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Future Patterns of U.S. Grains, Biofuels, and Livestock and Poultry Feeding Summary

By Robert Wisner, David Anderson, Ronald Plain, Don Hofstrand, and Daniel O'Brien

A project financed by the Institute for Feed Education & Research (IFEEDER) on behalf of the American Feed Industry Association (AFIA) and The Council on Food, Agricultural and Resource Economics (C-FARE)

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Report Summary: Future Patterns of U.S. Livestock and Poultry Feeding

In this report, we have reviewed recent trends in the U.S. and the global bioenergy, grain, feed, and livestock industries. The report focuses on the impact of development of the U.S. bioenergy industry on grain and feed availability for the livestock sector as well as industry profitability, production, efficiency, demand, and the future of the feed-livestock sector. Bioenergy likely will continue to be a driving force influencing the future direction of the feed and livestock industries.

We focused on the feed-livestock industry's adjustments to the new dynamics of the feed and grain sectors, how the industry has and will be affected, and some key challenges to monitor. Our focal points include: 1) grain and livestock production efficiency; 2) future bioenergy production; 3) rapid foreign economic growth, especially in East Asia, with its implications for dietary change, demand for feedstuffs, and feed availability; and 4) long-term challenges, including global population growth, increased foreign consumption of livestock products, cropland constraints, climate change, and related issues.

Bioenergy Development Drivers

It is beyond the scope of this report to evaluate the costs and benefits of biofuels, except to acknowledge that some recently highlighted benefits will influence policy decisions. An objective analysis of long term costs and benefits of U.S. ethanol production would require comparing the direct positive impact of ethanol on U.S. consumers' fuel expenditures with the negative impacts on the feed, livestock, and food sectors and food costs.

On the benefit side, a recent study by the Center for Agricultural and Rural Development (CARD) at Iowa State Universityⁱ indicates the growth in U.S. ethanol production reduced wholesale gasoline prices by an average of \$0.29 per gallon from January 2000 to December 2011. In 2011, increasing ethanol production and higher crude oil prices pushed the price reduction to \$1.09 per gallon, indicating that consumers benefit more from ethanol as gasoline prices rise.

The large 2011 price effect comes partly from reducing stress on the nation's limited petroleum refinery capacity, which is expected to decrease further in late 2012. In 2011, the U.S. Energy Information Administration (EIA) reported that the U.S. consumed 134 billion gallons of gasoline domesticallyⁱⁱ. Applying the CARD estimates, the direct public benefit of ethanol production in 2011 was about \$146 billion dollars. Over 2000-11, estimated benefits averaged \$35-\$40 billion annually.

U.S. government expenditures for U.S. ethanol production subsidies of approximately \$5.1 billion dollars in 2009ⁱⁱⁱ partially offset the average benefits from lower gasoline prices. In addition, ethanol policies that contributed to higher corn prices reduced farm program expenditures. Higher corn prices, however, have increased costs to the feed-livestock sector and have contributed to higher food costs.

The estimated benefits from ethanol production will be a major factor in developing and debating future biofuel policy options. We expect current U.S. ethanol and biodiesel policies and mandates prescribed through 2022 by the 2007 Energy Independence and Security Act^{iv} will remain in effect.

U.S. corn use for ethanol production increased by 4.42 billion bushels or 623% from the 2000-01 to 2010-11 corn marketing years. At the same time, total use of U.S. corn for feed declined by about 1.27 billion bushels. We estimate that approximately 55% of this decline was offset by increased feeding of distillers' grain and solubles (DGS), the major by-product or co-product of the ethanol industry. Other non-ethanol and non-feed uses plus exports declined by 182 million bushels.

U.S. corn going into domestic food processing and non-ethanol industrial uses accounts for about 8 to 10 percent of the total demand for corn and has increased by only 55 million bushels since 2000-01. Therefore, the largest adjustment to increased use of corn for ethanol and tightening supplies was in domestic livestock feeding. A number of developments contributed to the explosive biofuels demand growth, including higher fuel costs that increased the energy value of corn

and soybeans, the September 11, 2001 crisis and government programs that support U.S. energy independence, such as mandated volumes of ethanol and biodiesel blending with motor fuels, a blenders' tax credit that expired at the end of 2011, and efforts to reduce greenhouse gas emissions.

Easing of Tight Feed Supplies Anticipated

In the next three to seven years, provided U.S. corn yields return to their longer-term upward trend, corn supplies appear likely to be more adequate than in the past few years. Ethanol blending mandates will increase more slowly from the current 13.2 billion gallons to a maximum of 15 billion gallons in 2015. To meet these mandates, about 380 to 400 million bushels more corn will be needed in 2015 than are projected to be processed into ethanol in the 2011-12 corn marketing year. From 2015 onward, the ethanol mandates remain constant.

Corn processing for ethanol will increase more slowly in the next few years. At the same time, increased U.S. corn yields should provide more adequate corn supplies for the livestock sector. However, when U.S. or major foreign producer crop yields are low, the biofuel mandates and highly inelastic demand for biofuel will set the stage for additional sharp feed price spikes. Feed costs also will be influenced by the price of crude petroleum and gasoline.

Beyond the Seven-year Horizon

At least two major uncertainties will need to be monitored by the feed-livestock sector beyond 2020. The first is China's demand for corn and the second is the possibility of a second-stage growth in corn processing for biofuel.

China appears to be on the verge of becoming a major corn importer, as it is for soybeans. Rapid growth in China's economy, rising consumer incomes, and urbanization are bringing rapid shifts in diets from grain to increased consumption of animal products. Because China's cropland base is limited, U.S. exports increased to an estimated 200 million bushels of corn in the 2011-12 marketing year – despite record Chinese corn yields and production.

USDA's 10-year global economic model projects Chinese corn imports of 9 million tons or about 350 million bushels in 2016-17, with a doubling of its imports by 2021-22. Chinese soybean imports accounted for about 60% of the world total and about 60% of U.S. soybean exports in 2011-12. China's corn imports also will be affected by how rapidly its farmers can adopt new corn genetics, increase crop fertility, improve weed control, enhance water management, and adopt other technology to increase corn yields. Reported Chinese average corn yield was about 56% of a normal U.S. corn yield in 2011-12.

It also will be important for the feed and livestock industries to monitor the development of biobutanol. Several U.S. ethanol plants have announced that they are in the initial stages of either converting plants to biobutanol production or adding a biobutanol production unit to the plant. Biobutanol can be produced by a corn fermentation process, with DGS as a co-product. Biobutanol may offer opportunities for the biofuels industry to move beyond the blend wall since it does not require engine modifications and can be shipped in petroleum pipelines. As this report was being written, no economic analysis of biobutanol was available.

Bioenergy Impacts in the Livestock Sector

The rapid increase in corn-starch ethanol production since 2005, along with increasing Chinese soybean import demand^v have had a significant impact on U.S. grain and livestock enterprise profitability as feed costs have increased and become more volatile.

High feed prices, while not the sole cause of the intermittent periods of financial losses, down-sizing, and restructuring that have recently occurred in the U.S. livestock industry, have been the primary contributor in the poultry and beef industry. Species with shorter production cycles (poultry, followed by pork) have been able to manage and adapt to chang-

ing feed conditions more quickly than those with longer response times (beef and dairy). Looking to the future, these input market cost dynamics are expected to continue to favor species that are more flexible and quick-responding.

If not for the positive impact of strong exports on prices in the last few years, financial losses to the livestock sector would have been even more severe. In spite of, or perhaps at least partly because of, the financial pressures placed on U.S. livestock producers from rising feed prices, the drive toward increasingly efficient cost-reducing livestock production will continue to be a primary means of the poultry and livestock sectors adjusting to the biofuels expansion and international competition.

Adjustments by Species

Adjustments of the livestock sector to dramatically higher and more volatile feed costs, the severe 2010-12 Great Plains drought and other developments vary by species.

Pork — Pork producers have enjoyed relatively steady decades-long growth. If U.S. corn yields are near normal in the next three to seven years, that trend will likely continue and will allow further increases in production and may give pork a slightly larger share of the domestic meat market. Pork producers have a long history of increasing production efficiency which will continue in the years ahead. Any structural changes in the pork industry are expected to be minor in the next three to eight years. Global demand for U.S. pork has created an important and expanding export market. Current export markets absorb about one pound of U.S. pork out of every five produced. Strong export demand has helped to strengthen hog prices and assist the pork industry in coping with higher feed costs. The pork export market is expected to continue expanding.

Dairy — Dairy farmers recently experienced a period of severe losses stemming from rising feed costs and reduced exports. However, after a year of some financial recovery in 2011, the industry is again facing stress from low milk prices and high feed costs. In the next several years, if current expectations of much slower ethanol demand growth and increasing U.S. corn yields materialize, the dairy industry will again continue long-term expansion and increases in efficiency and productivity.

Beef — Cattle have the advantage of being able to use grass and other roughages produced on range and pasture lands unsuitable for cropping. Cattle producers also are able to use crop residues such as corn stover and ethanol co-products, to lower production costs. Cattle's ability as ruminants to use forages provides flexibility in that only the finishing period in beef production is grain-based, not the entire production cycle as with other species.

Cattle are able to use DGS more effectively than monogastric species which may give beef producers with an advantage over pork and poultry as more ethanol plants remove corn oil from DGS. Corn oil is being removed to provide a feedstock for reaching government biodiesel and advanced biofuels mandates. Oil in the DGS provides energy for livestock and poultry rations. Removing some or all of it requires changes in ration formulations to adjust for the lower energy content of de-oiled DGS. Ruminants, unlike poultry and hogs, are able to convert fiber in DGS into energy.

Beef cow inventories and production have declined for several years due to the economic transition to higher costs. The downturn was accelerated by the severe southern Plains drought of 2010-12, which will almost certainly result in reduced numbers of cattle being grain fed and lower beef production in the next few years. If adequate feed supplies are available at reasonable cost in the future as currently anticipated, a cyclical upturn in beef cow numbers and beef production can be anticipated. However, the cattle industry's longer biological production cycle and greater grain requirements per pound of meat produced than other species create some disadvantages for the industry. These aspects of production, especially with high feed costs, will increase pressure on the industry to increase its production efficiency and feed conversion efficiency.

Poultry — If feed costs move up to unprofitable levels, the poultry industry is capable of adjusting more rapidly than producers of other species. That is because a short biological production cycle allows the poultry industry to quickly reduce production and wait for improved profit margins. The poultry industry also has greater grain-to-meat conversion

efficiency than either pork or beef. These features likely will allow the poultry industry to grow more rapidly in the years ahead than the red meat industry, as well as to adjust more quickly to changing feed market conditions. Domestic per capita consumption of broilers has increased almost steadily for several decades and that trend is expected to continue for the intermediate future.

De-oiled DGS and Research Needs

De-oiled DGS is a relatively new development stemming largely from government blending mandates for biodiesel and advanced biofuels. Biodiesel currently is the only U.S.-produced advanced biofuel produced in large volumes for commercial sales. As advanced biofuel mandates increase in the next ten years, greater production of de-oiled or partially de-oiled DGS is almost certain. For the feed and livestock industries, additional research on how to most effectively feed this product will be important.

A large and expanding DGS supply has partially reduced corn use in the beef industry as well as other livestock sectors and has helped control costs. However, DGS prices are closely related to corn prices and have risen in response to higher prices for corn. Even with extensive DGS feeding, the beef industry has been stressed by higher feed costs and the need for adjustments in rations and production levels. Beef cattle numbers are cyclical, and as beef profitability declined in the past few years, cow owners reduced their herds. With a time lag, easing of feed cost pressures may set the stage for a future increase in beef production.

Longer Term Challenges

Looking ahead two to three decades, the feed-livestock sector will face a number of other important issues and potential challenges, including global population and income growth, constraints on global crop acreage, the need to increase grain yields, foreign biofuels mandates, possible large-scale cellulosic ethanol production, environmental concerns, and climate change issues.

Food-Population Issues

By 2050, two billion more people are expected in the world, for a total of nine billion. Most of the growth will occur in developing countries, while some industrialized countries will lose population. Much of the population growth will occur in countries with limited arable land so that more food or feed will need to be imported.

- If recent strong economic growth in developing countries continues, much of the world's population will move from poverty into the middle class, resulting in less direct human grain consumption per person and more grain consumed in the form of animal products.
- Higher feed grain production to meet dietary changes will occur from increased yields and modestly expanded acreage. Most of the increased output will need to come from higher yields. Maintaining or increasing agricultural research investments will be critically important in generating the required productivity growth.
- Expanding crop production will place additional stresses on water, fertilizer, agricultural chemicals, fuel, and other global resources.
- In this environment, the long-term role of biofuels is uncertain.

Possible Climate Change Issues

- The potential for “carbon fertilization” due to higher levels of atmospheric carbon dioxide to improve the yields of most crops except corn may place corn at a competitive disadvantage to other crops. It may result in a longer-term decline in corn acreage and production that would have a significant impact on the livestock feed sector.
- Possible sluggishness of crop enterprises in adjusting to climate changes could negatively impact yields in some regions, and in turn, the livestock-feed sector.
- Some researchers postulate more frequent extreme weather events caused by climate-change. If so, this would increase volatility and risk in crop yields, feed supplies and prices.



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