the plant location and at varying distances from the plant. This data shows that the closer the cattle are located to the ethanol plant, the more profitable the feedlot operation.

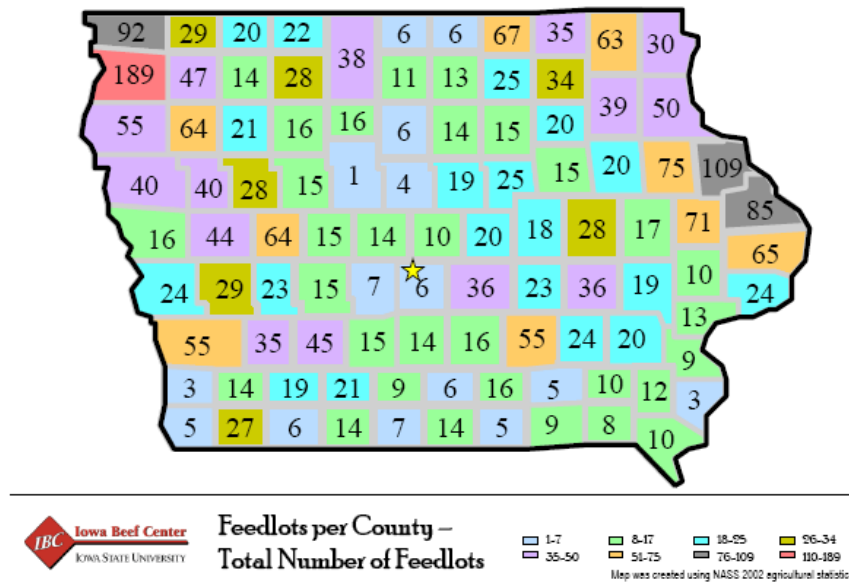
Figure 2. Effect of feeding wet cake in beef cattle



Source: 2006 Nebraska Feed Report

Iowa’s ethanol plants are heavily concentrated in the north central and east central parts of the state. In north central Iowa, there is competition among the plants for corn, and competition from swine producers as well. In east central Iowa, there is yet more competition from corn wetmillers for the corn and competition with corn gluten meal and corn gluten feed for markets for the co-products. Figure 3 shows the total number of cattle feedlots per county in Iowa. Though some counties in western Iowa have a relatively high concentration of cattle on feed, plant managers stated that there are not enough local markets for wet-cake distillers grains, so some wet-cake is sold to feedlots in neighboring states.

Figure 3. Feedlots per County - Iowa



Source: Iowa Beef Center, Iowa State University

John Lawrence, director of the Iowa Beef Center, estimates that Iowa has approximately one million cattle on feed at any one time in Iowa. Depending on inclusion rate of distillers grains in the diet, a plant that produces 45 million gallons of ethanol annually can produce enough distillers grains to support 85,000 – 225,000 cattle. These estimates would suggest that it would take as few as four plants or as many as twelve plants to support all of the cattle on feed in Iowa. Though plant managers attributed most of the current use of distillers grains to substitution for other feed ingredients, plant managers in north central and northwest Iowa noted increases in dairy and feedlot cattle. Plant managers in southwest Iowa noted increases in cattle feedlots and cow-calf operations.

Distillers Grains - Quality issues

One of the problems that users of distillers grains encounter is the lack of standardized quality measurements for the nutrient characteristics in distillers grains. Distillers grains produced at different plants vary in texture, color, and nutritional profile, mostly due to differences in individual plant operations. Even though all plants are using the same feedstock, USDA #2 Yellow Corn, there are operational differences that affect nutrients; for example, high drying temperatures denature proteins and make some nutritionally unavailable. Other grain feedstocks, such as wheat, produce a much different distillers grain product in terms of color, texture, and nutrient profile, as would other biomass.

Industry data collected by Dr. Kenneth Kalscheur at South Dakota State University shows that nutrient composition in DGS from several upper Midwest ethanol plants varied significantly; for example, crude protein ranged from 27 to 35 percent (100 percent dm). (Kalscheur, 2006). Anecdotal reports from feeders agree that protein levels can be extremely variable. Earlier this year, the USDA Grain Inspectors, Packers and Stockyards Administration (GIPSA) considered establishing standards for quality in distillers grains as is done for commodity grains, but the industry persuaded GIPSA

officials that standards would not benefit either the buyer or seller. (USDA GIPSA, 2005) Instead, inherent differences among distillers grain products were considered beneficial as long as the sellers could provide an accurate description of nutrient content of their particular product to the buyers. To insure this, a standardized measurement system is needed.

Another hurdle that needs to be overcome to encourage use of distillers grains is flowability. Shipping long distances by rail and storing in silos and bins causes caking and bridging to occur, which then make the product difficult to load and unload. Severe damage in rail hopper cars occurs when workers pound the outer sides of cars to release the caked DDGS, and workers risk injury and death by climbing inside hopper cars and bins to attempt to release the grains. Dr. Kurt Rosentrater at USDA ARS Northern Grain Insects Research Laboratory is currently studying the physical causes affecting flowability. He states that “Flowability problems may arise from a number of synergistically interacting factors, including product moisture, particle size distribution, storage temperature, relative humidity, time, compaction pressure distributions within the product mass, vibrations during transport (i.e., rail shipping), and/or variations in the levels of these factors throughout the storage process.” (Rosentrater, 2006)

Plant managers were asked to suggest potential new uses for distillers grains. The most common responses were to burn distillers grains for fuel to operate the plant or to use them as fertilizer. Opportunities to use distillers grains in livestock feed are being explored by public and private research groups, and recommendations are available for inclusion of wet and dry distillers grains in ruminant diets (beef, dairy, and sheep) and for dry distillers grains in swine and poultry diets and in pet foods. Uses in human foods, such as baked products and pasta, are being explored as well. (Rosentrater and Krishnan, 2006)

Industry challenges

Through the interviews, plant managers were asked to share concerns and challenges for Iowa’s ethanol industry. The major concern was each plant’s ability to access enough corn to keep it operating at the rated capacity, at minimum. Following closely was the concern over the excess capacity of distillers grains and the need to find new markets. Plant managers thought that educators could be extremely helpful in showing livestock producers how to use distillers grains in feed mixes, and that researchers should try to solve the flowability problems with distillers grains and create a uniform measurement system for nutrient quality. Adequate rail service to transport both ethanol and distillers grains was another concern that will require cooperation between rail companies and ethanol companies.

More than half of the plant managers stated that the threat of increasing environmental regulations was a concern, both from the standpoint of plant emissions (carbon dioxide and steam) and manure runoff from feedlots. They encouraged Extension personnel to work with feedlot managers to develop ways to mitigate runoff problems, and to explore new uses for carbon dioxide and waste heat.

Worker training was seen as a major area in which Iowa needs to dedicate resources. Ethanol plants usually seek process engineers to manage general plant operations, but the technical personnel who serve as shift supervisors, quality control managers, corn acquisition personnel, and co-product merchandisers also need general background in life sciences and/or marketing and specific higher level training in their areas of responsibility. “These are good paying jobs, particularly in rural areas,” said one plant manager, “but it is difficult to find one person who has all the background he/she needs for a certain job.” One strategy employed by plant managers is to leverage skills in personnel management with specific scientific/engineering skills across a group of people in the organization, thus creating more of a team approach.

Summary

The production of ethanol from corn has expanded local processing opportunities for Iowa’s corn crop and has markedly changed corn distribution patterns. The potentially huge demand for corn by ethanol processors is changing producers’ routines of storing, selling, and managing harvested corn as ethanol plant managers seek to access the majority of their corn supply directly from farmers. However, most ethanol plants had absolute limits (typical 18% moisture, 10% damage) on acceptable corn quality, unlike the general acceptance policies of traditional elevators. More attention will need to be paid to stored grain quality, over a longer period, than current markets require.

Plants in or near Iowa operating or under construction will consume 1.61 billion bushels of Iowa corn. If all the ethanol plant projects that have been announced are actually constructed, ethanol production would require 2.68 billion bushels of Iowa corn. This is an aggressive, maximum use scenario because construction of all announced plants would require continuation of favorable economic conditions in corn and fuel markets. This report does not evaluate the likelihood of their construction.

Plants had onsite storage for about 5% of annual corn use and 2.5% of annual distillers grains production, which makes consistent logistics a major need. Distillers grains, the co-products of ethanol processing, are being produced in amounts that outrun their current uses. Currently, sales of distillers grains represent only about 5-10 percent of ethanol plant income, but they are produced in such large amounts that plant managers need to find new markets or uses for them within the plant. The availability of distillers grains could encourage substantial growth in Iowa’s cattle and dairy industry. Distillers grains can be used in non-ruminant diets as well, and potentially in human foods. Non-food uses being explored include plastics, building materials, fertilizer, and energy generation.

Related challenges identified by ethanol processors include securing adequate rail service for regular shipments of both ethanol and distillers grains. Increased environmental regulations were also a concern. The need for ongoing training for current and future ethanol plant workers was stressed by managers, pointing to Iowa’s regents universities, community colleges, and Extension to take this responsibility.

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