STATUS OF

Wisconsin Agriculture

2009

- **Status of the Wisconsin Farm Economy**
- **Situation and Outlook— Farm Products, Farm Inputs and the General Economy**
- ***Special Article*: Bioenergy and Agriculture in Wisconsin**

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Status of Wisconsin Agriculture, 2009

An annual report by the University of Wisconsin-Madison Department of Agricultural and Applied Economics, and University of Wisconsin-Extension Cooperative Extension

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Preface

Status of Wisconsin Agriculture is an annual agricultural situation and outlook report authored (except where noted) by faculty in the Department of Agricultural and Applied Economics. The report contains three parts. Part I provides a brief overview of the financial environment in the Wisconsin farming sector. In Part II, market analysts review current conditions in major Wisconsin commodity sub-sectors and offer their forecasts for 2009. Part III contains a special article that addresses the sustainability of biofuel development in Wisconsin from several perspectives.

Status of Wisconsin Agriculture may be downloaded free from the Internet in Adobe Acrobat® format at http://www.aae.wisc.edu/www/pub/. If you do not have internet access, contact Ms. Linda Davis, Department of Agricultural and Applied Economics, UW-Madison, 427 Lorch Street, Madison, WI 53706, to obtain a printed copy of the report.

The faculty of the Department of Agricultural and Applied Economics welcomes your comments and questions on material in this report. We also encourage your suggestions regarding rural Wisconsin issues that we might address in subsequent editions.

Acknowledgements

Funding for *Status of Wisconsin Agriculture* was provided by the University of Wisconsin-Madison Program on Agricultural Technology Studies and by generous contributors to the University of Wisconsin Foundation. We also wish to thank Diane Doering, designer and Bob Mitchell, editor, of the College of Agricultural and Life Sciences, UW-Madison for their assistance.

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January 2009

Status of Wisconsin Agriculture, 2009

Summary

It's an overused analogy, but when it comes to describing Wisconsin farm finances in 2008, there's no better comparison than a roller coaster. Net farm income hovered near the top at $2.3 billion, the second highest (to 2007) on record. But many farmers watched prices climb to historic levels during the first half of the year and then plunge during the second half. The price swing was especially dramatic for grains and soybeans.

Despite unprecedented price volatility, higher average commodity prices drove Wisconsin 2008 gross farm income $900 million higher than 2007, a new record. But the higher revenue was more than offset by much higher input costs, especially for fuels, fertilizers and animal feeds, which pushed net farm income more than $300 million below that of 2007. Farm input prices should ease in 2009, but so will prices for most farm products. Market analysts aren't sure which set of prices—commodities or inputs—will win the 2009 "how low will they go" race, making 2009 net income projections very iffy and farmers very apprehensive.

While Wisconsin farmers are justifiably nervous about economic conditions in 2009, as a whole they have a strong balance sheet to help them weather a financial storm. At the beginning of 2008, farm assets totaled $61 billion and farm debt was only $7.3 billion. Farm real estate made up almost three-quarters of Wisconsin farm assets. Farmland values have grown rapidly over the last five years, but will likely moderate in the near term because of lower commodity prices and possible restrictions on credit available to non-farm investors.

Review of 2008

The collapse of U.S. financial markets and the meltdown of the U.S. economy in the second half of 2008 had far-reaching effects on agriculture, some positive and some negative. The general collapse of commodity prices hurt grain and soybean producers' revenue expectations, but also cut oil-related input costs and the cost of feed for livestock, dairy and poultry producers.

Even though the prices for many farming inputs were easing at year-end, farmers paid much more for supplies and services in 2008 than in 2007. Fertilizer prices almost doubled, fuel prices were up 35 percent and seed prices climbed 26 percent. After showing very little change over the last five years, Wisconsin cropland rents jumped 18 percent, on average, in 2008, with much larger increases in some parts of the state's "corn belt." About the only good news on the cost side of the profit ledger was that interest rates remained low in 2008.

Dairy, the 800-pound gorilla among Wisconsin farming enterprises, did OK in 2008. Wisconsin all-milk prices for the first half of the year were above the strong prices of 2007, but fell increasingly short of 2007 as the year progressed. The average all-milk price for the year was about $19 per hundredweight, marginally below 2007's record $19.27. But by December, the milk price was $5 under 2007 and headed even lower. The fall-off in milk prices was due to an erosion of prices for most manufactured dairy products. Particularly painful for Wisconsin, year-end cheese prices were off more than 80 cents per pound from their June peak of $2.10, and whey prices had fallen by a third. Domestic dairy product sales were hurt by high retail prices early in the year and by the economic recession later in the year. U.S. dairy exports, which had seen decent prices and good volume through mid-year, turned sour in the fourth quarter as other suppliers displaced the U.S. in many foreign markets.

U.S. meat supplies were up 3 percent in 2008, with gains in all major species (beef, pork, broilers and turkey). But per capita meat consumption was down 4 pounds from 2007. Lagging domestic consumption was more than offset by strong exports, especially for pork. Exports absorbed nearly a quarter of U.S. pork production in 2008 and have accounted for all of the 3.6-billion-pound gain in production since 2003. Finished livestock and poultry prices (including eggs) were all higher in 2008 than 2007. But feeder cattle prices averaged lower because high feed prices cut the profitability of fattening cattle.

Grain and soybean prices in 2008 hit record highs but were extremely volatile. Wisconsin average corn prices ranged from $5.36 per bushel (August) to $3.70 (November). Wisconsin soybean prices peaked at $13.80 per bushel in July and fell to $9.00 in November. The national corn crop in 2008 was 1 billion bushels (8 percent) under 2007, while the soybean crop was up 9 percent. Wisconsin produced 7 percent less corn and 5 percent less soybeans. USDA estimates that farmers received a season average price of $4.20 per bushel for their 2007/2008 corn crop and $10.10 for their beans. Those prices were $1.16 and $3.67 per bushel higher than their respective averages for the 2006/07 crop.

Wisconsin apple production was down slightly in 2007. The tart cherry crop was all but wiped out by bad weather. The state's cranberry output was marginally above last year. Prices for all three major Wisconsin fruit crops were firm. Wisconsin potato production was down 8.5 percent in 2008 — too bad, because a short national fall crop has resulted in strong prices. Both sweet corn and snap bean production were up about 13 percent.

Prospects for 2009

Continued general economic malaise will loom over the agricultural economy in 2009. The biggest effect of the ongoing recession will be on food demand, both here and abroad. Obviously, people have to eat, but what and where people eat depends on how much money is in their pockets. The global reach of the financial crisis— along with the surprising strengthening of the U.S. dollar against other currencies — will negatively affect U.S. agricultural exports, meaning that more of what U.S. farmers produce will need to clear domestic markets.

Partly because of the effects of the recession and government efforts to mitigate its effects, most farm inputs will cost less in 2009. Fertilizer prices will drop because of lower natural gas prices (nitrogen) and a higher-valued dollar, making imports of potash cheaper. Oil prices are expected to stay low for much of 2009, reducing fuel costs, but could escalate by year-end. Farmland rents could increase some, but not nearly as much as they did in 2008. Interest rates will remain low, and credit should be readily available to farmers.

Milk prices will be lower in 2009, perhaps much lower if demand (domestic and foreign) for dairy products weakens further and conforming supply adjustments are slow to occur. But dairy farmers are already trimming herd size and making ration changes in response to rapidly thinning profit margins. Look for U.S. milk production to increase by less than 1 percent in 2009, with about a 1.5 percent increase in Wisconsin output to 24.8 billion pounds. The average Wisconsin all-milk price for the year will likely end up in the $15.00–$15.50 range. This could spell a difficult financial year for many Wisconsin dairy farmers unless feed or other costs fall further than we expect.

U.S. meat production will likely decline in 2009, a delayed response to very high feed prices over the last two years. Even though meat output will be down, cattle and hog prices are expected to drop slightly from 2008 because of weaker U.S. and foreign demand. Broiler prices should stay even with last year, and lower feed costs will improve profitability compared to last year's dismal bottom line. Turkey output will be lower in 2009, but large frozen inventories will likely limit any price gain. Changes in egg production and price will be small.

There is little current guidance on planting intentions for 2009 grain and oilseed crops, but regardless of intentions, price levels will not likely come close to the records set in 2008. Demand for the 2008/09 corn crop is expected to soften across all categories except ethanol, with exports down 26 percent and feed use down more than 10 percent. Still, USDA's December 2008 forecast indicates a season average corn price of $4.00 per bushel for the 2008/09 marketing year, down only $0.20 from 2007/08. Demand for soybeans is also expected to weaken in 2009, with exports expected to fall by 10 percent from last year. USDA's latest forecast is for a season-average 2008/09 soybean price of $9.00 per bushel, $1.10 under last year.

Bioenergy and Wisconsin Agriculture

This year's special article represents a departure from previous editions of Status of Wisconsin Agriculture. The UW-Madison Program on Agricultural Technology Studies commissioned several authors to address the broad topic of bioenergy development in Wisconsin and its implications for the state's agricultural sector. The authors were asked to go beyond the economic opportunities afforded Wisconsin farmers and other producers of biofuel sources and to look at how the inevitable expansion of bioenergy production can accommodate wide-ranging goals such as environmental protection, rural development and maintenance of cultural and social amenities. The resulting articles summarize the results of completed research, describe ongoing and planned research, and offer experiential insights on how bioenergy development can best be adapted to Wisconsin's diverse agriculture.

I. Status of the Wisconsin Farm Economy

Ed Jesse (608-262-6348)

Wisconsin Farm Income

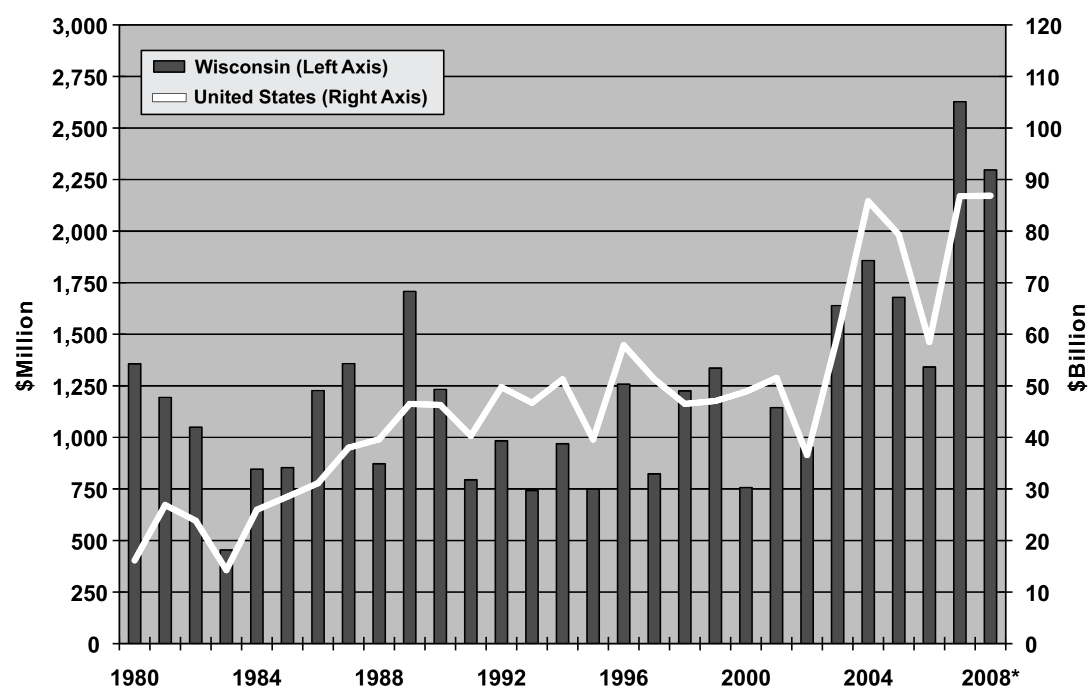
Wisconsin farmers' net income in 2008 was down about $330 million (12.5 percent) from 2007's record high. We estimate the state's 2008 net farm income to be $2.3 billion, which would still be the second highest ever recorded in nominal dollars and more than 50 percent above the 2000-2007 average.

However, 2008 was much different from 2007, which ended on a positive note of high and rising farm commodity prices pretty much across the board. In contrast, 2008 ended with falling farm prices and considerable apprehension about the effect of the global financial crises on food demand here and abroad. Compared to their 2008 highs, end-of-year U.S. farm prices for corn were down 35 percent, soybeans 40 percent, milk 15 percent and live cattle 12 percent.

The drop in net farm income was due entirely to higher costs incurred by Wisconsin farmers. Because of high commodity prices through mid-year, gross farm income was up over 2007 by $900 million. But the gain in income was more than erased by more expensive purchased inputs, especially fertilizer, fuels and animal feeds. Labor costs, rents, and depreciation were also well above 2007 levels.

In comparison to Wisconsin, 2008 U.S. net farm income is forecast to match the 2007 record. This distinction is attributable to the relatively large contribution of dairy income to Wisconsin gross farm income. Dairy was the only commodity sector to show a fall-off in the value of sales between 2007 and 2008.

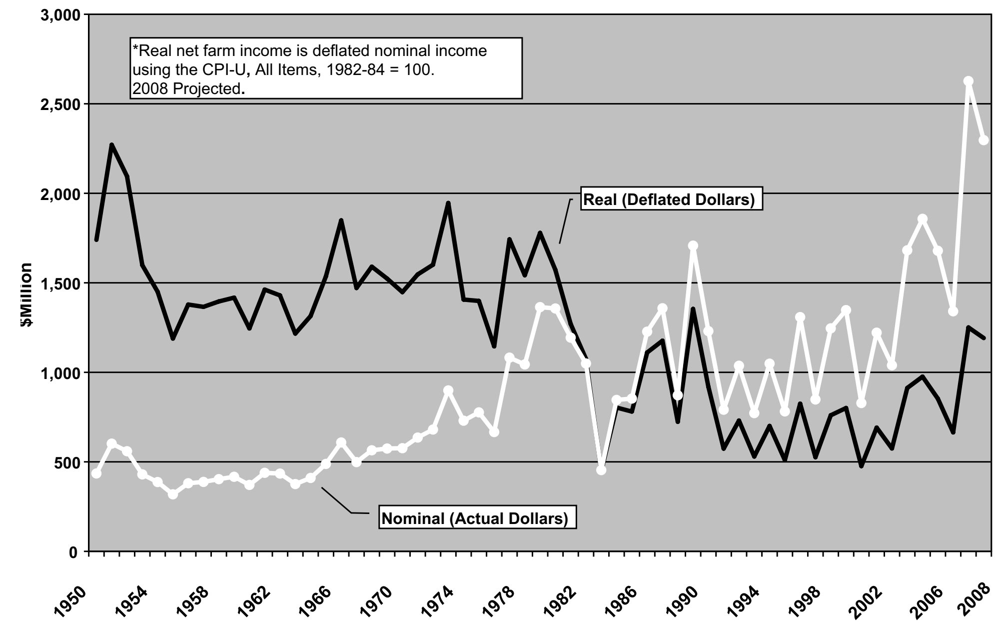
Net Farm Income: U.S. and Wisconsin



Derivation of Wisconsin Net Farm Income ($1000)

		2006	2007	2008 (Est*)
	Value of crop production:			
	Food grains	65,926	106,424	160,000
	Feed crops	1,025,374	1,314,898	1,860,000
	Oil crops	278,603	321,716	410,000
	Fruits and tree nuts	185,338	213,226	250,000
	Vegetables	418,519	432,654	480,000
	All other crops	298,153	265,572	280,000
	Home consumption	1,062	1,627	2,000
	Inventory adjustment	-141,581	2,214	0
	Total Crops	2,131,394	2,658,331	3,442,000
plus:	**Value of livestock production**:			
	Meat animals	1,047,307	1,025,669	1,060,000
	Dairy products	3,075,492	4,593,207	4,500,000
	Poultry and eggs	316,804	399,344	450,000
	Miscellaneous livestock	209,378	185,532	190,000
	Home consumption	16,062	17,229	20,000
	Value of inventory adjustment	3,053	-3,808	0
	Total Livestock	4,668,096	6,217,173	6,220,000
plus:	**Revenues from services and forestry:**			
	Machine hire and custom work	112,474	126,666	145,000
	Forest products sold	147,900	81,100	80,000
	Other farm income	175,343	209,511	220,000
	Gross imputed rental value of farm dwellings	891,831	1,019,808	1,070,000
	Total	1,327,548	1,437,085	1,515,000
equals	**Value of agricultural sector production**	8,127,038	10,312,589	11,177,000
less:	**Purchased inputs:**			
	Farm origin	1,357,663	1,568,965	1,900,000
	Manufactured inputs	1,149,913	1,329,628	1,800,000
	Other purchased inputs and Services	1,704,549	1,894,857	2,135,000
	Total	4,212,125	4,793,450	5,835,000
plus:	**Government transactions:**			
+	Direct Government payments	414,250	207,973	200,000
-	Motor vehicle registration and licensing fees	10,934	13,775	15,000
-	Property taxes	340,000	380,000	400,000
	Total	63,316	-185,802	-215,000
equals	**Gross value added**	3,978,229	5,333,337	5,127,000
less:	**Depreciation**	1,201,356	1,241,284	1,310,000
equals	**Net value added**	2,776,873	4,092,053	3,817,000
less:	**Payments to stakeholders**			
	Employee compensation (total hired labor)	663,151	783,326	820,000
	Net rent received by non-operator landlords	269,455	143,785	175,000
	Real estate and non-real estate interest	503,333	537,453	525,000
	Total	1,435,939	1,464,564	1,520,000
Equals	**Net Farm Income**	**1,340,934**	**2,627,489**	**2,297,000**

Wisconsin Net Farm Income: Nominal and Real*



While Wisconsin net farm income expressed in nominal dollars has grown substantially in this decade, the growth has been more modest when income is adjusted for inflation. When this is done, net farm income was higher in the 1950s, 1960s and 1970s than it has been since. Over the three decades ending in 1979, inflation-adjusted net farm income (using the Consumer Price Index as a deflator) averaged more than $1.5 billion. Since 1980, deflated Wisconsin net farm income has averaged about $850 million and ranged from $500 million to $1.3 billion.

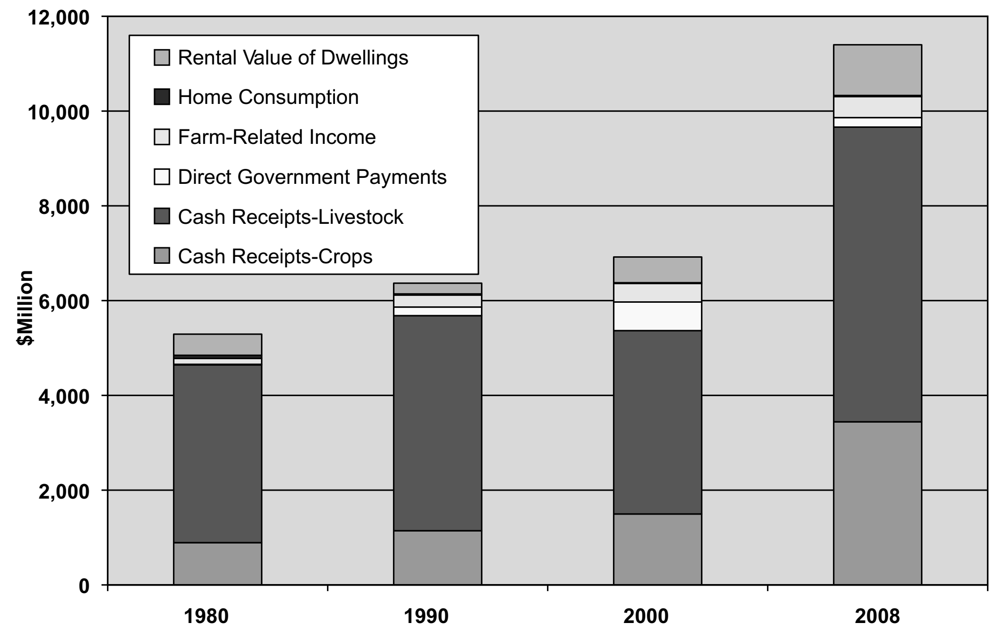
Income and Costs

The following charts show how elements of Wisconsin gross farm income and farm expenses have changed over time. Cash receipts from the sale of Wisconsin crops grew slowly from 1980 to 2000, but crop receipts in 2008 were 230 percent of those in 2000. This vividly illustrates the extreme run-up in corn, soybean and wheat prices during the early part of 2008. Cash receipts from sale of livestock products in 2008 were 160 percent of 2000, reflecting very strong milk prices through mid-year. Direct government payments in 2008 were only about a third of those received in 2000, since high market prices sharply reduced countercyclical government payments.

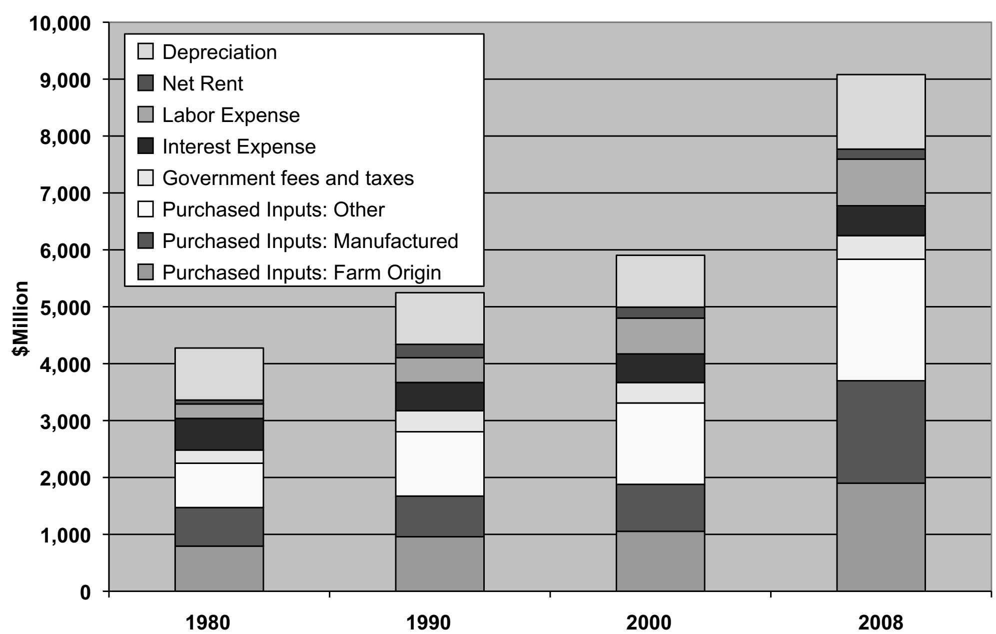
The imputed rental value of operator dwellings doubled between 2000 and 2008. This is clearly indicates the changing nature of "farmers" in Wisconsin, with a larger proportion of operators relying on non-farming occupations as their principal source of income. While technically defined as farmers because of their farm sales, these rural residents tend to have higher-valued homes than full-time farmers.

Total Wisconsin farm expenses also rose dramatically since the turn of the century. Purchased inputs cost $2.5 billion more in 2008 than in 2000. The largest increases were for feed, seed, fertilizers and petroleum products. Depreciation was up $400 million (43 percent) due to higher machinery costs. Labor expenses were up about 30 percent, due to higher wages and more use of hired labor. Other cost items showed relatively little change between 2000 and 2008.

Sources of Wisconsin Gross Farm income



Breakout of Wisconsin Farm Expenses



Wisconsin Farm Balance Sheet

USDA's Economic Research Service estimated that Wisconsin farmers held assets valued at $61 billion at the beginning of 2008. Of that total, $45 billion was in the form of land and buildings. Wisconsin farmers held debts totaling $7.3 billion, most as long-term real estate loans. The aggregate debt-to-asset ratio was 0.120 and the debt-to-equity ratio was 0.136. These values reflect a strong financial position.

There are noteworthy differences in the balance sheets of different types of Wisconsin farms. Using USDA-Economic Research Service farm typology, farms designated rural residences (comprising more than 60 percent of total Wisconsin farms) have a relatively high percentage of total assets in land. With the exception of financial assets, current assets are very small on a per farm basis compared to the average for all farms. These farms hold very little debt, yielding debt-to-asset and debt-to-equity ratios under 10 percent.

In contrast, commercial farms hold a relatively small proportion of their assets in land. These farms hold 46 percent of Wisconsin farm debt and debt is a significantly larger percentage of assets and equity. This by no means suggests a weak financial position; only that commercial farms are larger and so make greater use of credit.

Wisconsin Farm Balance Sheet by Farm Type, December 2007

	*Type of Farm**			
	Rural Residence Farms	***Intermediate Farms***	***Commercial Farms***	***All Farms***
No. of Farms	46,144	21,083	8,774	76,001
	---Million Dollars---			
Current assets				
Livestock inventory	199	242	366	807
Crop inventory	216	550	1,378	2,145
Purchased inputs	41	84	239	365
Cash invested in growing crops	8	15	47	70
Prepaid insurance	11	14	24	50
Financial & Accts. Rec.	717	829	520	2,066
Total Current	1,192	1,736	2,574	5,502
Non-current assets				
Investment in cooperatives	16	64	95	176
Land and buildings**	18,944	13,895	12,017	44,856
Farm equipment	1,791	2,440	2,696	6,927
Breeding animals	308	1,197	2,037	3,542
Total Non-Current	21,059	17,595	16,845	55,500
TOTAL ASSETS	***22,251***	***19,331***	***19,419***	***61,003***
Current liabilities				
Notes payable within one year	61	172	360	593
Current portion of term debt	152	196	355	703
Accrued interest	54	58	95	207
Accounts payable	46	42	89	176
Total Current	314	468	899	1,680
Non-current liabilities				
Nonreal estate	85	276	630	991
Real estate**	1,513	1,291	1,826	4,630
Total Non-Current	1,598	1,567	2,456	5,621
TOTAL LIABILITIES	***1,911***	***2,034***	***3,355***	***7,301***
EQUITY	***20,340***	***17,297***	***16,065***	***53,702***
Ratios: Debt to Assets	8.6%	10.5%	17.3%	12.0%
Debt to Equity	9.4%	11.8%	20.9%	13.6%
Real Estate as % of Assets	85.1%	71.9%	61.9%	73.5%

II. Current Outlook: Wisconsin Agricultural Commodities, Production Inputs and the General Economy

In this section, analysts offer their insights on economic conditions for Wisconsin agriculture. Forecasts are provided for major Wisconsin farm commodities, farming inputs and the general economy. Because of the far-reaching effects on agriculture of the global financial crisis that began in late 2008, we begin this section with a detailed discussion of the current macroeconomic environment and what to expect in 2009. Interested readers are encouraged to contact authors for more current or more detailed information regarding their analyses.

The General Economy and Agricultural Trade

Bill Dobson (608-262-6974)

Synopsis

What a difference a year makes! In early 2008, many economic forecasters thought that the U.S. economy was heading for period of slower growth and perhaps a relatively mild recession. Late in 2008, the forecasters' worst-case scenarios unfolded as the U.S. economy sank into recession.

How bad will the U.S. recession be? The possibilities are described in terms of how economic growth would look on a graph:

•**V-shaped recession:** Rapid downturn, rapid recovery early in 2009.

•**U-shaped recession:** Fairly rapid downturn, followed by a substantial period of shrinkage of the economy and a gradual recovery beginning late in 2009.

•**L-shaped recession:** Rapid downturn and a long period of decline or weak and erratic growth, with no strong uptrend in economic growth until 2010 or later.

Economic conditions have already deteriorated enough that a V-shaped recession can be ruled out. There will be no short, mild recession in 2009. Whether there will be a U-shaped (most likely outcome) or L-shaped recession in the U.S. depends on how soon the U.S. housing market stabilizes, the success of monetary and fiscal policy measures taken by the U.S. government and foreign governments, the strength of U.S. exports, oil prices and a host of other developments.

While a few observers predict a 1930s-type Great Depression, such a scenario seems highly unlikely. A depression will be prevented by government monetary and fiscal policy measures, federal deposit insurance for banks and credit unions, government bailouts for troubled companies posing systemic risk (those deemed too big or too important to fail), food stamps and automatic stabilizers operating in the U.S. economy, such as unemployment compensation.

While agriculture's prospects are stronger than those for the rest of the economy, U.S. farmers and agribusinesses will feel the impact of recession-driven declines in the demand for farm products in 2009. The lower demand will stem partly from a drop in U.S. agricultural exports from the robust ($115.5 billion) figure for fiscal 2008. Credit conditions in agriculture will continue to be generally more favorable than in other segments of the U.S. economy.

The global recession that began in 2008 will be a game changer, featuring global de-leveraging and re-regulation of financial markets in the United States.

Macroeconomic Statistics for the U.S. Economy

Year or Quarter	*Real GDP Growth*	*Inflation Rate (CPI)*	*Unemployment Rate*	*Oil Price*	*Housing Starts*
	%	*%*	*%*	*$/Barrel*	*Mil. Units*
2000	3.7	3.4	4.0	30.35	1.573
2001	0.8	2.8	4.7	25.96	1.601
2002	1.6	1.6	5.8	26.11	1.710
2003	2.5	2.3	6.0	31.12	1.854
2004	3.6	2.7	5.5	41.47	1.950
2005	2.9	3.4	5.1	56.56	2.073
2006	2.8	3.2	4.6	66.12	1.812
2007	2.0	2.9	4.6	72.18	1.341
2008 Q1	0.9	4.3	4.9	97.87	1.053
Q2	2.8	5.0	5.3	123.78	1.025
Q3	- 0.5	6.7	6.0	118.01	0.879

*Sources: Global Insight, U.S. Executive Summary, various issues 2008 and Wall Street Journal, various issues November and December 2008. Quarterly housing starts for 2008 represent estimates of annual figures for the series. Oil price is for West Texas Intermediate crude oil.

The U.S. Economy Sinks Into Recession

After growing by 2.0 to 3.6 percent during 2003 through 2007, the U.S. economy slowed in the first quarter of 2008 and began to sink into recession (defined as two consecutive quarters of negative real GDP growth) in the third quarter of 2008 (See table). The economy is now likely to record negative growth at least until late 2009 (U-shaped recovery). Specifically, U.S. real GDP growth is likely to drop sharply in the fourth quarter of 2008 to about -3.0 percent and remain in the -1.0 to -2.0 range from the first quarter through the third quarter of 2009 before turning positive in the final quarter. Whether the economy will follow the expected U-shaped trajectory or languish in recession for a longer period (L-shaped recession) depends partly on impacts of the positive and negative factors discussed below.

The Positives

The relatively short list of plus factors will cushion the downward impact of the recession.

Lower oil prices: After a meteoric rise to about $147 per barrel in early July 2008, oil prices fell below $50 per barrel by the end of the year in response to declining global demand for oil. The sharp drop in crude oil prices helped to push regular gasoline prices below $2 per gallon in most places in the United States, or to levels about half those recorded in July 2008. The lower oil prices function much like a tax cut for many consumers. The lower oil prices also reduce home heating costs and fuel costs for farmers, trucking companies and airlines.

While consumers warmly welcomed lower oil and gasoline prices, their happiness with the situation is likely to be short-lived. As soon as the U.S. and global economies recover, oil prices will again rise sharply. The strength of oil demand—especially from China and India—that produced high oil prices in July 2008 was not an aberration. Moreover, the recession-related decline in oil prices caused some oil exploration and alternative energy initiatives to be temporarily shelved. These developments will add strength to the upswing in oil prices once oil demand recovers.

Lower inflation: While inflation was relatively high in the third quarter of 2008, high prices are rapidly falling as a result of the recession. The record 1 percent drop in consumer prices in October 2008 foreshadows additional price weakness. Thus, U.S. consumer prices are likely to decline from the fourth quarter of 2008 through mid-2009 before increasing late in 2009. This will take pressure off consumer budgets. Stable or lower prices also will allow the Federal Reserve to keep the federal funds rate under 1 percent without fear of rekindling inflation.

A few analysts raised the specter of harmful deflation after the 1 percent drop in consumer prices in October 2008. This is possible, but not likely.

Large federal expenditures: The Economic Stimulus Act of 2008 provided federal income tax rebates and other economic stimuli for a cost to the government of about $152 billion in 2008. The tax rebates, many of which reached the hands of most U.S. taxpayers in the second quarter of 2008, helped to produce the 2.8 percent real GDP growth in that quarter.

A $700 billion Troubled Assets Relief Program (TARP) was signed into law by President Bush in October 2008. Initial TARP outlays were used to purchase preferred stock from banks and other financial organizations to help the firms rebuild their capital positions. Subsequently TARP outlays and funds from other government agencies (Treasury, Federal Reserve and Federal Deposit Insurance Corporation) were used to shore up markets for credit card receivables, auto loans and student loans, to rescue Citigroup and provide additional bailout funds for Freddie Mac and Fannie Mae. The massive infusion of funds and loan guarantees from the TARP and other government agencies helped to partially thaw frozen credit markets in October through December 2008, but banks and other lenders still exhibited strong reluctance to extend credit. More help for the U.S. economy should be available from the TARP in 2009. However, it is unclear how much of the $700 billion will remain unspent when the Obama administration takes office, since the financial rescue efforts are fluid and somewhat unpredictable.

Additional stimulus packages are almost certain to be passed early in the Obama administration if not before. As discussed later, General Motors, Ford and Chrysler are likely to receive bail-out funds or loans to keep them in business during the current recession. How many other industries will qualify for federal assistance is unknown. Financially strapped state and city governments are likely to queue up for federal assistance. Wisconsin's government officials may be part of the queue because the state government faces over a $5 billion budget shortfall for 2009-2011.

The Negatives

The minus factors underpinning the recession are powerful and potentially long-lasting. Many are connected to financial market problems which former Federal Reserve Chairman Alan Greenspan call a "once-in-a-century credit tsunami."

A troubled residential housing market: The current recession originated in large part with lending practices in the mammoth ($11 trillion) U.S. residential mortgage market. The U.S. housing bubble, which began in the early 2000s and which burst beginning in 2006, was fueled by low mortgage interest rates, low or zero down payment requirements, interest-only mortgages and even a few NINJA (no income, no job or assets) mortgage loans to homeowners. Many banks and other mortgage lenders believed there were manageable risks associated with the sub-prime home loans that they extended. They assumed that appreciation of home values would permit refinancing of troubled mortgages. When refinancing was not feasible, the lenders believed that the mortgaged properties could be sold for more than the loan balances. When the housing bubble burst, these were revealed to be huge mistakes.

U.S. mortgage problems arose partly because of what happened after financial firms acquired risky mortgage loans originated by local banks and other mortgage lenders and packaged the loans into collateralized debt obligations and asset-backed securities. Frequently these bundles were sliced into different risk categories and sold nationally and internationally. Credit rating companies such as Moody's, Standard and Poor's, and Fitch often rated the mortgage bundles and slices higher than warranted given the risks associated with the loans.

Freddie Mac and Fannie Mae, government-sponsored entities, acquired or guaranteed large quantities of mortgage packages, which turned out to contain many high-risk, default-prone mortgages. Freddie and Fannie required large infusions of U.S. government money in early September 2008 to remain in operation. In late 2008, Freddie and Fannie continued to incur large losses, found it impossible to raise funds in private capital markets and required additional infusions of government funds to remain in operation. The government, for good reason, considers Freddie and Fannie as being too big to fail, since the entities owned or guaranteed about $4.5 trillion in home mortgage debt late in 2008.

Problems similar to those that struck Freddie and Fannie hit other firms that had acquired toxic mortgages. The U.S. government bailed out a few huge private companies whose balance sheets had been ravaged by mortgage problems and other credit market difficulties (e.g., AIG Insurance and Citigroup). Government capital infusions were also provided to regional and other banks such as the Wisconsin-headquartered M&I Bank. Other firms, such as Bear Stearns and Lehman Brothers, were allowed to fail and have disappeared as independent entities.

How big is the sub-prime mortgage lending problem? According to the Wall Street Journal (October 31, 2008), about 12 million U.S. home mortgages were "underwater" as of September 30, 2008, representing more than 18 percent of all outstanding home loans. An underwater mortgage means that the loan balance exceeds the market value of the mortgaged property. Nearly half of all home mortgages in Nevada were underwater. Other high-ranking states were Michigan (47.8 percent), Florida and Arizona (29.2 percent), and California (27.4 percent).

Clearly not all borrowers with underwater mortgage loans will default. This is suggested by figures showing that only about 5 percent of U.S. mortgages were delinquent in mid-2008. But given the prospect of further declines in home prices, the unfolding recession and expected increases in worker layoffs, the percentage of delinquent mortgages will almost certainly increase. Incentives for default also exist because U.S. mortgages are non-recourse loans. These loans specify that a creditor can take the property if an individual defaults but cannot take other assets or income to make up the difference between the unpaid loan and the lower value of the house. So for a number of reasons, substantial problems remain for the U.S. mortgage market.

Stabilized prices of U.S. homes and greater real estate market activity would, of course, lift many mortgages above the water line and solve other problems facing the mortgage industry. Corrections are underway. In a move which lessens supply pressures, U.S. home builders reduced housing starts from about 2.1 million units in 2005 to about 879 thousand units (adjusted annual rate) for the third quarter of 2008, about a 58 percent decline.

However, the correction is not over. U.S. sales of existing homes fell by 3.1 percent from September to October, 2008 despite the fact that home prices for October were about 11 percent below year-earlier levels. Modest increases from year-earlier levels in sales of existing homes were recorded in the fall of 2008 in parts of California, Arizona and Nevada, where foreclosures and other developments put houses on the market at distressed prices.

U.S. average home prices fell by about 20 percent from 2006 peak levels to November 2008 and by over 30 percent in this same period in parts of Florida, California, Arizona and Nevada. A further decline of at least 10 percent in U.S. average home prices probably will occur before the real estate market stabilizes late in 2009 or early 2010.

While mortgage defaults have increased in Wisconsin, the problems have been less severe than in states where home prices increased the most. Home financing conditions in Wisconsin also appear closer to stabilizing than in states hardest hit by the collapse of the housing bubble. However, inventories of houses and condos on the market remain high in Southern Wisconsin. Sales of these properties are not likely to return to more normal, sustainable levels until 2010.

The mortgage meltdown in the U.S. has had far-reaching effects. The systemic problems created by the meltdown contributed to a seize-up of credit markets in the fall of 2008. In December 2008, credit conditions were still tight but mortgages were available at affordable interest rates to credit-worthy borrowers but not to people with weak credit histories.

The next year or two will likely bring additional financial experiments aimed at working out of the sub-prime mortgage problem. Some will involve private sector-government partnerships. How effective these initiatives will be is unclear. But the record so far is not encouraging because the government lacks a model for dealing successfully with the huge, complex problem. Critics describe the ad hoc efforts to date as a "Whack-a-Mole" strategy.

Many financial industry officials believe that the practice of bundling mortgages into asset-backed securities and collateralized debt obligations will find much more limited use in the future. Financial analysts have learned how difficult it is to put a realistic value on mortgages in such packages. And it became clear that mortgage originators and others had strong incentives to pass along the high risks associated with bundled and sliced mortgages to someone else in the financial system. This had devastating impacts on those who ended up holding toxic, un-saleable mortgages. Consequently, the industry will need to develop transparent mortgage bundles that carry less risk, or most mortgages will have to remain with the originators. Simultaneously there will be substantial de-leveraging of the U.S. housing market. The U.S. government also will implement new regulations in efforts to prevent a future sub-prime mortgage meltdown.

The effect of global de-leveraging should not be underestimated. Economic growth in the United States and Western Europe, in particular, has been facilitated by low-cost, readily available credit that promoted strong consumer spending. If, as expected, low interest credit from sources such as home equity loans becomes less readily available, economic growth in these countries will drop by non-trivial amounts.

A weak domestic auto industry: General Motors, Ford and Chrysler face huge problems. Vehicle sales for the Big-3 sagged sharply in mid to late 2008. GM faces the most severe difficulties and probably will be forced into bankruptcy in the absence of a government bailout. In late 2008, GM and Chrysler were unable to obtain the private credit needed to continue operations for the duration of the recession. Ford, which arranged some of its future financing needs before this recession, was in somewhat better shape.

It's difficult to interpret predictions of job losses that could result if the Big-3 fail, but their demise could cause the loss of as many as two million jobs, many of them at suppliers and dealerships. Given the impact that this would have in an already weakened economy, it is likely that government help for U.S. automakers will be forthcoming.

U.S. automakers face both short-run and longer-run problems. Even if U.S. government bailouts allow them to stay in business during the current recession, there is no assurance they can remain competitive over the longer run. In comparison to the world's most successful automakers, GM, in particular, has too many brands, plants and dealers, too little innovation, and legacy costs for retirees (retirement pensions and health care costs) that hobble the company. Chrysler and Ford have similar problems.

Foreign firms building cars in the U.S. have largely avoided these problems. Toyota, Honda, Hyundai, Nissan, Subaru, Mercedes and BMW all manufacture vehicles in the U.S. and generally have profitable operations. In part, this is because the foreign automakers' U.S. operations use largely non-union labor. But they also have fewer brands, fewer and more efficient plants and fewer dealers. Many in the Congress are aware of these differences and are skittish about providing bailouts to the Big-3, fearing that these firms lack the ability to make sustained profits over the longer run.

A few analysts suggest that the only way for GM, at least, to remedy its longer-term problems is to enter Chapter 11 bankruptcy and reorganize into a much leaner company. This strategy is problematic, however. Consumers are leery of buying from a bankrupt auto company, fearing that warranties will not be honored, repairs will be difficult to get, and the resale value of the vehicles would be low.

The bottom line is that if U.S. automakers survive the recession, they will face nearly insurmountable problems over the longer run.

Lower agricultural and non-agricultural exports: Total U.S. exports grew by 8 to 9 percent per year during much of 2006 through 2008 and represented an important source of strength for the U.S. economy. U.S. export growth will be anemic (about 1 percent per year) in 2009 and 2010.

The weaker U.S. exports reflect both lower foreign demand associated with the global recession and a stronger U.S. dollar. The U.S. dollar has strengthened, in part, because of a flight from higher-risk currencies to U.S. dollar-denominated assets during the recession.

U.S. agricultural exports were valued at a record $115.5 billion in fiscal 2008, up about 40 percent from fiscal 2007. The U.S. agricultural trade balance of a plus $36 billion for fiscal 2008 was three times that of fiscal 2007.

The USDA's December 1, 2008 outlook report forecasts that U.S. agricultural exports for fiscal 2009 would be about $98.5 billion, down $17 billion (15 percent) from the record total for fiscal 2008. The USDA attributes the lower U.S. agricultural exports to nearly across-the-board weakness in foreign demand for different commodities. Overseas demand for wheat and coarse grains is likely to be especially weak. U.S. dairy exports were forecast to decline from a record $4 billion in fiscal 2008 to $3.1 billion in fiscal 2009.

The triple whammy of a stronger dollar, falling prices and weak global demand obviously will substantially curtail U.S. agricultural exports for FY2009. Importers also may find it difficult to obtain letters of credit needed to import U.S. agricultural products. In this environment, U.S. agricultural exports could decline to levels even lower than the $98.5 billion forecast by the USDA for FY2009. After all, the $98.5 billion figure is second only to the record $115.5 billion agricultural export total for FY2008.

What is one to make of the plus and minus factors affecting the U.S. economy? On balance, the situation certainly is not bullish. Moreover, some negative developments spell lower longer-term growth once the current recession ends.

Consumer spending, which accounts for about 70 percent of real GDP, dropped by one percent in October 2008. Mortgage foreclosures, loss of equity in houses and massive losses in the stock market have caused consumers to limit spending. We are witnessing how the wealth effect works in reverse as lower home equities and devastated stock portfolios reduce consumer spending. Prospects for layoffs in addition to the 1.2 million jobs shed by the U.S. economy during the first 10 months of 2008 could push the unemployment rate up to 8 to 9 percent by the end of 2009, adding to consumer fears and further limiting spending.

In the unfolding economic environment, business investment is likely to weaken further. Exports, which were a major bright spot for the U.S. economy in the past two to three years, also will make a much smaller contribution to economic growth in 2009.

Economic stimuli implemented by the Obama administration may help to restore consumer confidence and economic growth. However, it will be challenging for the new administration to figure out how much to spend on infrastructure, green energy initiatives, aid to the U.S. auto industry, mortgage relief, tax cuts and other potentially high priority uses. Presumably, the spending will need to combine the longer-term benefits of infrastructure investments with initiatives for arresting the downward spiral in markets and credit availability. Treasury Secretary Paulson of the Bush Administration suggested how difficult it is to pick the correct stimulus mix in the following comment made before the U.S. Congress in November 2008: "If we have learned anything throughout this year, we have learned that this financial crisis is unpredictable and difficult to counteract."

The federal income tax rebates provided by the Economic Stimulus Act of 2008 appear to have had a positive effect on real GDP growth. When the rebates reached taxpayers, they helped to boost consumer spending (albeit temporarily) and push economic growth up from 0.9 percent in the first quarter to 2.8 percent in the second quarter of 2008. Possibly too many mostly negative developments have ensued which would prevent tax rebates from having a similar effect in 2009. But there may be a useful lesson in the tax rebate experience.

How large should the stimulus package be? The rapid deterioration of the economy suggests that a large stimulus packages will be needed. In late November 2008, former Federal Reserve Governor Lyle Gramley joined other economists and political figures—including House Speaker Nancy Pelosi—in calling for bold action to shore up the economy. He suggested that a stimulus package of "$500 or $600 billion would be just fine." Gramley also lamented the fact that the needed stimulus will be delayed by the transition between U.S. presidents.

The bottom line is that U.S. economic growth is likely to drop sharply in the fourth quarter of 2008 to about -3.0 percent and remain at -1.0 to -2.0 percent from the first quarter of 2009 through the third quarter of 2009 before turning positive in the final quarter of 2009. While this U-shaped recovery scenario is most likely, a shrinking economy could be with us until 2010 if we are unlucky.

Implications for the U.S. Agricultural Sector

Supply and demand conditions for individual farm products are usually more important to agriculture than the overall macroeconomic environment. This will probably not be the case in 2009. Depressed conditions in the rest of the economy will have a substantial negative impact on U.S. farms and agribusinesses.

The USDA estimates that net farm income for 2008 will be $86.9 billion, the same as 2007. Downward adjustments in 2008 income are likely, since this late November estimate did not account for subsequent drops in some commodity prices.

And net farm income in 2009 will be down—possibly sharply. Still, because of strong balance sheets and high farm commodity prices during 2007 and much of 2008, the U.S. farm sector is positioned to weather the 2009 economic downturn better than most other sectors.

A mixed picture emerges for U.S. agribusinesses in 2009. Agribusiness firms whose profits are linked directly to farm prosperity, such as farm equipment manufacturers, face a leaner year.

U.S. agricultural lenders are in better shape than other lenders. Only about 5 percent of U.S. agricultural banks had negative income during the first half of 2008, and over 50 percent of the agricultural banks reported that net incomes during that period were above year-earlier levels. Farm Credit System lenders also have recorded strong profitability recently. However, Farmer Mac, the government-sponsored entity which serves as the secondary market for agricultural loans, did suffer capital losses in 2008, partly because it had invested in securities issued by financially-troubled Fannie Mae, Freddie Mac and Lehman Brothers. Farmer Mac has issued $65 million in preferred stock to rebuild its capital position.

The outlook for firms involved in large-scale poultry production is bearish for 2009. For example, Tyson Foods fourth quarter 2008 net income of $48 million was reduced sharply by a $91 million loss from broiler operations, mostly due to high feed prices early in the year and industry over-production. Pilgrim's Pride, the world's largest producer of broilers, has had similar problems and also has burdensome debts partly as a result acquiring Gold Kist, Inc. for $1.1 billion in early 2007. In December 2008, Pilgrim's Pride was downsizing and had filed for Chapter 11 bankruptcy.

Several developments have slammed U.S. ethanol processors, including high corn feedstock prices early in 2008, hedging and contracting decisions that turned sour when corn prices fell in the summer and fall, ethanol prices that declined partly in response to falling oil prices, over-capacity in the industry and problems raising capital. VeraSun Energy Corporation of Sioux Falls, South Dakota—among the three largest U.S. ethanol producers—was a noteworthy casualty. The firm lost $476 million in its 2008 third quarter and sought Chapter 11 bankruptcy protection in October.

Profits of some other U.S. agribusinesses are being influenced by the nature of their product mix. Monsanto believes that demand for the company's genetically modified seeds and herbicides will remain strong in 2009 despite weak farm commodity prices. Companies producing items needed by financially strapped consumers will see those products generate higher returns.

Businesses that market such products include Hormel Foods (Spam), Kraft Foods (Kool-Aid Products and some cheese products), Tree House Foods (soups, non-dairy creamers and private-label, store-brand products). Whole Foods Market, Inc., which sells organic products and upscale specialty food items, has witnessed wilting demand for its products and has experienced financial problems. General Mills and Kellogg could see their revenues enhanced if consumers have more meals at home rather eating out.

Farm Inputs and Services

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Inputs

Strong demand for fertilizer and seed coupled with tight supplies resulted in large price increases for these two key crop production inputs in 2008. USDA's National Agricultural Statistics Service (NASS) estimates that fertilizer prices were about 80 percent above 2007 levels, while seed prices were up about 26 percent. Nitrogen prices rose about 50 percent, while prices for phosphorous and potassium were up about 140 percent. The fertilizer that suppliers were able to get their hands on in 2008 was expensive. This was due to higher prices for natural gas, used to make anhydrous ammonia, and a weak U.S. dollar, which made it more costly to import potash from Canada and elsewhere.

Natural gas prices have tumbled as oil prices fell from around $150 per barrel in July of 2008 to about $50 per barrel now. This makes it cheaper to produce anhydrous ammonia fertilizer, which should push down prices for other nitrogen fertilizers such as urea.

During the last half of 2008, the U.S. dollar gained against the Canadian dollar. The two currencies were at par in mid-July, but by early December one U.S. dollar was worth 1.3 Canadian dollars. This strengthening of the U.S. dollar has, in effect, reduced the prices of goods imported from Canada by about 30 percent. This should translate into lower prices for potash for farmers in 2009.

Farmers and fertilizer suppliers are playing a game of wait-and-see regarding fertilizer purchases for 2009 crops. It is widely acknowledged that fertilizer prices will likely fall if oil prices remain low and the U.S. dollar retains its strength against other currencies. Farmers are not aggressively booking fertilizer, and suppliers are holding back on producing fertilizers that have an uncertain selling price.

So farmers may be placing their fertilizer orders at the last minute and suppliers may be scrambling to meet that demand. Last-minute purchasing by farmers combined with just-in-time ordering by fertilizer suppliers could cause fertilizer prices to spike around planting time.

Seed prices rose nearly 26 percent from 2007 to 2008 and have nearly doubled since 2002. The run-up in seed prices partly reflects increased demand, but a more important factor is a change in the quality of the seed. In particular, farmers are buying more GMO (genetically-modified) seeds. GMO seeds are relatively expensive due to their higher yield potential and other production characteristics that allow farmers to save on pesticides and harvest more production per acre.

Farmers had no trouble acquiring enough diesel fuel and gasoline in 2008 and this should not change in 2009. Fuel costs will be much less than in 2008. Gasoline and diesel prices have dropped dramatically as oil prices fell nearly $100 per barrel in the last half of 2008.

Farmers will likely protect themselves against any rapid rise in oil prices later in the year by using contracts to lock in these "bargain" fuel prices in the first quarter of 2009.

Land Rents

For nearly a decade, farmers in Wisconsin and neighboring states have seen very small year-to-year increases in land rents. This stability in cash rents reflects stable cropping returns. During this period the prices received for major field crops held fairly constant. Yields trended higher, while the costs of seed, fertilizer and fuel rose at modest rates. As a result, net operating margins (the difference between income per acre and variable costs) were essentially constant. Landlords apparently recognized this and set land rents accordingly.

But the farmland rental market has changed dramatically in response to strong gains in the prices for corn, wheat and soybeans. Potential returns from raising these crops increased substantially and landlords took notice, charging considerably higher rents in 2008.

Average cash rents in Wisconsin rose from $72 per acre in 2007 to $85 per acre in 2008. This $13 one-year increase compares to a total increase of only $5 per acre from 2002 to 2007.

Cash rents increased more in Wisconsin (18 percent) than in adjacent states on a percentage basis but not in absolute amount. Iowa and Illinois cash rents were up $25 and $19 per acre, respectively, in 2008. The larger rent increases for these states reflects their higher yield potential and greater concentration in row crops compared to Wisconsin, Michigan and Minnesota.

Rising cash rents raise questions about whether the rent is fair. One crude method of judging the fairness of rents is to compare them to the value of the land being rented. The ratio of rent to land value is a standard return-on-investment yardstick. It reflects the earnings received per $1 value of investment, comparable to the rate of return on common financial investments such as bonds or certificates of deposit.

The average cash rent paid on Wisconsin cropland in 2008 was $85 per acre. The average reported value of Wisconsin cropland in 2008 was $3,810 per acre. Putting the two together gives a return of 2.23 percent, which is comparable to what investors were earning on short-term investments (the yield on one-year Treasury Notes was around 2 per-

Farm Input Price Indices (1990-92=100)

	2002	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Fertilizer	108	124	140	164	176	216	387
Nitrogen	111	141	161	193	203	231	353
Potash and Phosphate	106	109	128	158	158	198	471
Fuels	115	140	165	216	239	264	356
Diesel: Bulk Delivery	114	137	165	232	259	284	397
Gasoline	115	136	157	192	210	226	280
Seeds	142	154	158	168	182	204	257
Chemicals	119	121	121	123	128	129	141

Source: USDA-NASS

Rent as a Percent of Land Value for Cropland Rented for Cash							
State	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
Wisconsin	3.35	3.09	2.98	2.69	2.37	2.05	2.23
Illinois	5.02	4.92	4.67	3.83	3.44	3.16	3.02
Iowa	5.88	5.75	5.43	4.73	4.35	3.86	3.83
Michigan	2.79	2.55	2.43	2.25	2.17	2.12	2.16
Minnesota	5.66	5.39	4.94	4.44	4.04	3.76	3.87

Source: USDA-NASS

cent for the first three quarters of 2008). So the rental returns earned on cropland were in line with what landlords could have earned if they had invested their capital in U.S. Treasury Notes instead.

The rent-to-value for cropland in Wisconsin is well below that in Illinois, Iowa, and Minnesota, where it ran to 3 percent or more in 2008, as it was for 2004-2007, reflecting that these states' higher incidence of cash grain farming and related stronger demand for rented acreage.

Cash rents for Wisconsin cropland are likely to rise again in 2009, but not as much as in 2008. Commodity prices are generally no better than a year ago, and there is not a consensus that corn and soybean prices have moved to new, higher plane, so the prospects for higher gross returns on cash crops are not favorable. Moreover, some key inputs like seed and fertilizer will remain costly, eroding the margins that farmers can use to pay rents.

While the statewide average cash rent for Wisconsin cropland was $85 per acre, there were reported cases of cash rents of $200 per acre or more on highly productive land in the southern and eastern regions of the state. Rents of this magnitude are making some farmers take a hard look at the risks they are assuming in the face of volatile crop and input prices. In an effort to manage these risks, some farmers are trying to negotiate flexible cash rent agreements. These "flex leases" give tenants some downside protection against dramatic drops in commodity prices or yields or large increases in input costs. The flip side is that landlords receive "bonus rents" if yields or market prices exceed mutually agreed-upon levels.

If these agreements replace traditional cash rent agreements to a large extent, it may become difficult to track and compare rents. Terms of flexible rental agreements vary, making it difficult to meaningfully compare rental arrangements across the state or even a county.

Cropland Rented for Cash: Average Cash Rent per Acre by State, 2002-2006							
State	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***	***2008***
Wisconsin	67	68	70	70	71	72	85
Illinois	122	123	126	129	132	141	160
Iowa	120	122	126	131	133	140	165
Michigan	60	60	62	62	65	73	80
Minnesota	81	82	83.5	86.5	88	94	109

Source: USDA-NASS

Credit

The troubled state of U.S. and global financial markets is not likely to translate into credit problems for farmers and ranchers. There should be no shortage of credit for farmers and ranchers in 2009 and the interest rates charged on farm loans should remain relatively low.

Rural banks generally did not get involved in the sub-prime home mortgage lending that is widely blamed for the 2008 financial crisis. As a result, rural banks have not taken any major financial hits and are well positioned to make loans.

The Farm Credit System (FCS) is a farmer-owned cooperative that by law is only allowed to loan to farmers, farm-related businesses, and in some special cases, rural homeowners. This restriction prevented FCS from getting directly involved in the sub-prime mortgage mess.

While farmer-owned, FCS is a government-sponsored enterprise that is able to sell bonds that have the implicit backing of the U.S. government. This "guarantee" relationship between the U.S. government and FCS essentially ensures that FCS can raise the funds it needs to satisfy the credit needs of agricultural producers and related businesses.

The sub-prime mortgage debacle did have some adverse effects on FCS. Losses on sub-prime mortgages caused a steep drop in the stock value of Fannie Mae (Federal National Mortgage Association)—another government sponsored enterprises that discounts home mortgages. This became a problem for Farmer Mac (Federal Agricultural Mortgage Corporation)—yet another government sponsored enterprise that ironically was created during the farm financial crisis of the 1980s for the purpose of discounting farm real estate loans.

Farmer Mac, which discounts farm mortgages for commercial banks and other originators of farm mortgages, held stock in Fannie Mae as an investment. As Fannie Mae stock tanked, the financial health of Farmer Mac weakened to the point where it needed an injection of capital to prevent bankruptcy. FCS stepped in to bail out Farmer Mac, purchasing about $60 million of Farmer Mac preferred stock.

The bailout ensures that commercial banks and other lending institutions will continue to be able to sell farm real estate mortgages to a secondary lender—Farmer Mac. This means that credit for the purchase of farm real estate should continue to be readily available in the coming year.

The Federal Reserve Bank of Chicago reports that interest rates on both farm operating loans and farm mortgages were well below 8 percent in 2008, as has generally been the case since 2002. Low interest rates on farm loans are due indirectly to a low-interest-rate policy the Federal Reserve Board has pursued to keep the economy out of recession. This strategy worked for a while, but the nation eventually slipped into recession despite the Fed's monetary policies.

With the U.S. economy in recession, demands for credit in non-farm sectors of the economy will likely be lower than in the last couple of years. This soft demand for credit should help keep interest rates low across the economy.

The bursting of the housing bubble and the problems it triggered in financial markets have caused some to note parallels with the farm financial crisis of the mid-1980s, when farm real estate values fell quickly and precipitously. The farm financial crisis was largely the result of farm debt growing at a rate of slightly more than 13 percent annually during the 1974-78 period. This surge in farm debt was due to farmers' demand for more credit to purchase land and lenders' willingness to satisfy this demand because rapidly rising land values brought commensurate increases in collateral.

The boom of the 1970s was followed by a marked contraction of farm credit markets. In the 1984-88 period, farm debt decreased at an average annual rate of about 8 percent per year, partly because farmers repaid loans and partly because lenders either restructured or wrote off uncollectible debt.

Since the turmoil of the 1980s farm finance crisis, farmers appear to have been cautious in their use of credit. Since 1994, the average annual growth in farm debt has stayed near 4 percent. This consistency is encouraging. Farmers have not gone on borrowing binges and debt has been rising at modest rates even as farm real estate values have shot up. Slow growth in farm debt despite rapid growth in farmland values means that farmers and their lenders are not repeating the mistakes of the 1980s.

The Federal Reserve Bank of Chicago regularly surveys agricultural bankers to learn about their assessments of loan demands and loan repayments in the Seventh Federal Reserve District (which includes about two thirds of Wisconsin). Lender responses to this survey confirm that agricultural credit is being used more judiciously at present than it was a few decades ago.

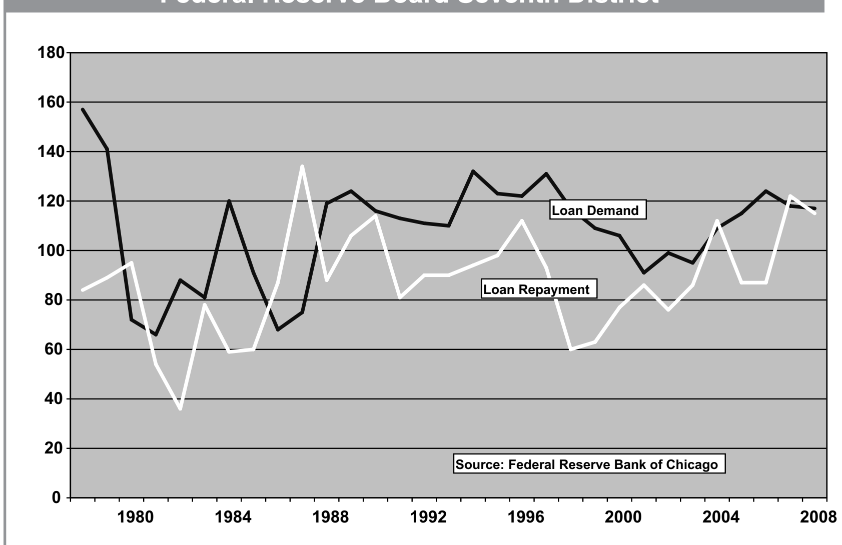
Note from the figure below that in the early 1980s, loan demand was high relative to loan repayment. Since approximately 1990, loan demand and repayment have come together. This equating of loan demands and repayments is an indication of stability in agricultural credit markets, lending support to our expectation that farm credit markets will function in the coming year as they have in the last few years.

Average Annual Percent Changes in U.S. Farm Debt

	1974-78	*1984-88*	*1994-98*	*2004-08*
Total farm debt	13.49	-8.36	4.33	4.13
Real estate	12.52	-8.58	4.42	3.49
Nonreal estate	14.55	-8.12	4.25	4.84

Source: ERS-USDA

Agricultural Loan Demand and Repayment Indices, Federal Reserve Board Seventh District



Dairy

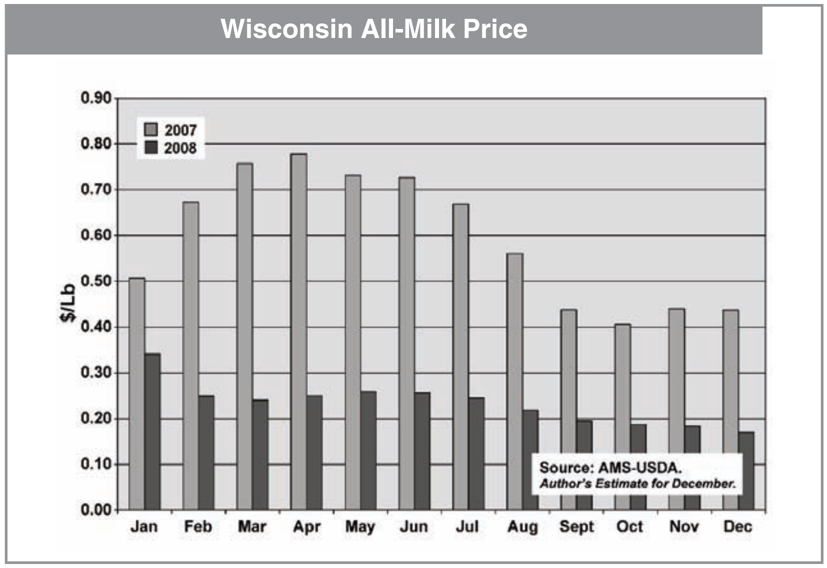
Bob Cropp (608-262-9483)

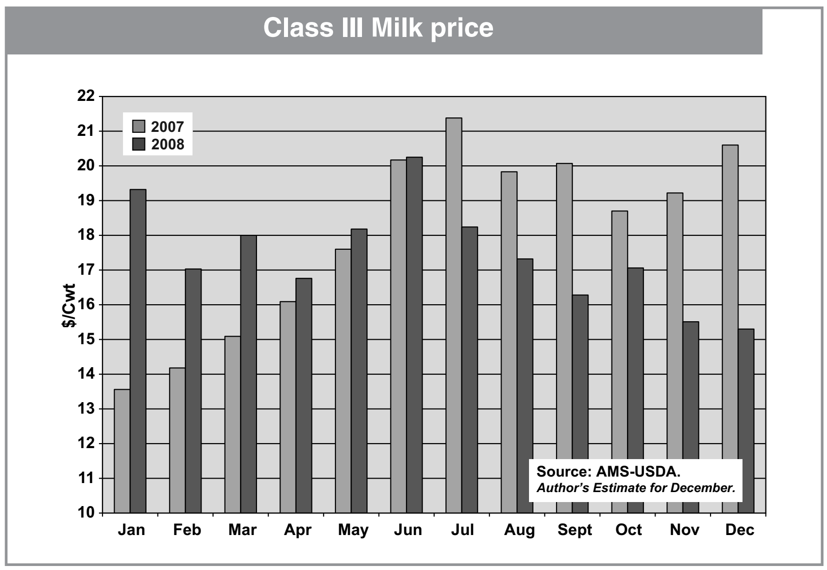
Review of 2008

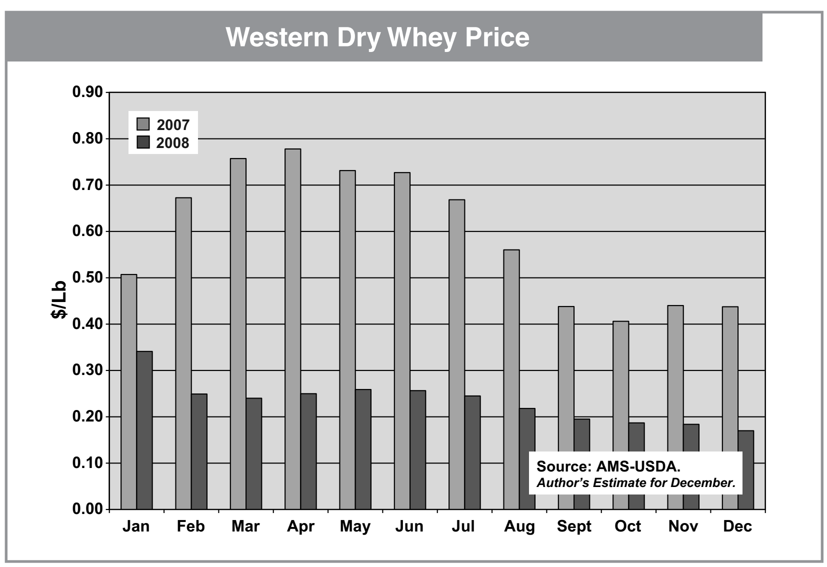
Wisconsin's average all-milk price set a record high in 2007, averaging $19.27 per hundredweight. For 2008, the monthly all-milk price averaged $2.43 per hundredweight higher than 2007 for the first half of 2008 and about $3.00 lower during the second half. By December the all-milk price was more than $5.00 below a year ago. Because larger volumes were sold at lower prices in the second half of 2008, the average Wisconsin all-milk price will be around $18.95, about $0.30 lower than the 2007 record but still the second-highest price on record.[1]

Since about 90 percent of Wisconsin's milk is used for cheese, farm level milk prices are driven primarily by cheese and dry whey prices. For the first half of 2008, the federal Class III (cheese milk) price averaged $2.14 per hundredweight higher than 2007, but it was about $3.40 lower for the second half. For the year, the Class III price averaged about $17.40, compared to $18.04 for 2007. Strong dry whey prices were a major factor for record-high Class III prices in 2007, boosting them by more than $2.00 per hundredweight for some months. The dry whey price was over $0.70 per pound from March through June 2007 and averaged $0.59 for the year. But for 2008, dry whey prices were in the 20-cents-per-pound range through August before falling below $0.20 and averaging only about $0.23 for the year.

Because of higher cheese prices, Class III prices were higher than in 2007 for the first seven months of 2008. The Chicago Mercantile







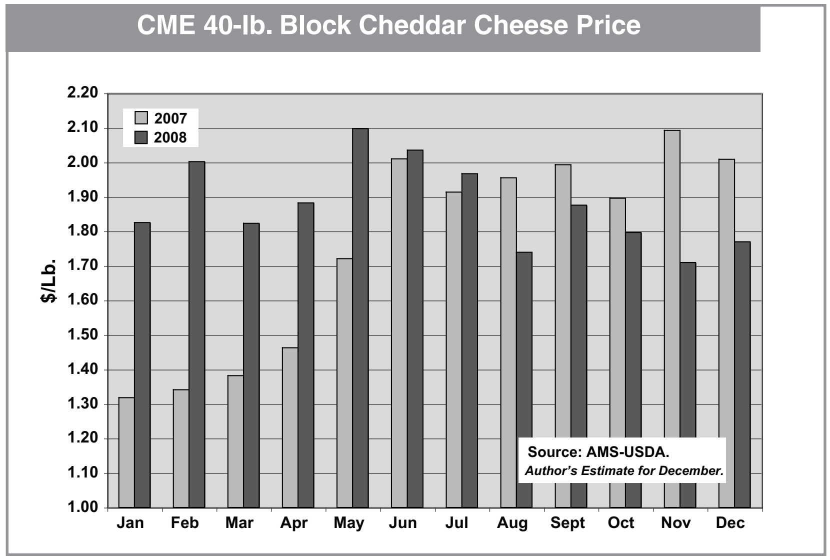
[1] *December 2008 milk prices and 2008 annual averages reported here are author's estimates as of mid-December.*

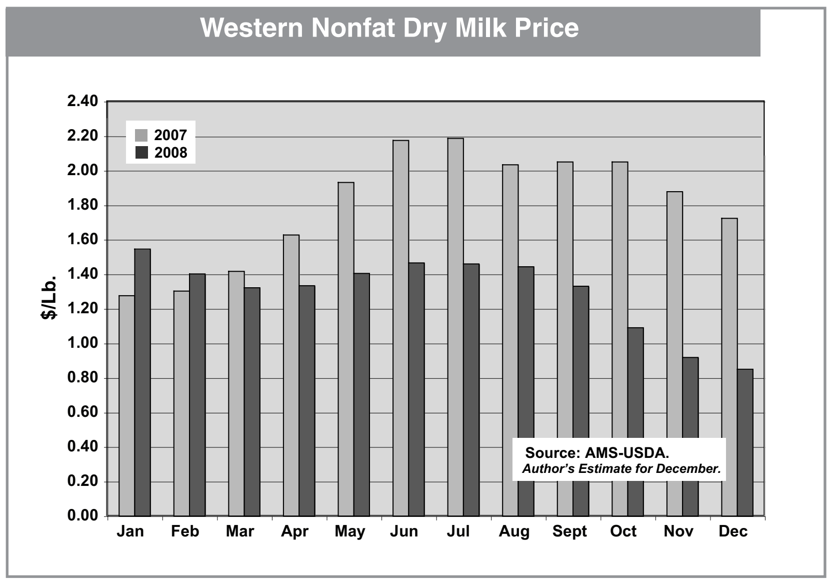
Exchange (CME) 40-pound cheddar block price averaged $1.95 per pound January through August, $0.36 higher than 2007. But from August through December, the average was about $1.75 per pound, $0.25 lower than 2007. By the end of December cheese had fallen to below $1.15 per pound on the CME.

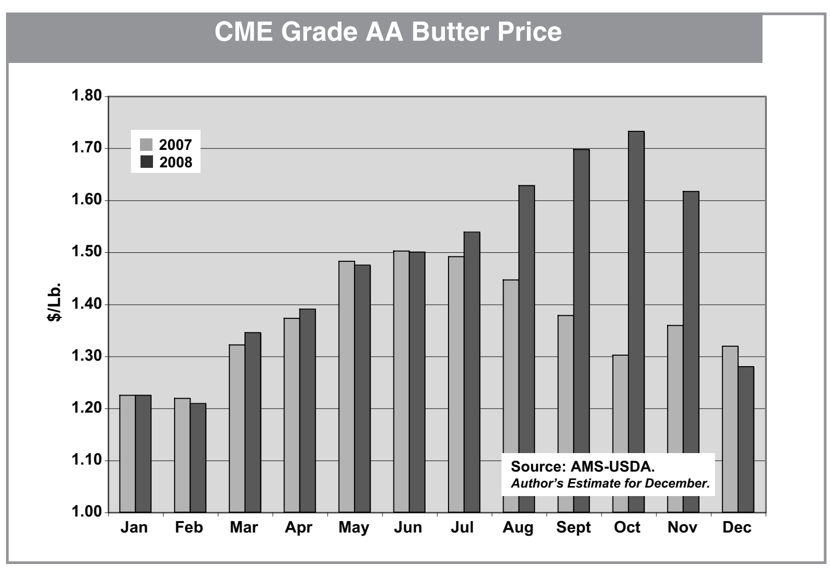
Under federal milk marketing orders, the price for milk used for Class I (beverage milk) is moved by the higher of an advanced Class III or Class IV (milk used for nonfat dry milk and butter) price. Usually the advanced Class III price drives Class I prices. But in 2007, Wisconsin producers benefited from high nonfat dry milk prices, so the advanced Class IV price was the mover from June through November. In 2008, nonfat dry milk prices were much lower and the advanced Class III price was the mover of Class I prices every month except September. Nonfat dry milk prices were above $2.00 per pound June through October of 2007 and averaged $1.80 for the year. For 2008, nonfat dry milk peaked at $1.46 per pound in June and July and averaged about $1.30 per pound for the year, $0.50 below 2007.

In contrast to prices for cheese, dry whey and nonfat dry milk, butter prices in 2008 averaged higher than 2007. CME butter prices were close to 2007 for the first half of the year but were higher July through November. The CME butter price averaged about $1.45 per pound for the year, compared to $1.37 for 2007. By December, butter had fallen to $1.17 per pound.

Total milk production on a daily basis in 2008 averaged 2.4 percent higher than 2007 for the first half of the year, but slowed to just 1.4 percent higher in the second half. For the year, total U.S. milk output was 189.7 billion pounds, 1.9 percent above 2007 on a daily basis and (since 2008 was a leap year) 2.2 percent higher on a calendar year basis.

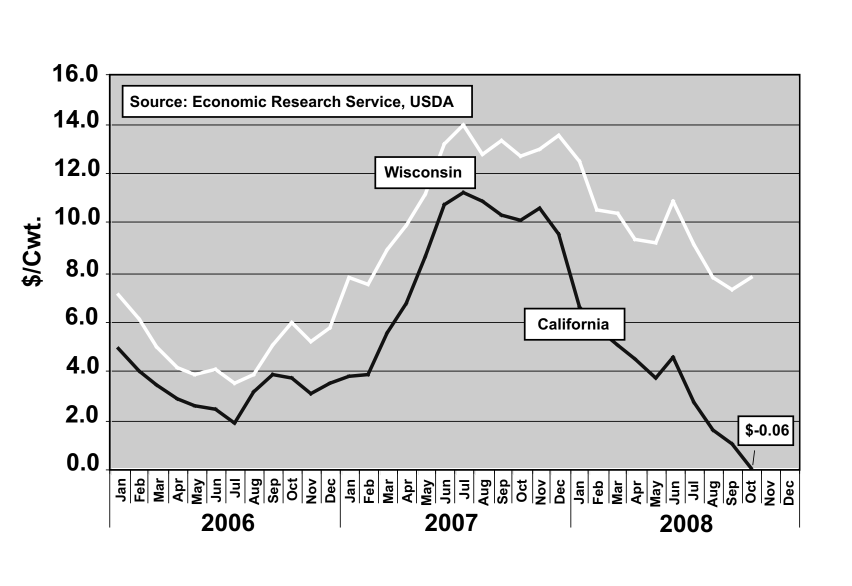






U.S. milk cow numbers increased every month from May of 2007 through July of 2008. But because of higher feed costs and anticipated lower milk prices, dairy producers reduced the size of the nation's dairy herd during the second half of 2008. From July through October, 895,000 dairy cows were slaughtered, 6.9 percent more than the same period in 2007. While the estimated average size of the nation's dairy herd for 2008 was 9.268 million head or 1.2 percent higher than 2007, cow numbers at the end of 2008 were estimated to be only about 0.6 percent higher.

Return over Feed Costs, Wisconsin and California



Total milk production was held in check by below-normal increases in milk per cow. A combination of relatively high grain and concentrate costs, less use of rBST and unfavorable weather in some states kept the increase in milk per cow well below the normal increase of about 2 percent. For the second half of 2008, year-over-year monthly increases in milk per cow were under 1 percent. The estimated total milk per cow for the year was 0.7 percent higher than 2007 on a daily basis and 1.0 percent higher for the year for a total of 20,465 pounds.

During 2006, depressed milk prices kept Wisconsin returns over feed costs below $4.00 per hundredweight in mid-summer and below $6.00 the rest of the year. Despite higher feed costs in 2007, much higher milk prices pushed returns over feed costs above $12.00 per hundredweight from May through December. But in 2008 feed costs were much higher and rising, so returns over feed costs declined steadily from January through May. Higher milk prices helped some in June, but even though feed costs came down by fall, milk prices fell even faster, reducing returns over feeds costs to below $8.00 per hundredweight by October.

Feed costs will average lower in 2009 than they did in 2007 and 2008. But returns over feed costs in 2009 will be lower due to much lower milk prices. Lower returns will encourage increased dairy cow slaughter in 2009, slow the increase in milk per cow, slow dairy expansions and increase the number of producers who exit from dairying.

Note from the chart above (based on ERS calculations) that returns over feed costs tend to average considerably higher for Wisconsin than for California. Wisconsin's milk prices are higher than in California while feed costs are lower. In October 2008, ERS reported a negative return over feed costs for California. This suggests that lower milk prices in 2009 will have a larger negative

Changes in U.S. Cow Numbers, Milk per Cow, and Daily Milk Production, 2008 versus 2007

Month	*Number of Milk Cows*	*Milk Per Cow*	*Milk Production (daily basis)*
		Percent Change	
January	1.1%	1.1%	2.2%
February	1.3%	0.9%	2.1%
March	1.3%	0.7%	1.9%
April	1.5%	1.0%	2.1%
May	1.5%	1.6%	3.0%
June	1.5%	1.4%	2.8%
July	1.4%	0.2%	1.6%
August	1.3%	0.2%	1.5%
September	1.1%	0.4%	1.6%
October	1.0%	0.4%	1.3%
November	0.8%	0.6%	1.1%
December	0.5%	0.9%	1.4%
Annual Average	**1.2%**	**0.7%**	**1.9%**

effect on dairy profitability in California than in Wisconsin.

With milk production increasing by less than 2 percent over year-earlier levels, farm milk prices would normally be more favorable. But domestic milk and dairy product sales have weakened considerably. Retail prices for dairy products averaged more than 10 percent higher than a year ago during the first half of 2008. With lower farm-level milk prices during the second half of the year, retail prices slowly declined. But as late as October, retail prices of dairy products as a group were still up 3.6 percent from a year ago.

Dairy product sales have been hurt by relatively high retail food prices along with a slowdown in the domestic economy. Fluid milk (beverage) sales from January through September were down 0.5 percent from a year ago, with sales of American cheese 1.9 percent higher and other types of cheese (mainly Italian types) 1.6 percent lower. A drop in restaurant traffic hurt cheese sales. A bright spot was butter sales, up about 18 percent from a year ago.

Dairy exports added significant strength to cheese, butter, nonfat dry milk and dry whey prices in 2007 and for the first nine months of 2008. On a total solids basis, exports absorbed 9.5 percent of total U.S. milk production in 2007 and will account for more than 10 percent in 2008. For the first nine months of 2008, cheese exports were up 48 percent from 2007 and represented more than 3 percent of total production. Comparable figures for butter and nonfat dry milk were, respectively, +299 percent/12.6 percent of production and +77 percent/51 percent of production. Exports of dry whey in 2008 were 25 percent lower than 2007, but still accounted for 41 percent of dry whey production.

Export demand for U.S. dairy products eased considerably in the last quarter of 2008, which was a major reason for declining dairy product prices. Demand weakened for several reasons, including a slowdown in the world economy, more dairy products available for the international market (particularly from New Zealand, Australia, Argentina, Brazil and the European Union), strengthening of the U.S. dollar against other currencies, and the fact that some importing counties had trouble obtaining credit. In the face of a larger supply of product and weakening demand, world dairy product prices had declined substantially by December 2008. Earlier in the year, world prices of butter, cheddar cheese, nonfat dry milk and dry whey were at levels enabling U.S. exports without subsidies. By year-end, world prices were much closer to U.S. prices.

World and U.S. Dairy Product Prices, 2008

Product	*World Price**		*U.S. Price***
	2008 High	***December***	***December***
	Dollars per Pound		
Butter	$2.04 (July)	$1.36	$1.17
Cheddar cheese	$2.49 (January)	$1.43	$1.76
Nonfat dry milk	$1.76 (February)	$1.02	$0.84
Dry whey	$0.45 (May)	$0.27	$0.176

*EU price for butter, nonfat dry milk, and dry whey; Oceania price for cheese. Source: USDA-FAS.

**USDA-NASS prices for week ending December 20, 2008

Despite lagging exports, U.S. dairy product stocks had not approached burdensome levels and were not responsible for declining dairy product prices and farm milk prices in the last quarter of the year. October 31 stocks of butter were actually 24 percent lower than a year ago. American cheese stocks on the same date were only 3.1 percent higher and total cheese stocks 1.6 percent higher than year-ago levels. Nonfat dry milk stocks totaled 144.5 million pounds, which was 18 percent higher than a year ago but tiny in comparison to the 1.1 billion pounds in storage on October 31, 2003. October 31 dry whey stocks were 4.4 percent lower than a year ago.

Outlook for 2009

Dairy analysts in the USDA and elsewhere forecast much lower dairy product prices and farm milk prices for 2009. While any increase in milk production will be modest, continued depressed economic conditions and reduced dairy exports will cut demand and bring lower prices.

Total milk production for 2009 will grow no more than 1 percent. Prices for corn, soybean and hay are expected to be lower than 2008, but average feed costs will still be well above 2005 and 2006 levels. Higher feed costs and lower milk prices will squeeze dairy producers' operating margins. Some operations are likely to see negative net margins, especially during the first half of the year. This will not only slow dairy expansions in 2009, but also spur dairy cow slaughter and encourage more producers to exit the business.

The effect of the National Milk Producers Federation's sixth round of herd buyouts under its CWT program will also moderate milk production in 2009. The deadline for dairy producers to submit bids to participate in the latest buyout was November 24, 2008. A total of 184 bids were accepted, involving 61,078 cows, 1,548 bred heifers and 1.2 billion pounds of milk. Producers with accepted bids will start slaughtering cows in January 2009. The combination of the CWT program and increased dairy cow slaughter by other producers will reduce cow numbers through at least the first half of the year. The average number of cows for the year is expected to be around 9.21 million head, 0.6 percent fewer than 2007.

Relatively high feed costs and tighter operating margins will also hurt per cow production. But that will be offset by a good supply of higher-producing dairy heifers replacing older cows. Dairy replacements number about 3.9 million head, about 42 replacements for every 100 cows. While increases in milk per cow will likely remain below the 10-year average annual increase of 2 percent, an increase of around 1.4 percent to 20,755 pounds seems quite possible, depending on weather conditions. With 0.6 percent fewer milk cows producing 1.4 percent more milk per cow, milk production would total 191.2 billion pounds, 0.8 percent more than 2008. USDA is forecasting a slightly higher total at 191.4 billion pounds.

The weak economy will continue to hurt milk and dairy product sales in 2009, but lower retail prices should be a plus. Cheese and butter sales rely heavily on the restaurant business, which is projected to be slower in 2009 as consumers eat more meals at home. More at-home meals won't help cheese and butter sales, but could support fluid milk sales. In fact, the impact of lower retail prices and more at-home meals is already being felt. October 2008 fluid milk sales were up 0.7 percent from a year earlier.

For 2009, USDA forecasts a 2.07 percent increase in commercial disappearance on a milkfat basis and more than a 2.8 percent increase on a skim solids basis. The lower increase on a milkfat basis is due to smaller increases in butter and cheese sales. Much lower prices for nonfat dry milk are projected to increase its use in other dairy products and as a food ingredient, supporting the greater increase in usage on a skim solids basis.

Forecast NASS Prices for Dairy Products, 2009

Quarter	*Product*			
	Cheddar Cheese	*Butter*	*Dry Whey*	*Nonfat Dry Milk*
	Dollars per Pound			
1st	$1.40 - $1.45	$1.15 - $1.20	$0.17 -$0.18	$0.85 - $0.90
2nd	$1.50 - $1.55	$1.20 - $1.25	$0.19 - $0.20	$0.90 - $0.95
3rd	$1.60- $1.65	$1.35 - $1.40	$0.23 - $0.24	$1.00 - $1.05
4th	$1.70 - $1.75	$1.40 - $1.45	$0.25 - $0.27	$1.05 - $1.15

USDA's forecast for commercial disappearance includes commercial exports. While lower retail prices will help domestic sales, U.S. dairy exports will be hurt by lower world prices (due to a weakening global economy), a strengthening dollar and increased supply of dairy products from major U.S. competitors. The National Milk Producers Federation's CWT export assistance program will continue. During 2008 a milk-equivalent of 1.9 billion pounds was exported under this program in the form of butter, cheese, whole milk powder and anhydrous milk fat. USDA forecasts a 26 percent decrease in exports from 2008 on a milkfat basis and an 11 percent decrease on a skim solids basis. Other forecasts have U.S. dairy exports declining 25 to 35 percent.

Based on this supply-and-demand scenario, forecasts for dairy product prices by quarters are shown in the table above. All prices are considerably lower than 2008. Prices will likely be lower during the first half of the year than during the second half, when lower retail prices are expected to boost sales of milk and dairy products. Dairy exports may also improve during the second half of the year, although some forecasts show little improvement until 2010.

These product prices would result in the estimated Class III, Class IV and Wisconsin all-milk prices as shown below. Since Wisconsin makes very little nonfat dry milk, cheese prices and the Class III price will drive the Wisconsin all-milk price. While the all-milk price is considerable lower than 2008, Wisconsin producers will see comparably better milk prices than producers in the West, where a major share of the output goes into nonfat dry milk. With lower nonfat dry milk and butter prices the Class IV (and the California 4a price) will average $2.80 to $3.60 per hundredweight lower than 2007.

First-quarter Class III prices are expected to be in the range of $11.85 to $12.40 per hundredweight and the all-milk price $13.25 to $13.80. In the second quarter the Class III price improves marginally to $12.95-$13.50 and the all-milk price to $14.35 to $14.90. With some improvement in domestic milk and dairy product sales and, perhaps, dairy exports, prices should continue to improve in both the third and fourth quarters. By the fourth quarter the Class III price could range from $15.30 to $15.90 per hundredweight and the all-milk price $16.70 to $17.30.

For the year, the Class III price is expected to average $13.60 to $14.15 per hundredweight. This compares to the most recent USDA forecast of $14.70 to $15.70. The forecast Class IV price averages $11.50 to $12.20 per hundredweight, compared to USDA's forecast range of $11.15 to $12.25 per hundredweight. The Wisconsin all-milk price is forecast to average $15.00 to $15.55 per hundredweight for the year. USDA forecasts a U.S. all-milk price range of $14.80 to $15.80. Wisconsin's all-milk price is normally $0.15 to $0.40 higher than the national average.

This forecast puts the average Wisconsin all-milk price for 2009 at $3.40 to $3.95 per hundredweight lower than 2008, which would mean a difficult year for many producers. But milk prices are very volatile and can change quickly with relatively small changes in milk production or milk and dairy product sales. While some analysts forecast even lower prices, at this point it appears more likely that milk prices will be higher those forecast than even lower. Unfortunately, current dairy futures and available cash forward contracts are at levels even lower than the forecast prices, so these tools do not allow dairy producers to lock in favorable operating margins in 2009.

Under the dairy provisions of the 2008 Farm Bill, dairy producers receive MILC payments on eligible milk whenever the Boston Class I price falls below $16.94 per hundredweight (the target price). MILC payments per hundredweight are 45 percent of this difference. The $16.94 target price may be increased by a feed price adjuster, which compares the value of a 16 percent protein dairy ration comprised of 51 pounds of corn, 8 pounds of soybeans and 41 pounds of alfalfa hay with a base $7.35 per hundredweight. If the total value of the ration for any given month exceeds $7.35, then the percentage difference is multiplied by 45 percent and the resulting percentage is used to increase the $16.94 Boston Class I target price for that month.

At the end of 2008, corn, soybean and hay prices were at levels that would trigger a small feed price adjuster. Using even higher corn and soybean futures prices in 2009, a feed adjuster would increase the Boston target Class I price from $16.94 to around $17.85 for the first quarter, $18.15 for the second quarter, $18.40 for the third quarter and $18.50 for the fourth quarter. With these feed prices and the Class III prices forecast, there would be MILC payments every month during 2009. MILC payments could be around $1.30 per hundredweight for the first quarter and decline to about $0.25 per hundredweight for the fourth quarter. MILC payments for an individual dairy operation are limited to 2.985 million pounds of milk for a fiscal year (October – September), the production of a herd of about 155 cows. MILC payments will only offer partial relief to the low milk prices in 2009

Projected Class III, Class IV, and Wisconsin All-Milk Prices, 2009

Quarter	*Class III Price*	*Class IV Price*	*All-Milk Price*
	Dollars per Hundredweight		
1st	$11.85 - $12.40	$10.00 - $10.65	$13.25 - $13.80
2nd	$12.95 -$13.50	$10.65 - $11.30	$14.35 - $14.90
3rd	$14.20 -$14.75	$12.20 - $12.80	$15.60 - $16.15
4th	$15.30 - $15.90	$12.80 - $13.90	$16.70 - $17.30
Annual Average	***$13.60 - $14.15***	***$11.40 - $12.20***	***$15.00 - $15.55***

Wisconsin's milk production

Wisconsin milk production peaked at 25 billion pounds in 1988, declined to a low of 22.07 billion pounds in 2002, then began to turn around in 2005. Milk cow numbers started to increase in 2006. From 2004 to 2007 milk production grew almost 2 billion pounds, to 24.1 billion pounds. Production for 2008 is estimated to increase another 1.8 percent to 24.4 billion pounds. With tighter operating margins forecasted for 2009 and anticipated participation in the CWT herd buyout program, Wisconsin milk cow numbers may not increase in 2009, but milk per cow will increase at least 1.5 percent. That would yield 2009 milk production of 24.8 billion pounds.

Wisconsin Milk Production, 2004-2009

	Milk Cows		*Milk Per Cow*		*Total milk*	
Year	*Million Head*	*% Change*	*Pounds*	*% Change*	*Billion Pounds*	*% Change*
2004	1.241	-1.2	17,796	+0.4	22.085	-0.8
2005	1.236	-0.4	18,500	+4.0	22.866	+3.5
2006	1.243	+0.6	18,824	+1.8	23.398	+2.3
2007	1.247	+0.3	19,310	+2.6	24.080	+2.9
2008	1.251	+0.3	19,600	+1.5	24.400	+1.8
2009	1.251	+0.0	19,895	+1.5	24.800	+1.5

Source: 2004 to 2007 USDA, NASS; 2008 and 2009 author's estimates.

Livestock and Poultry

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2008 in Review

U.S. meat production set a new record in 2008, increasing more than 3 percent from 2007 to more than 94 billion pounds. Production of pork, broilers and turkey all recorded new highs. Beef production was up 1 percent from 2007, but remained a bit below its record high set in 2002. U.S. meat production has increased in 24 of the last 26 years, with small downturns of less than 0.25 percent in 2003 and 2004.

Exports of beef and pork were both very strong in 2008. Beef exports recorded their fourth consecutive annual gain and approached pre-BSE levels reached in 2003 (exports plummeted 82 percent from 2003 to 2004 after a cow in Washington state was diagnosed with bovine spongiform encephalopathy).

The strong exports offset a weakening domestic market later in the year so that the average annual price of choice cattle and hogs was up a little from 2007. The average annual prices of boning cows, broilers and turkeys were also a bit higher than a year earlier. But the average annual price of feeder steers was down due to high feed prices.

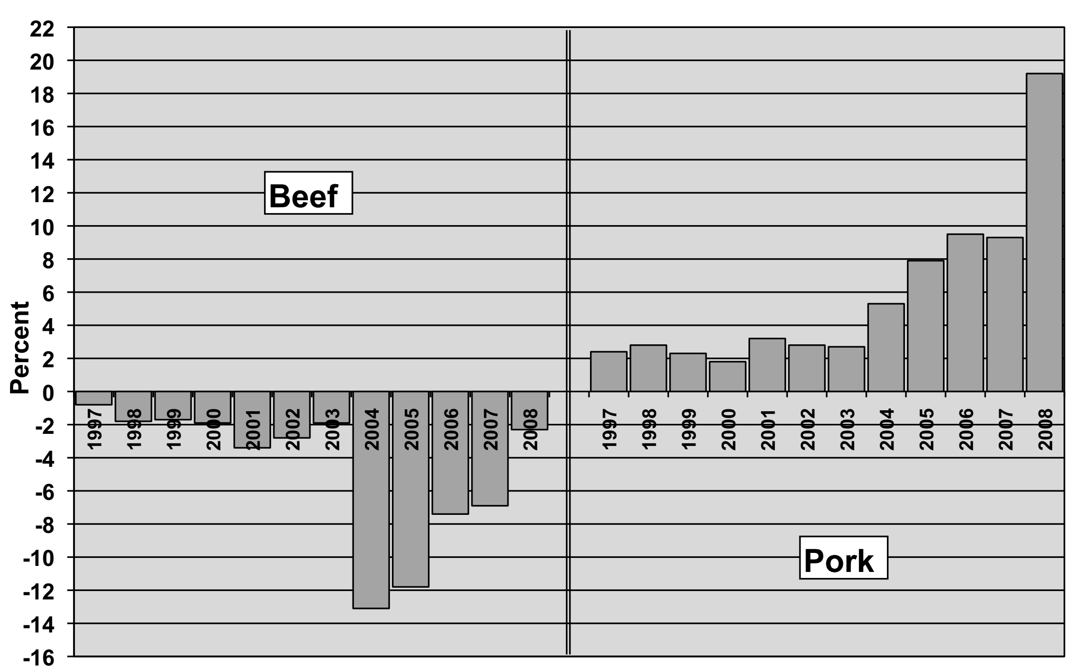
Pork exports were well over five billion pounds in 2008, up two-thirds from 2007 and by far a new record high. U.S. pork production increased by 3.6 billion pounds (18 percent) from 2003 to 2008. All of the increased production was exported, so there was little change in total domestic pork consumption during these five years. And since population was increasing, per capita pork consumption dropped from 51.8 pounds in 2003 to little more than 48 pounds in 2008.

Pork exports accounted for about 23 percent of U.S. pork production in 2008, up from 8.6 percent in 2003. Net exports (exports minus imports) rose from 2.7 percent to more than 19 percent during that time.

Cow slaughter was up more than 10 percent in 2008. Slaughter of non-dairy cows was up about 15 percent. Total cow slaughter in 2008 was more than 35 percent above the low in 2005.

Per capita consumption of meat fell more than four pounds in 2008 from the record 221.6 pounds per person reached in both 2004 and 2007. This was the lowest per capita meat consumption in seven years.

U.S. Foreign Trade Balance (Exports minus Imports) as a Percent of Production



2009 Forecast

U.S. Meat Production Expected to Decline in 2009

Meat output is expected to decline more than one billion pounds in 2009 as a consequence of higher feed prices during the last couple of years and extended drought conditions in much of the West for most of the last decade. This would be the largest annual decline in production since 1982 and only the third time that production has dropped since that year (1982 marked the end of a difficult recession and years of high inflation).

Steer Prices Likely a Little Lower in 2009

Despite expected moderate declines in beef production and total meat production in 2009, the average annual price of U.S. choice steers (Texas-Oklahoma) will likely drop in 2009 due to weaker domestic consumer and export demand. Choice steer prices weakened during the last quarter of 2008, but the average annual price still was near the record high $93.00 per cwt. level achieved in 2007.

Feeder Cattle Prices May Decline a Little More in 2009.

Following three years of relatively high levels, the average annual feeder cattle price declined about 4 percent in 2008. Feeder prices were depressed in the first half of the year by rising corn prices and later in the year by declining domestic and foreign demand. Although feed prices may be a little lower in 2009, weaker demand for beef should cause feeder cattle prices to average slightly lower in 2009.

Although the cattle numbers cycle began an upward phase in 2004, this trend is stalled. The size of the annual calf crop and the number of beef cows continued in a sidewise to slightly lower pattern in 2008, reaching the lowest levels since the 1960's. These trends should help keep cattle prices stable despite any demand problems that may emerge during the next several years.

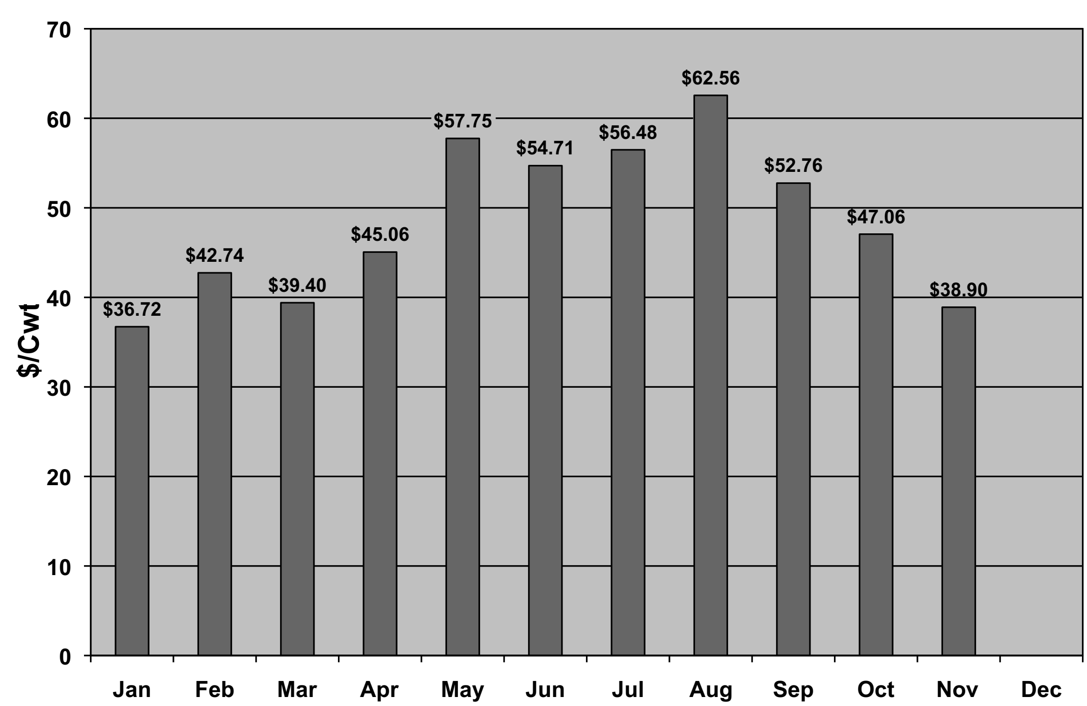
Cow Prices May Not Match 2008's Record Level

The annual average price of cows (boning utility, Sioux Falls) in 2008 reached a record high of about $56.00 per cwt., up 7 percent from a year earlier. This was mostly because beef imports dropped nearly 20 percent to the lowest level in years, more than offsetting the 10 percent increase in U.S. cow slaughter. Beef imports are expected to rise a bit in 2009, which may keep average cow prices below the record level reached in 2008.

A Repeat of 2008's Hog Price Bubble Is Unlikely

Following nearly a decade of very small annual changes in total hog slaughter, the widespread use of a vaccine to protect hogs from cir-

Average Monthly U.S. Hog Price, 2008



covirus caused U.S. hog slaughter to quickly rise 9.4 percent from Oct. 2007 through Sept. 2008 compared with the previous 12-month stretch. This triggered a rapid drop in hog prices, from an average of $51.45 for April through August of 2007 to an average of $39.54 for the following six months.

This price decline was followed by an explosion in the demand for U.S. pork, triggered by a combination of a weak dollar and low pork prices. Pork exports nearly doubled. By August, prices averaged $62.56, a rise of 59 percent in five months. This occurred despite a record pace of hog slaughter, 9 percent above year-earlier levels for that period.

Percentage Change in Hog Prices, Pork Production, and Net Pork Exports, 2008 vs. 2007

Quarter	*Hog Price*	*Pork Prod.*	*Net Pork Exports*
Q1	(14)	12	40
Q2	0	9	102
Q3	14	7	81
Q4 *(est.)*	9	2	62

A world-wide recession helped deflate export demand and puncture the hog price bubble. By November, prices had fallen 38 percent to $38.90, despite the fact that hog slaughter barely exceeded year-earlier levels. The number of hogs kept for breeding was down 3 percent on September 1 and hog slaughter should be down several percentage points during the first three quarters of 2009. Nevertheless, weaker domestic and foreign demand should cause hog prices to average a little below the $48.00 average reached in 2008. A more normal seasonal price pattern is expected

Broiler Producers Likely to Have Better Financial Results in 2009

The high and volatile price of feed created substantial financial problems for many broiler producers in 2008 despite a record high average price of broilers. While total broiler production increased for the 33rd consecutive year, fourth quarter output declined. The number of broiler chicks placed has been declining since July, 2008 indicating reduced broiler output in the first quarter of 2009. While the average weight of broilers continues to rise 1-2 percent per year, total broiler output may decline a bit in 2009 for the first time since 1975.

With little if any production increases expected, broiler prices in 2009 may average near the record high levels of 2008. However, a repeat of the 16 percent increase in broiler meat exports in 2008 (to a record high of over 6.6 billion pounds) is not likely in 2009. Still, with lower feed costs expected in 2009, broiler firms should attain better financial results than last year.

Will Fewer Turkeys Mean Better Prices?

Turkey prices increased for the fifth consecutive year in 2008, despite a late-year price tumble caused by weaker demand and a large increase in frozen inventory.

The industry substantially reduced placement of poults during the last four months of 2008, which should bring a corresponding reduction in annual output in 2009. Lower output in 2009 may offset the bearish effect of a large frozen inventory, yielding a sixth annual price advance. But the odds are not favorable.

Little Change for Lamb Prices and Production Likely in 2009

The domestic lamb producing industry continues to slowly contract. In 2006, lamb and mutton imports exceeded domestic lamb production for the first time. These trends continued through 2008 and will likely to do so again in 2009. The average annual price of lambs has risen in six of the last seven years. That streak may not be extended in 2009 due to weaker consumer demand. Consumption of lamb per capita has slipped to a new low of 1.0 pounds per person per year.

Can the Strength in Egg Prices Continue?

Average annual wholesale egg prices increased about 95 percent from 2005 to 2008. The total annual output was practically unchanged over that time at about 6.4 billion dozen. Egg prices have been volatile. The average annual percentage price changes from 2003 through 2008 were 31, -6, -20, 10, 59, and an estimated 12 percent in 2008. This volatility occurred despite only small changes in egg production. The average year-to-year change in egg output during those years was only 1.1 percent. Very small changes in production and price are expected in 2009.

Meat Consumption Likely to Decline Again in 2009

Meat consumption per person has been in an uptrend for decades and peaked in the four years from 2004 through 2007 at between 221.0 and 221.6 pounds each year.

However, meat consumption per person fell to about 217 pounds in 2008. A significant rise in net meat exports from 7.8 billion pounds in 2007 to 11.2 billion pounds in 2008, plus a rise of about 1 percent in the country's population more than offset record high meat output.

The combination of more people and slightly less meat output should yield another fall-off in per capita meat consumption in 2009.

Corn and Soybeans

Randy Fortenbery (608-262-4908)

Introduction

The 2007/08 marketing year (Sept. 1 through August 31) for grains and oilseeds was punctuated by record high prices and a continuation of the extreme price volatility experienced during the previous marketing year. While several factors contributed to the price action, ethanol production was often singled out as the cause for the general rise in prices of all agricultural commodities. The strength of this argument, however, was seriously tested by the collapse of commodity prices, including grains and oilseeds, in the first quarter of the current marketing year. As noted in the Special Article section of this publication, much of the discussion attributing the increase in world food prices to ethanol production has overstated actual impacts.

Despite the rapid decline in prices during the first quarter of the 2008/09 marketing year, higher prices should be expected later in the year, along with continued significant price volatility. Although because of the current economic situation there may be less speculation in grain futures markets this year than last, demand fundamentals remain generally positive and support higher prices.

Corn

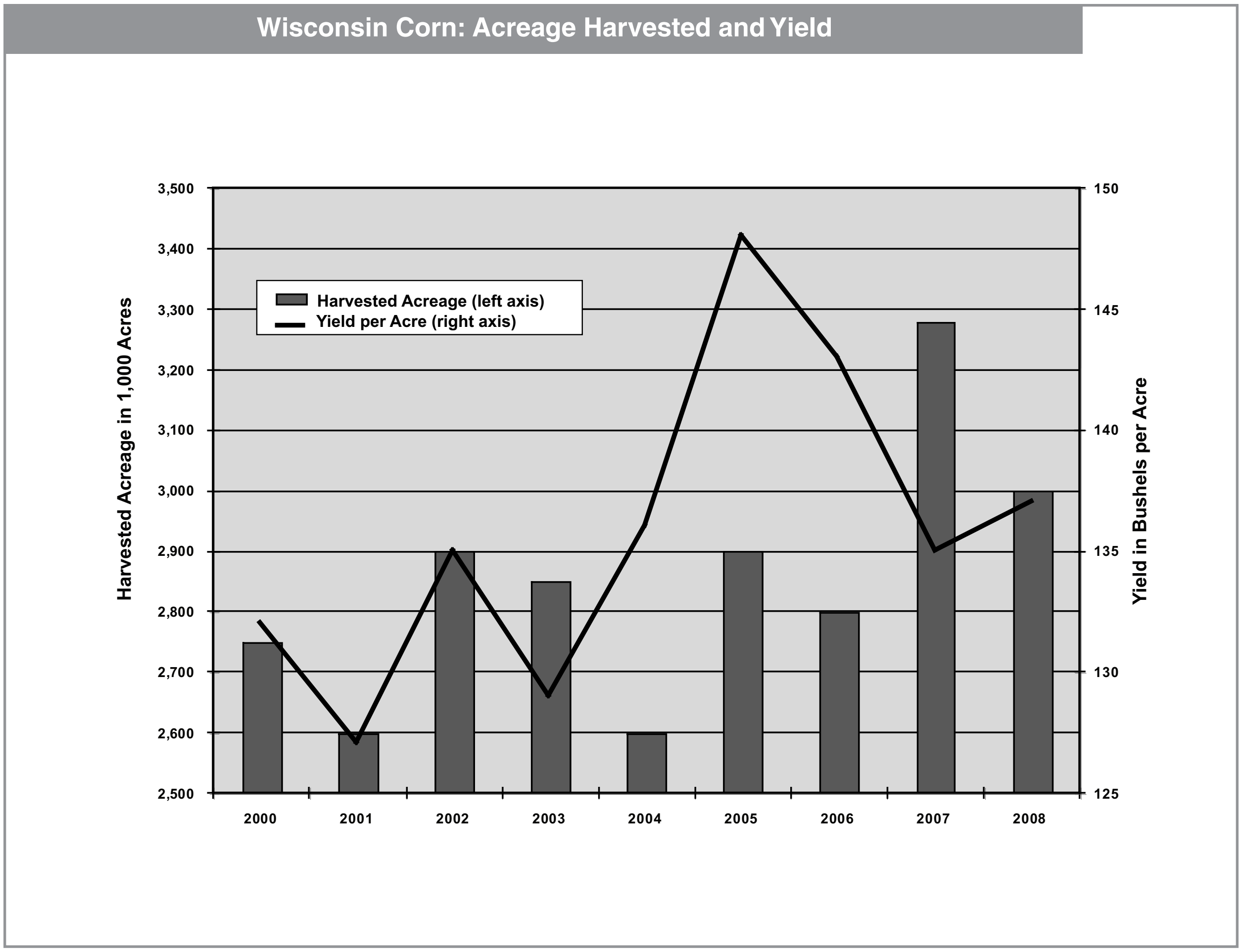
USDA's Dec. 11 World Agricultural Supply and Demand Estimates put the total U.S. corn supply at 13.7 billion bushels for the 2008/09 marketing year, down from 14.4 billion bushels last year. This includes a carryover from last year of 1.6 billion bushels and a 2008 harvest of just over 12 billion bushels.

USDA estimates that 85.9 million acres were planted to corn in 2008. This is 7.7 million acres less than in 2007, but still exceeds 2006 planted acres by more than 8 million. Despite the spring flooding that occurred over much of the Corn Belt, corn producers harvested 91 percent of their planted acres, consistent with percent harvested in most years. In addition, the average yield was almost 154 bushels per acre, second only to the record yield of 160.4 bushels per acre in 2004.

World corn production this marketing year was below last year's by about 1.5 percent, but when added to beginning stocks (corn left over

U.S. Corn Balance Sheet (Sep/Aug)

Mktg. Year	*01/02*	*02/03*	*03/04*	*04/05*	*05/06*	*06/07*	*07/08**	*08/09***
				Million Bushels (Except as Noted)				
Beg. Stocks	1,899	1,596	1,087	958	2,114	1,967	1,304	1,624
Imports	10	14	14	11	9	12	20	15
Acres Planted (Mil.)	75.8	78.9	78.6	80.9	81.5	78.3	93.6	85.9
Acres Hvst. (Mil.)	68.8	69.3	70.9	73.6	75.1	70.6	86.5	78.2
% Harvested	90.8%	87.8%	90.2%	91.0%	92.1%	90.2%	92.4%	91.0%
Yield (Bu/A)	138.2	129.3	142.2	160.4	148	149.1	151.1	153.8
Production	9,507	8,967	10,089	11,807	11,114	10,535	13,074	12,020
Total Supply	**11,416**	**10,578**	**11,190**	**12,776**	**13,237**	**12,514**	**14,398**	**13,659**
Feed & Res.	5,868	5,563	5,795	6,158	6,155	5,595	5,974	5,300
Food/Seed/Ind.	2,054	2,340	2,537	2,686	2,981	3,490	4,364	5,035
Ethanol				1,323	1,603	2,119	3,026	3,700
Exports	1,905	1,588	1,900	1,818	2,134	2,125	2,436	1,800
Total Demand	**9,820**	**9,491**	**10,232**	**10,662**	**11,270**	**11,210**	**12,773**	**12,535**
Ending Stocks	1,596	1,087	958	2,114	1,967	1,304	1,624	1,474
Stocks to Use (%)	**16.25%**	**11.45%**	**9.36%**	**19.83%**	**17.45%**	**11.63%**	**12.71%**	**11.76%**
Average Farm Price ($/Bu.)	**$1.97**	**$2.32**	**$2.42**	**$2.06**	**$2.00**	**$3.04**	**$4.20**	**$4.00**



from previous production years) total world supply is actually up by about 1.5 percent from a year ago. This is largely explained by a year-over-year increase in production among major corn importing countries and larger beginning stocks from major exporters.

Wisconsin followed the national trend in 2008 both by planting fewer corn acres than in 2007 and increasing average yields. According to USDA's November Crop Production Report (the most recent available at the time of this writing) Wisconsin farmers harvested 3 million acres of corn for grain in fall 2008, down from 3.28 million acres in 2007. The average yield was 137 bushels, up 2 bushels from 2007. The total Wisconsin crop was 411 million bushels, down from the 442.8 million bushels harvested in 2007. Wisconsin's corn crop had a lower total value this year than last because of a decease in production combined with somewhat lower average prices. This breaks a three-year streak of increasing total value. Based on average prices mid-December 2008, the Wisconsin corn crop following harvest had a total value of about $1.44 billion, compared to $1.73 billion for the 2007 crop.

Total corn demand for 2008/09 is projected to be 12.2 billion bushels, down from 12.8 billion last marketing year. This still exceeds 2008 production, so the carryout at the end of the marketing year (September 31) is expected to be less than beginning stocks. Carryout is currently projected to total 1.5 billion bushels. Demand this year is expected to soften in every category except ethanol use. Feed use is projected to decline by 10 or 11 percent, and exports by more than 25 percent. While ethanol use is expected to total 3.7 billion bushels, up from 3.03 billion the previous year, this is a significant reduction compared to what was being projected in September and October 2008. The demand for corn for ethanol production has scaled back in the face of poor processing margins for ethanol producers, coupled with financial failure on the part of a major player in that industry.

For most corn producers, 2008 continued the recent history of better-than-average returns. However, the extreme price volatility between planting and harvest made it very difficult to decide when to price the 2008 crop. Unless there is a serious weather-induced rally in late spring this year, prices are not likely to reach last year's peaks, but opportunities should exist to sell above current prices offered for fall 2009.

Even without the price extremes of last year, however, the kind of volatility experienced over the last couple of years will continue in the months to come. A tightening of the carryout this year coupled with relatively strong demand (even though current estimates fall short of last year) suggests that prices will be quite sensitive to any changes in market conditions or expectations.

Soybeans

USDA estimates that U.S. farmers harvested over 2.9 billion bushels of soybeans in 2008, almost 9 percent more than was harvested in 2007 but still below the 3.2 billion bushels than in 2006. The larger production came entirely from an increase in harvested soybean acres, as average yields were actually lower than in 2007. U.S. farmers planted 75.9 million acres of soybeans in 2008 and harvested 98 percent of those acres. That harvest percentage is below average and the lowest in six years.

Average U.S. soybean yields were 39.3 bushels per acre, below 40 bushels for the first time in five years. In September 2008, USDA was still estimating average yields in the 40-bushel-per-acre range, but as harvest progressed those expectations were revised downward.

Beginning stocks for the 2008/09 marketing year were estimated at 205 million bushels, a big reduction from the 574 million bushels brought into the 2007/08 marketing year. In the current year USDA is projecting that total consumption will exactly equal production plus imports, leaving carryout unchanged in September 2009.

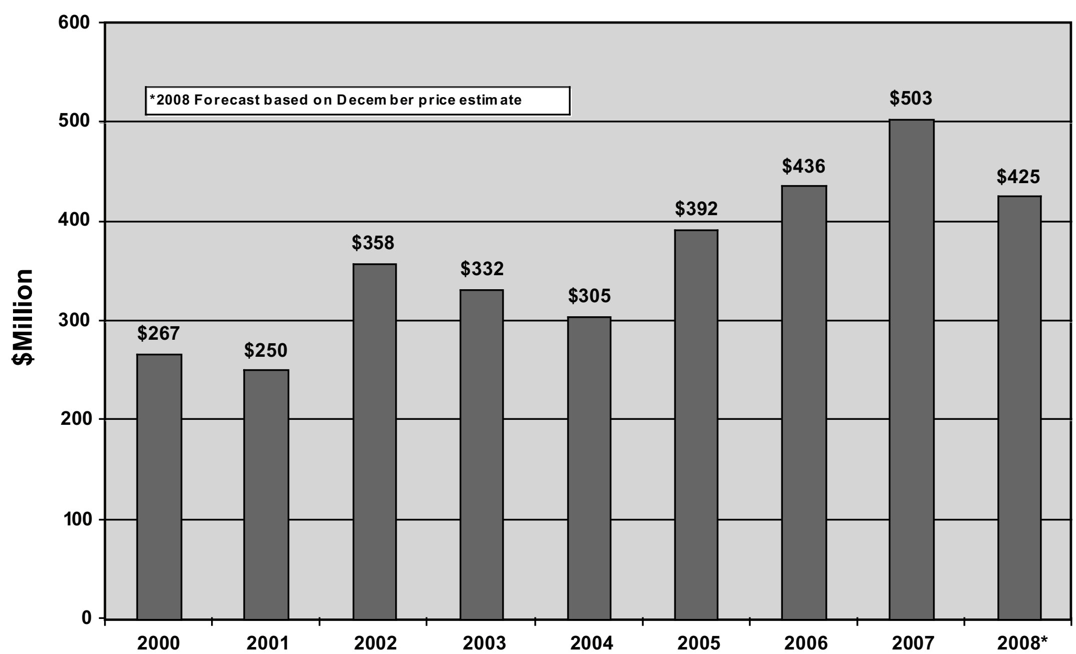
Wisconsin harvested about 180 thousand more soybean acres in 2008 compared to 2007, but decreased yield offset increased acres and led to a smaller 2008 crop. Wisconsin producers harvested 53 million bushels of soybeans this year, compared to 55.9 million in 2007. The average Wisconsin yield was 34 bushels per acre based on November estimates, well off early season estimates. Based on average December prices, the total value Wisconsin's 2008 soybean crop was about $435 million, well below last year's value, and about equal to the value of the 2006 crop.

U.S. soybean demand is expected to be 100 million bushels below last year's demand, and almost 150 million below the 2006/07 marketing year. Demand for crush, exports, and seed is expected to decrease. Despite a smaller crush, however, more soybean oil is expected to be

U.S. Soybean Balance Sheet (Sep/Aug)

Mktg. Year	*01/02*	*02/03*	*03/04*	*04/05*	*05/06*	*06/07*	*07/08**	*08/09***
	Million Bushels (Except as Noted)							
Beg Stocks	248	208	178	112	256	449	574	205
Imports	2	5	6	6	3	9	10	7
Acres Planted (Mil.)	74.1	74.0	73.4	75.2	72.0	75.5	64.7	75.9
Acres Hvst. (Mil.)	73.0	72.5	72.5	74.0	71.3	74.6	64.1	74.4
% Harvested	98.5%	98.0%	98.8%	98.4%	99.0%	98.5%	99.1%	98.0%
Yield	**39.6**	**38.0**	**33.9**	**42.2**	**43.0**	**42.7**	**41.7**	**39.3**
Production	2,891	2,756	2,454	3,124	3,063	3,188	2,676	2,921
Total Supply	**3,141**	**2,969**	**2,638**	**3,242**	**3,322**	**3,647**	**3,260**	**3,133**
Crush Sep/Aug	1,700	1,615	1,530	1,696	1,739	1,808	1,801	1,715
Exports	1,064	1,044	887	1,097	940	1,116	1,161	1,050
F/S/R	169	130	109	192	194	149	92	162
Total Demand	**2,933**	**2,791**	**2,526**	**2,986**	**2,873**	**3,073**	**3,054**	**2,927**
Ending Stocks	208	178	112	256	449	574	205	205
Stocks To Use (%)	**7.09%**	**6.38%**	**4.43%**	**8.57%**	**15.62%**	**18.28%**	**6.71%**	**7.00%**
Avg. Farm Price	**$4.38**	**$5.53**	**$7.34**	**$5.74**	**$5.66**	**$6.43**	**$10.10**	**$9.00**

Value of Wisconsin Soybean Production



used for bio-diesel production. USDA currently projects that 3.1 billion pounds of soybean oil will be used for bio-diesel. Based on average yields, this would result in over 413 million gallons of bio-diesel.

Total U.S. soybean meal demand in 2008/09 is expected to decrease between 5 and 6 percent from 2007/08, with ending stocks increasing marginally. Domestic soybean meal prices are currently expected to average about $270 per short ton, well below last year's average price of $336 per ton.

World production of soybeans this year is forecast to be up about 6 percent from last year, but still below production in 2006/07. USDA estimates that Brazil will produce 59 million metric tons of soybeans this year, down 2 million tons from last year. Argentina's production is forecast to total 50.5 million metric tons, an increase of over 9 percent compared to last year. World ending stocks are expected to increase slightly, but still be well below 2006/07 levels.

Like corn, soybean prices experienced a sharp correction the first quarter of the marketing year from record high levels last summer. Absent a weather scare in late spring/early summer, this year's highs aren't likely to equal last year's, but prices above current levels are certainly possible. As has been the case for the last two years, one of the biggest challenges to producers this year will be extreme price volatility. The supply/demand balance sheet is tight enough that the market will continue to see dramatic price swings in reaction in market conditions.

Fruits and Vegetables

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Synopsis

Wisconsin cranberry production increased slightly in 2008, and prices remained strong. Apple production was down slightly and tart cherry output was reduced dramatically, mainly due to unfavorable weather in January. Cranberry prices are increasing because of strong demand for cranberry products, and plans have been implemented for industry expansion.

Strong grain prices and land values and higher input costs put severe pressure on the commercial potato and vegetable industries. Potato plantings dropped 8 percent nationwide in 2008. Flooding destroyed some planted acreage, leading to an 11 percent drop in Wisconsin harvested acres from 2007. Open-market potato prices were already 2 to 3 times higher than 2007 due to short stocks of the 2007-2008 crop. Contract prices for processed vegetables increased in response to competition from grains and soybeans. Wisconsin, Minnesota and Illinois remain the nation's largest concentration of canned/frozen vegetable production. The acreage that Wisconsin producers devotes to these crops changes slightly based on changes in cropped acres in Illinois and Minnesota, but total production has remained remarkably consistent across the region over time.

Fruit Crops

Apples

USDA's July 2008 apple production estimates put Wisconsin's crop at 55 million pounds, 7 percent below the 59 million pounds produced in 2007. Growers in northern and east central Wisconsin were concerned that dry conditions over the past few years would reduce yields, while wet conditions in southern Wisconsin had grower worried about scab. Hail jeopardized the crop in the east central part of the state as well. Apple prices continued an upward trend in 2008. In October, fresh apple prices were at $0.44 per pound, 6 cents higher than last year, and were as much as 20 cents per pound higher earlier in the fall.

Tart Cherries

USDA estimated 2008 tart cherry production in Wisconsin at 200,000 pounds, down from 10 million pounds in 2007. This is the smallest state tart cherry crop of the past 5 years. Dry conditions and a heavy 2007 crop stressed trees, leading to poor bud formation in 2008. Many trees were also damaged by dramatic temperature shifts during January. Nationally, production was estimated to have dropped 30 percent from 2007, portending strong grower prices in 2008. Multiple spring freezes and wet conditions during pollination reduced fruit set in Michigan. Wisconsin is expected to produce only 1 to 2 percent of the nation's 2008 tart cherry crop on about 1,700 acres.

Cranberries

Wisconsin's 2008 cranberry crop is expected to increase slightly from 2007 to 3.9 million barrels (1 barrel = 100 pounds). Cool spring and summer weather delayed crop maturity, but late frost may have allowed the crop to reach yield projections. Wisconsin had a long frost-free autumn, giving growers ample opportunity to harvest fruit. Wisconsin leads the nation in cranberry production and will produce about 56 percent of U.S. cranberries in 2008.

Wisconsin cranberry growers received an average price of $46.00 per barrel in 2007, and the price is expected to increase marginally for 2008. Demand for cranberry products remains high. Over the past 10 years, total cranberry sales climbed by 62 percent. Foreign sales increased 321 percent during that time, while domestic sales were up 44 percent. In response to growing demand, the industry intends to add 5,000 acres to its production base over the next few years. Much of that new acreage will likely be in Wisconsin.

Vegetable Crops

Potatoes

Wisconsin farmers planted 64,000 acres of potatoes in 2008, 1,000 fewer than 2007, and left 2,000 of the planted acres unharvested. Flooding destroyed 1,500 to 2,000 acres in early June on muck soils and in the Wisconsin River valley in the southern part of the state. The lost acreage was offset by substantial replanting of many flooded fields through mid July.

Total production was estimated at 25.7 million cwt., down 2.4 million-hundredweight (8.5 percent) from 2007. Average yield was about 415 hundredweight, down from 440 in 2007. Nine percent of the Wisconsin crop was used for seed potatoes, while 19 percent went for chipping, 23 percent for freezing and dehydration, and 49 percent for the fresh market.

Wisconsin chip potato acreage increased in 2008, but that was offset by reduced processing potato acreage, resulting in a 1,000-acre reduction in planted potato acres. The fresh market price was 250 percent higher in December 2008 than a year earlier. The stored potato crop in April and May of 2008 was much shorter than had been expected, resulting in shortages of raw product throughout the summer. Open-market potato prices are strong due to an 80,000-acre reduction nationwide and a 34-million cwt. reduction in the nation's fall harvest. Wisconsin's inventory of stored potatoes was down 12.5 percent in December 2008 from a year earlier, and the current volume of stored potatoes is the lowest since 1991.

Heavy snow led to a late spring thaw and delayed planting again in 2008. There were snowdrifts along the edges of many fields well into planting. Cool temperatures during the season delayed crop maturity. This decreased yields, especially for early season crops. Frost came relatively late (mid October), resulting in larger yields and tuber size in late-maturing potatoes.

Multiple heavy rains in central and southern Wisconsin led to storage losses due to bacterial soft rot, pink rot or leak. In contrast, persistent drought in northern Wisconsin required extensive irrigation to maintain yield and quality.

Sweet Corn

Wisconsin is a leading producer of processed sweet corn, with an estimated 93,900-acre harvest in 2008, up 8,500 acres from 2007. Yields were also expected to rise, leading to a 12.5 percent increase in total harvest to 648,230 tons, 21 percent of the expected national crop. Temperatures were cooler than ideal for sweet corn, causing a delay in crop maturity ranging from 5–15 days depending on the production region. As of mid-September, more than half of the state's sweet corn for processing had yet to be harvested. Later than normal frost dates allowed for almost complete harvest of the planted 2008 crop. The sweet corn contract price increased in the face of much higher field corn and soybean prices.

Snap Beans

Snap bean production was estimated at 293,200 tons for 2008, up 13 percent from 2007. Wisconsin was expected to produce 38 percent of the nation's snap beans for processing in 2008. Production was expected to increase due to an increase in planted acreage and better production conditions than 2007. Ample precipitation in northwestern Wisconsin helped increase yields of snap beans and sweet corn, but some flooded acres had to be replanted in southern Wisconsin, which reduced yields there.

Onions

Wisconsin onion production in 2008 is expected to be down 57 percent from 2007 at 286,000 hundredweight. At 1,800 acres, planted onion acreage was the lowest in five years. Flooding destroyed over 50 percent of the onion crop and caused decreased yield and quality for what was harvested. Yield in 2008 was estimated to be 340 hundredweight per acre, down from 370 hundredweight per acre in 2007.

III. Special Article: Bioenergy and Agriculture in Wisconsin

Edited by Brad Barham (608-265-3090) and Alan Turnquist[1] (608-265-3463)

Introduction

This section showcases individual contributions on the topic of bioenergy and agriculture in Wisconsin, authored by UW-Madison and UW-Extension faculty and their research teams. This discussion starts with the assumption that bioenergy production offers many potential benefits, which, coupled with government programs, are likely to spur continued growth in this young industry. Given that premise, these articles offer insights from multiple disciplines about the challenges, opportunities and impacts that bioenergy presents to Wisconsin's unique agricultural sector, communities and landscapes.

These articles address a variety of issues that will shape the growth and performance of the state's bioenergy industry. At the core of the ongoing research is the understanding that farmers will seek options that optimize the agronomics and economics of growing bioenergy crops. With that as a given, the authors go on to consider how the various options will affect broader elements of performance such as food production, rural community growth and development, and environmental protection.

Four broad summary points come out of this document:

- While the U.S. corn markets for food and bioenergy are closely linked, the impact of ethanol production on corn prices has been often overstated and the impact of oil prices on ethanol prices is often underappreciated.
- Bioenergy in Wisconsin can be generated from multiple feedstocks (e.g., corn, grasses, wood and manure) for distinctive energy uses.
- The diversity of Wisconsin's agricultural activities, landscapes and communities mean that the impacts of bioenergy activity can vary significantly across locales and types of bioenergy produced.
- Greater public awareness and understanding of environmental services will likely affect bioenergy markets and the balance of production and conservation goals.

Background

The last few years have seen expansive growth in bioenergy production and research. According to the U.S. Department of Energy, domestic ethanol production increased five-fold between 1997 and 2007 and tripled in the past five years. Wisconsin produced no ethanol until 2001 but now has nine plants with capacity nearing 500 million gallons per year.

While corn ethanol production is well developed, research money is pouring in to streamline processing, improve yields and expand feedstock options. A notable example is the Department of Energy's $135 million grant to the UW-Madison in 2007 to fund research on converting cellulosic material to ethanol.

This expansion in bioenergy production and research has spurred public discussions that range from supportive to accusatory. Every day seems to bring news article or public events where opinions are expressed about the role bioenergy should (or should not) play in our energy future. There are numerous motivations for this rising interest, including concerns about national security, environmental protection, rural economic development and the price of oil-based fuels. While the demand for inexpensive, homegrown energy is at the center of the issue, the breadth of discussion and research shows that the public expects production goals to be balanced with other social objectives.

Whether from the standpoint of production, economics, or environmental performance, not all bioenergy is the same. Sources and production methods are extremely diverse. Corn grain ethanol is a case in point. For example, newer processing facilities are typically much more resource efficient. Additionally, plants vary considerably in the degree to which they integrate with local agricultural systems through byproducts like distillers' grains. Such variables can have a major effect on the economic and environmental performance of the facility as well as on neighboring livestock operations.[2] Although the effort to expand production to include cellulosic feedstocks indicates that ethanol will continue to play a large role in bioenergy production, it's far from clear how these new ethanol sources will be collected, processed and distributed.[3]

Bioenergy goes beyond liquid transportation fuels such as ethanol. Wisconsin has many projects to extract energy from landfill waste or manure pits, and forest and crop residue play a substantial role in residential heating. Taken as a whole, bioenergy production in Wisconsin ranges from state-of-the-art industrial facilities, such as Jefferson's 130-million-gallon ethanol refinery, to one person with a chainsaw and a pick-up truck in Price County. Both systems substitute a biological source of energy for a fossil fuel, but they do so at very different levels of sophistication.

Wisconsin's landscape and agricultural sector are very diverse. In the lower two-thirds of the state, flat land, fertile soils and long growing seasons lend themselves to row crop production. The steep hills in the southwest favor pasture-based livestock and smaller farms. Central Wisconsin's sandy soils are suited to vegetables. Food production is not prevalent in the far north, but the forestry industry harvests wood for a variety of products. Simply put, Wisconsin producers have adjusted their farming and land-use systems to best take advantage of local resources.

Market forces have led to further diversification within the state's agricultural sector. Loss of farm numbers and expansion of existing farms to take advantage of economies of size or to increase farm incomes is part of the story. But some producers have made other changes in response to growth in local and other value-added markets such as organic.[4] Public perceptions of the "healthiness" and "greenness" of various production systems have altered the market, offering new opportunities and incentives for both producers and consumers.

The fact that these perceptions have become factors in the food marketing system shows that some consumers are willing to pay for services that go beyond their primary goal of feeding themselves at the lowest possible cost. While value-added food markets are small in size when compared to customary market channels, their importance in terms of altering consumer expectations is significant. This type of market change may play a similar role in bioenergy production in Wisconsin, especially if some fuel sources can be tied to consumer concerns about health, environment and community.

Given pressing concerns about national security, economic uncertainty and global climate change, markets will also likely alter the economics of a given bioenergy system. Governmental "market-based" initiatives such as a cap-and-trade system for greenhouse gasses would promote low-carbon options. Similarly, consumers' willingness to pay for environmentally friendly energy may open the door for otherwise less-competitive options. Local communities' desire to bolster their economy while retaining the local character may also favor certain bioenergy systems. All of these potential forces suggest that factors beyond direct energy production costs will affect the viability and nature of bioenergy systems in Wisconsin.

The following articles are grouped into three parts that integrate the contributions of individual authors. Part One looks at the impact of ethanol production in Wisconsin, on corn prices, job creation, community cohesiveness or conflict, and the environment. Part Two describes university research initiatives related to the role of ecological services and "greenness" of production systems. Part Three explores the prospects for a dynamic bioenergy sector in the context of Wisconsin's diverse agriculture.

Corn Ethanol: Impacts on Markets, Communities, and the Environment

In this section, UW-Madison researchers analyze different types of impacts of corn ethanol. Fortenbery and Park address the "food versus fuel" price issue. Tigges and Nobel examine ownership structure, job creation and diversification in Wisconsin ethanol production facilities. Robinson and Bell analyze community-siting decisions. Ventura explores the environmental impacts of intensified corn production and ethanol production facilities.

Is Ethanol to Blame for High Food Prices?

T. Randall Fortenbery and Hwanil Park[5] (608) 262-4908

Introduction

Record-high commodity prices coupled with unprecedented price volatility have led to concerns about our ability to simultaneously meet demands for food and bio-fuel feedstocks. Much has been written (see Brown for example) on the negative impacts on food access and security associated with expanded use of agricultural products for bio-fuel.

One of the biggest concerns has centered on the impact of corn-based ethanol production on commodity prices. As 2008 corn prices reached record levels, the starch-based ethanol industry was blamed for high worldwide food prices and food shortages in parts of the developing world. Unfortunately, much of the anecdotal evidence cited in the press focused on correlations and inferred causality with no confirming research base.

Coincident with increases in ethanol production, the U.S. dollar experienced significant depreciation from 2002 until recently. The weak dollar contributed to an overall increase in U.S. corn exports in the 2007/2008 crop year (Sept. 1 through August 31). Despite record-high domestic prices, U.S. corn exports increased by almost 13 percent in 2007/2008 compared to the previous marketing year (USDA). If domestic ethanol production was compromising food supplies on a global basis, why were U.S. corn exports actually up last year?

In addition to currency fluctuations, markets for all commodities (not just agricultural products) saw record levels of activity from speculators over the last two years. Correlation does not imply causality, but it's worth noting that there's a positive correlation between commodity market speculation and commodity prices, including corn prices.

Analysis and Results

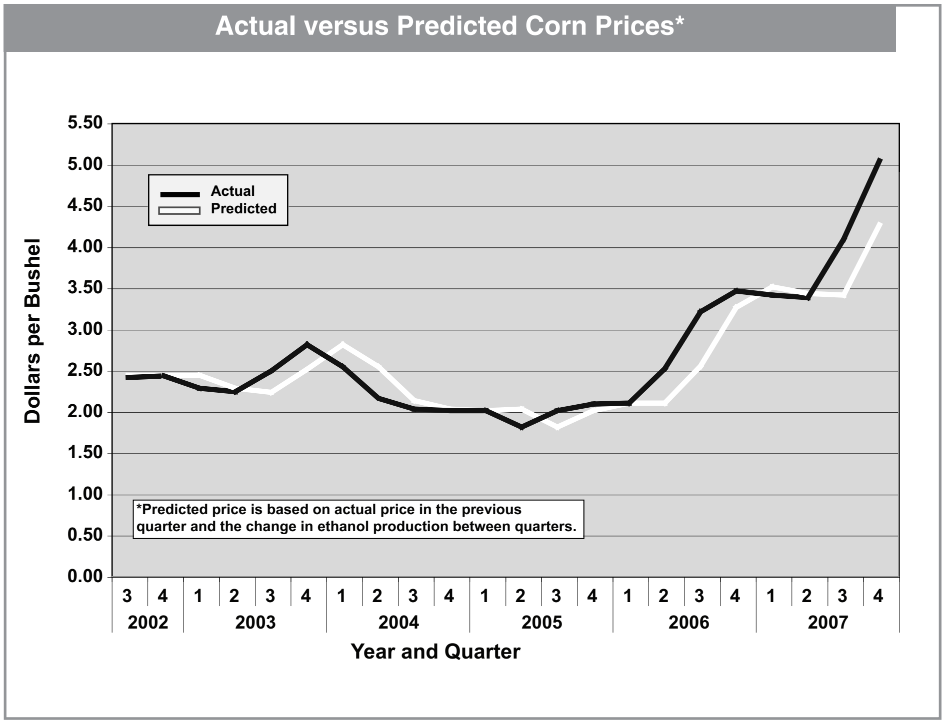
To better understand how the U.S. corn price (and by inference the international corn price) was affected by both ethanol production and exchange-rate values, we developed a set of models that replicate the supply/demand environment for the domestic corn market and measured the contributions of a variety of factors on the U.S. corn price. The intent was to see how much of the price rise between late 2006 and mid-2008 was due to ethanol production, how much to the weakening dollar, and most important, what part could not be explained by either factor, suggesting that other influences—including speculation in the corn futures market—were at play.[6]

The results suggest that a 1 percent increase in ethanol production resulted in a 0.18 percent increase in corn price in the short run. Thus, if ethanol production were to double from one time period to the next, the price of corn would increase by 18 percent if nothing else changed in the corn supply/demand balance sheet. As the market adjusts to the new price, the longer-term impact is a 0.43 percent increase in corn price for every 1 percent increase in ethanol production.

The figure on page 34 shows the projected short-term impact of ethanol production on corn price compared to actual corn prices. The data represent quarterly prices from mid-2002 through 2007. The projected price in each quarter represents the price expected in that quarter given the actual price in the previous quarter and the change in ethanol production between quarters. Note that changes in ethanol production do a reasonably good job of explaining U.S. cash corn price changes from 2002 through early 2006, but in later periods actual prices consistently exceed prices predicted based only on changes in domestic ethanol production. In the spring and summer of 2008, the spread between predicted and actual prices widened.

As noted above, the model also estimated the corn price impact associated with deterioration in the value of the U.S. dollar relative to other currencies. Changes in the dollar's value were measured by changes in the dollar index, which is a weighted average of the dollar's value relative to the values of the Japanese yen, the British pound, the Canadian dollar, the Swedish krona and the Swiss franc. Results indicated that the short-term elasticity of corn price associated with changes in the dollar's value is -0.23. This implies that every 1 percent decrease in the dollar's value results in a 0.23 percent increase in the U.S. corn price.

Considering the cumulative impact of both ethanol production and the value of the dollar from the fall of 2006 through the spring of 2008, a $0.91 per bushel year-over-year increase in the corn price would be expected. However, the actual increase in price was $2.51 per bushel. In other words, the combination of both ethanol production and the depreciating dollar account for less than half of the actual increase in corn price. While increased ethanol production has had a positive and statistically significant impact on U.S. corn prices, the tendency in the popular press to blame ethanol production for higher and more volatile food prices is overly simplistic and greatly overstates the true price impact.



What else can explain recent corn price activity? An additional factor that may have contributed to recent price action has been speculation in the corn futures market. From fall 2006 through late 2008, speculators increased their long positions in the futures market significantly and represented an increasing percentage of overall futures market activity. Coincidently, as prices began to fall in late 2008, speculative positions were reduced. Keep in mind that this only shows a correlation between speculative activity and price; it doesn't show that a change in one causes a change in the other. We are now conducting research to measure the impact of speculative activity on price similar to the measures of corn price movement attributable to ethanol production and exchange rate changes reported earlier.

Summary

This research indicates that recent corn prices cannot be explained solely by U.S. ethanol production. Demand from ethanol production has had a positive impact on corn prices. But attributing food security and access issues associated with high and volatile commodity prices to U.S. ethanol production ignores much of what has gone on in the market the last two years. Addressing the negative impacts of both high and unstable food prices in a meaningful way will require a much broader focus and understanding of current market dynamics than has generally been characterized in the most recent public debate.

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Corn-Ethanol Production in Wisconsin

Leann Tigges and Molly Noble[7] (608-890-0437)

Introduction

Some advocates of corn ethanol production claim that the industry has the potential to revitalize rural economies.[8] Such claims require empirical evidence and also deserve sociological attention, since they involve vulnerable populations. To the degree that communities depend on ethanol production facilities, they stand to lose if production of corn ethanol declines.

With this in mind, we set out to gather as much data as possible on the nine corn ethanol plants currently operating in Wisconsin. We base the following sketch of the Wisconsin corn ethanol industry on interviews with managers and owners of eight of the plants and a survey completed by all nine plants. Information about the communities in which ethanol plants are located is based on 2000 census data and 2006 U.S. Department of Commerce data.

Overview of Wisconsin Ethanol Plants

The first Wisconsin corn ethanol plant began operation in 2002, the latest in 2008. Several plants expanded production capacity over the years, but only one is currently slated for expansion. Economic and political uncertainties have led to the cancellation or postponement of plans to build several new plants.

Production capacities range from 40 million gallons per year (MGY) to 130 MGY, requiring between 14 and 60 million bushels of corn each at full capacity. Ethanol generally is shipped by a combination of truck and rail to destinations mostly within the United States and Canada. Corn is generally purchased from within a three- or four-county radius. Because of dramatic fluctuation of corn prices in the past year, some plants decreased the amount of corn purchased through contract.

Jobs

Information from our surveys supports the claim that jobs in ethanol production tend to pay more than jobs in other dominant sectors of the rural economy. The lowest-paying positions are generally production workers, maintenance workers and administrative assistants, with annual wages ranging from $30,000 to $40,000. In some cases, lab technicians and skilled production workers earn higher salaries, between $45,000 and $55,000. Management salaries are significantly higher, from $65,000 to $100,000.

However, corn-ethanol plants have a limited capacity to provide direct employment. Within Wisconsin, the largest corn-ethanol facilities employ 88 workers, while the others provide between 33 and 53 jobs. The number of jobs only minimally increases with production capacity of the plant. While plants generally recruit employees from the local labor market to fill administrative, production, maintenance and some lab positions, they often conduct a national search to fill management and higher-skilled lab positions. Several plants utilize a management company to recruit managers from outside the state.

Ownership Structure and Vertical Integration

Unlike the situation in many states with a larger number of corn-ethanol plants, none of Wisconsin's plants are owned by leading corn-ethanol producers. Most were initiated by local farming interests. However, in order to build equity, many of these local enterprises eventually sought investment from other, often out-of-state, sources affiliated with corn-ethanol production. Even when other local investment opportunities were opened up, participation was constrained by high minimum equity contributions. Only one plant is owned entirely by out-of-state interests. The result is a mix of investment sources among the different plants and considerable heterogeneity in organizational structures.

Variation in ownership structure affects not only the distribution of profits but also the governing and decision-making processes of these plants. While there is often a presumption that local ownership is optimal, the variations in ownership structure, including hybrids of local and external investment, complicate discussions about "local ownership" vis a vis the economic benefits of the ethanol industry. Rather, the combination of investments by local farmers and companies affiliated with corn-ethanol production suggests a form of vertical integration whereby independent producers or service providers each have a stake in the ownership of ethanol plants. In addition, we see evidence of vertical integration among ethanol-production companies that also own a trucking company, a grain elevator that supplies the corn used in the ethanol plant, and gas stations that distribute E85.

Co-Products

Ethanol plants in Wisconsin market both dry and wet distillers' grain. There are advantages and disadvantages to each. Dry distillers' grain is more costly to produce because of the energy needed to dry it, but has a much longer shelf life than wet distillers' grain. Wet distillers' grain, with a shelf life of about a week, is sold mostly to local livestock farmers. Because of its longer shelf life, most of the distillers' grain for most plants is dried and often is sold on the global market, much of it to Asia. Recent research has shown that there is potential for local markets to absorb a greater proportion of wet distillers' grain, thereby reducing energy and transportation costs. This could provide both economic and environmental benefits (Sinistore).

In addition to distillers' grain, many Wisconsin ethanol plants have capacity to capture and market other corn-ethanol by-products including liquid and gas CO_2, dry ice, alcohol and food-grade products such as corn oil, corn germ and corn bran. Operators of plants that market such products often refer to them as "co-products" rather than "by-products." Discussions about future expansion more frequently center on product diversification than on increasing ethanol production. Plants may be doing this as a-risk management strategy to deal with the uncertain future of the corn-ethanol industry.

Conclusion

Ownership, decision-making and product diversification will help Wisconsin's ethanol production facilities continue to be a viable part of the green economy. The fact that none of the Wisconsin ethanol plants are owned by the leading ethanol producers, combined with their ability to diversify their product line, may help them weather the current economic crisis. Our research shows that, in addition to contributing to the green economy, it may be beneficial for ethanol plants to coordinate their plans with state agendas and to utilize local resources and markets.

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Is Corn Ethanol Production a Socially Sustainable Enterprise for Wisconsin Communities?

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Introduction

Until quite recently the production of corn ethanol was a cottage industry, but over the last five years it has emerged as a rapidly growing component of the energy sector. Given the industry's recent boom and its general claims towards sustainability, a great deal of literature has been devoted to its potential environmental benefits and drawbacks. Another growing body of literature deals with the economic ramifications, including subjects such as job creation and tax revenue. But it is important that the "three-legged stool of sustainability" not have short a leg. Scholars need to give equal attention to the industry's social sustainability. We also need to assess whether corn ethanol facilities enhance the community life in the towns that host them.

This simple question immediately leads to a puzzle, at least in Wisconsin. In some Wisconsin communities, new ethanol facilities have been welcomed and have caused little local political conflict. But in others, new ethanol facilities have generated conflict from their inception. In this research, we try to answer the question: why this difference?

While local ownership and control has long been cited as a major determinant of community acceptance and conflict in the siting of industrial facilities (Heath and Fesenden-Raden, International Nuclear Societies Council, Constance), this by itself doesn't explain why some Wisconsin corn ethanol plants generate social conflict and others don't. We looked for other explanations through cases studies of four Wisconsin ethanol plants, which we selected to get a sampling of four relationships:[10]

1. Local ownership and no conflict (Friesland);

2. Local ownership and high conflict (Boyceville);

3. Non-local ownership and no conflict (Stanley);

4. Non-local ownership and high conflict (Cambria).

Of course, ownership structure can be more complex than a simple local/non-local dichotomy, and levels of conflict can be more complex than a simple high/low dichotomy. While the above plants broadly fit these dichotomies, there were important particularities to each site. In order to follow up on these particularities, we included a fifth plant in the study, Utica, a facility with largely non-local ownership but only a moderate level of

Community Conflict and Related Factors in Five Wisconsin Communities					
Community	***Cambria***	***Boyceville***	***Utica***	***Friesland***	***Stanley***
Level of Conflict	High	High	Moderate	Low	Low
Organized Opposition Group	Yes	Yes	Yes	No	No
Site Selection	Controversial	Controversial	Agreeable	Agreeable	Agreeable
Ownership Structure	Privately held, nonlocal	Local investors (60%), nonlocal investors (40%)	Privately held by non local (majority) and local	Local investment, affordable shares	State-wide investment, open but Expensive shares
Pre-existing Community Cohesion	Fragmented (newer commuters, long-time residents)	Fragmented (newer commuters, long-time residents)	Fragmented (newer commuters, long-time residents)	Cohesive (ethnic enclave)	Cohesive (active civic life, incorporation of new residents)

community conflict. In each community, we interviewed community members, farmers, municipal officials, local business owners and Cooperative Extension agents. These interviews, along with a review of local media coverage, gave us a window into how the industry affects community life.

Results

Our results (see table) indicate that while there is a connection between non-local ownership and community conflict, this is not the only factor that shapes community reception of the ethanol industry. We have identified three main factors: ownership structure (local vs. non-local), site selection (agreeable vs. problematic), and pre-existing community cohesion (cohesive vs. fragmented). Although each is important by itself, these factors interact and influence one another to produce a variety of outcomes in specific communities

Conflict at the Local Level—A deeper look

Reception of the industry on a local level varies widely from one location to the next within our group of five communities. Two of the communities —Friesland (with local public investment, pre-existing cohesion, and agreeable site selection) and Stanley (with non-local but public and state-wide investment, pre-existing cohesion, and agreeable site selection)—have experienced no notable conflict on this issue. As one Friesland resident described, "cause you have ownership in the plant, [at] the annual meeting if you don't like the way things are going you can get up at the meeting and you can tell them what you think you know."

In Cambria (private non-local ownership, pre-existing fragmentation, and controversial site location) and Boyceville (local investors but also many non-local ones, pre-existing fragmentation, and controversial site location), however, corn ethanol plants have involved considerable conflict. As one Boyceville resident described the community's discussion, "It was very polarized. Either you were for or you were against. There was nobody neutral that I saw." Many opponents from Cambria see their plant as entirely unresponsive to community needs or wants. One respondent quickly pointed out that, "… of course none of the principals involved live anywhere close to here." Utica (private and mainly non-local investment, pre-existing fragmentation, but an agreeable site location) has also experienced notable conflict, although to a somewhat lesser degree. "We had a standing-room-only crowd," said a Utica elected official, referring to a town council meeting at which a plant was discussed, "and people were standing outside the door [because] they couldn't get in… I have never been through something like this."

Conclusion

Given the geographic limitations of our study, it is difficult to make judgments regarding the industry as a whole. Within the state of Wisconsin, though, we have observed the emergence of social conflicts surrounding the industry on a local level. While some residents see the industry as locally beneficial, others perceive it as harmful to the community. Given this diversity of opinions, the presence of strong supporters and opponents has the potential to damage the social relations within a community. Based on our case studies, the introduction of a corn ethanol facility seems likely to amplify long-standing community social divisions unless other factors mitigate this potential.

Whether these conflicts are specific to this industry or whether they apply to rural industry in general is a question we leave to future research. Perhaps our identification of these three factors will provide a framework for the future analysis of conflicts in other locations. Most importantly, though, we hope to promote dialogue about the often-neglected third leg of sustainability—its social context.

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Near-Term Impacts of Bioenergy Production: Corn-based Ethanol as an Example

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Corn Production and Soil Erosion

Corn is a crop that conservationists usually associate with soil erosion. From planting in early May until the canopy closes in July, bare soil is exposed to wind and rain. The rate of erosion depends on soil properties, topography, and tillage and conservation practices. In general, erosion is greater with corn than with alternatives such as small grains, alfalfa, pasture, and other crops with tighter canopies. According to the National Resources Inventory (NRI) conducted by USDA's Natural Resources Conservation Service, Wisconsin ranks 8th in the nation in the volume of soil eroded from farm fields

NRI estimates that Wisconsin lost 31.7 million tons of soil to water erosion in 2003. A substantial portion of that soil flows down to the Gulf of Mexico, carrying fertilizer and pesticides with it. The resulting depletion of oxygen from Gulf waters creates hypoxia, a "dead zone" around the mouth of the Mississippi River. A related problem that only sporadically receives attention is the depositing of eroded soil along the way, leading to habitat loss, ship navigation problems, fishery destruction, loss of coastal storm barriers and other problems.

Donner and Kucharik, researchers at the UW-Madison Center for Sustainability and the Global Environment, recently developed a number of land-use change scenarios that could achieve federal ethanol production goals in the next 15 years. They concluded that converting either cropland or land currently enrolled in the Conservation Reserve Program (CRP) to meet federal biofuel production goals would result in continued growth of the Gulf's dead zone. Energy production and hypoxia reduction goals could only simultaneously be met under an unlikely scenario that entailed a radical reduction in meat consumption and a massive investment in energy conservation.

Use of CRP Land for Bioenergy Crops

The use of CRP land to meet bioenergy production needs is often touted as part of the solution. Long-term contracts for millions of acres of fallow fields in the set-aside programs nationwide and about 280,000 acres in Wisconsin will expire in the next five years. Recent trends indicate that rates of new and re-enrollment are down slightly. In Wisconsin, total CRP acreage declined by 1.2 percent from October 2007 to October 2008 (USDA Farm Service Agency). Although this net reduction of about 6,400 acres in 2007-2008 is small, the potential for much larger rates of conversion exist if federal policies change to allow use of these lands for energy crops.

These lands were eligible for the CRP program because they are "highly erodible" or environmentally sensitive in other ways. Fallowing these lands has halted or reversed the loss of soil organic matter associated with standard agricultural production. The potential for re-releasing this carbon and contributing to the accumulation of greenhouse gases such as CO2 also warrants attention in decisions that could return this land to crop production.

Since CRP lands are susceptible to high rates of erosion, we also need to consider if and how they can be managed safely for crop production. UW researchers Panuska, Good, and Wolkowski recently evaluated potential loss of soil and phosphorus associated with conversion of CRP land to corn production. Not surprisingly, conservation measures are essential to keep this land within regulatory limits. Specifically, continuous production of corn using the whole plant or a major portion of it (as in using corn stover for cellulosic ethanol production) is not sustainable on steep land. The study also looked at changes in soil health and concluded that these more intensive uses of CRP will lead to the long-term reduction of soil organic matter.

Environmental Impacts of Biofuel Production on Rural Communities

This section provides an overview of some of the environmental and land-use impacts of bioenergy production in Wisconsin and elsewhere and the potential for managing these impacts through better technology.

Water Quality and Quantity: Bioenergy facilities use large volumes of water. At one extreme are fermentation ethanol plants without water re-use, which can use more than five gallons of water for each gallon of ethanol produced. The Renewable Fuels Association suggests that new designs could bring this ratio down as low as 1.5 to 1, though an independent study suggests 3 or 4 to 1 is a more realistic near-term goal.

Discharged water from bioenergy facilities often contains pollutants. Reusing the water within the facility can reduce the amount of water used and discharged, making on-site or municipal wastewater treatment viable options.

Air Quality: Several air pollutants may result from biofuel and bioenergy production, depending on the process. Particulate matter occurs with the handling and processing of feedstocks. Combustion for heating or drying in any system results in greenhouse gases and ozone precursors. Fermentation generates CO2. Volatile organic compounds result from fermentation of ethanol and biodiesel production, as do carbon monoxide and other "criteria pollutants." Methane and ammonia may escape from digesters and biogas facilities. Discharge permits are required for plants expected to exceed threshold limits. Permits may impose requirements to use "best available control technology," but are also withheld in locales where ambient air quality degradation consistently exceeds standards.

Aesthetics: Dust, noise, odor, traffic, light pollution and visual blight may degrade quality of life around bioenergy facilities. These effects are not generally regulated by state or federal agencies, but clearly enter into community decisions such as zoning changes and building permits. Odor-related issues resulted in negotiations and ultimately relocation of a plant in Sparta.

Greenhouse Gases: The efficiency of biofuel production from a greenhouse gas perspective has been the subject of much research and debate. Agroecology student Julie Sinistore recently used a model called the Biofuel Energy System Simulator to do a life-cycle analysis of the energy and greenhouse gas emissions of three currently operating Wisconsin ethanol plants. She reports that:

> *"Across all scenarios and datasets, Wisconsin corn ethanol was found to produce more energy than was used to create it. Production and use of this ethanol results in less net greenhouse gas (GHG) emissions than gasoline. Corn ethanol alone, however, is not carbon negative or neutral since its production does create positive emissions. The most accessible and beneficial way in which Wisconsin corn ethanol plants could improve the energy use and GHG emissions embodied in their fuel is to feed all distillers' grains by-product (DG) locally in wet form."*

A key conclusion of this discussion is that all of the local environmental impacts are subject to management, and with careful attention to the local conditions, can be mitigated in substantive ways. In this sense, effective community discussions are likely to hinge on the capacity of participants to consider a full range of options for the processing of bioenergy and the effects of those options on a wide range of human and natural activities.

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Bioenergy Sustainability Research at the University of Wisconsin-Madison

This section highlights research into the environmental and economic sustainability of bioenergy development. Both articles describe research that focuses in part on production of environmental services. Jackson covers a number of different projects being undertaken as part of the Great Lakes Bioenergy Research Center on the Madison campus, all of which address ecosystem services. Reinemann outlines a project influenced by multiple stakeholder groups that aims to capture efficiencies and synergies among production of milk, energy and environmental goods.

Assessing the Sustainability of Alternative Bioenergy Cropping Systems in Southern Wisconsin

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Background

Massive public and private efforts are underway to eliminate bottlenecks in the conversion of vegetative biomass to ethanol. The partnership between the UW Bioenergy Initiative and the recently awarded $135 million DOE grant to UW-Madison to establish the Great Lakes Bioenergy Research Center (GLBRC) is an example of ongoing efforts to make industrial-scale cellulosic ethanol production a reality. As Timothy Baye describes in a subsequent article, bottlenecks in feedstock supply could become an issue even though molecular technologies and engineering may improve our ability to extract energy from cellulose (US DOE). To confront these bottlenecks, we need to understand which crops are most suitable and where they should be grown to maximize biomass production and carbon sequestration while minimizing energy and nutrient inputs, pest and pathogen buildup, nutrient loss and greenhouse gas emissions (Adler et al., Hill). Clearly, we will also need to understand how these crops are likely to fit into the business strategies of farmers and rural landowners.

Many types of high-yielding crops have been proposed as feedstock for the embryonic cellulosic ethanol industry. While all of these are known to produce large quantities of above-ground biomass, it is important to consider their relative sustainability under various agroecological settings (Jordan et al.). This includes the concept of ecosystem services —provisioning (e.g. food, fuel, and fiber production), supporting (e.g. soil building and water availability), regulating (e.g. climate stabilization and water quality) and cultural (e.g. spirituality, aesthetics, and educational) elements of ecosystems that promote human well-being (Stokstad).

It's essential to understand the tradeoffs among these services in order to evaluate the sustainability of biofuel cropping systems from farm to regional scales. For example, we may find that a production system that has a lower biomass yield potential may be preferred in some areas because of factors such as water use, greenhouse gas emissions or nutrient leaching. Ignoring these dimensions may make biofuel production incompatible with sustainability goals that society has deemed important through legislation (e.g. Clean Water Act, Endangered Species Act). A number of GLBRC projects focus on ecosystem services aspects of bioenergy feedstocks.

GLBRC Sustainability Research

Novel production systems. Jackson and Posner are using a subset of the Wisconsin Integrated Cropping Systems Trial (WICST) agronomic plots established at the Arlington Agricultural Research Station (AARS) in 1992 by Posner and John Hall (Michael Fields Institute) to assess the agronomics of biomass production in alternative cropping systems. In addition to the WICST plots, a new cropping systems experiment was initiated at AARS in 2008. Eight potential biomass feedstock systems, ranging from continuous corn to native grasses, are being compared for volume of production, biodiversity and agronomics.

Improved microbe-plant interactions. Jean-Michel Ane and Arijit Mukherjee are examining arbuscular mycorrhization (AM), which refers to a symbiotic association between plant roots and Glomeromycota fungi. This association strongly benefits host plants by improving the uptake of nutrients, especially phosphorus, from the soil and by protecting them against biotic and abiotic stresses. Improving the establishment and the development of AM associations, especially in sub-optimal growth conditions, has a tremendous potential to increase biomass production while limiting the use of fertilizers and pesticides.

Biogeochemical responses. Jackson is focused on above- and below-ground net primary production and greenhouse gas fluxes. He is working closely with Balser, who will characterize soil microbial communities, and Kucharik and Posner, who are describing soil C fractions at various depths under each treatment. Karthikeyan will evaluate both surface and sub-surface water, sediment and nutrient (N and P) dynamics under various plant density and weather scenarios. In addition, APEX/SWAT models will be used to assess long-term impacts of alternate biofuel production systems from field to watershed scales.

Biodiversity responses. The goals of this line of research are to (1) measure biodiversity, both as an ecosystem service and as it responds to alternative cropping system scenarios, and (2) relate biodiversity to key ecosystem services such as pollination and natural pest suppression. These measurements will help evaluate tradeoffs in ecosystem services among different biofuel cropping systems. In 2008, we identified sites to be used as "extensive" cropping systems in southern Wisconsin. Sites are interspersed in the landscape such that corn, switchgrass and prairie occur along a gradient of surrounding land-use types. Landscape composition surrounding extensive sites ranges from agriculture- to forest-dominated.

P Modeling. The objectives of the life cycle assessment (LCA) modeling are to evaluate the complete field-to-wheels system for bioenergy systems, providing comprehensive accounting of the energy inputs, energy outputs and greenhouse gas impacts of these systems. The LCA modeling project is closely coordinated with other biophysical modeling and economic modeling projects of GLBRC and is led by Meier, Gower, and Reinemann.

Sustainability of Switchgrass Production in the Driftless Area of Southwestern Wisconsin

In May 2008, Mark Renz, Steve Bertjens (Badger RC&D) and Randy Jackson established plots on 60 acres across six sites throughout Grant County to evaluate the sustainability of switchgrass as an energy crop when planted on marginal agricultural land, test how various management practices affect establishment and yield in the first three years of production, and estimate the cost associated with alternative management practices. Carbon sequestration, soil erosion, and nutrient loss as a result of establishment treatments are being estimated.

This information is critical to the development of biofuel policies because much of the economic and environmental sustainability of switchgrass production is unknown. This research will provide information about the yield of crops at the field scale and how various management methods will affect the environment.

Without this research, attempts to develop policies for the use of switchgrass or other native warm-season grasses as a biofuel will be based on data, models and assumptions from other regions that may not be representative of Wisconsin.Experiments compare four establishment methods for switchgrass and a planting of diverse native prairie grasses and forbs at each site. Initial results indicate that switchgrass establishment is improved by using the herbicide, Journey. Since no biomass has been harvested, relative yields in the establishment year are unknown.

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Energy Intensity and Environmental Impact of Integrated Dairy/Bio-Energy Systems in Wisconsin: The Green Cheese-Project

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Project Summary

This project, funded by Wisconsin Focus on Energy, aims to develop a decision aid for dairy farmers, dairy processors and policy makers that can be used to quantify the energy intensity and environmental impacts of integrating dairy and bio-fuels production systems. This tool will also allow assessment of the implications of implementing selected new technologies and management practices on the energy, greenhouse gas (GHG) emissions and nutrient balance of individual farms and of the state of Wisconsin as a whole. Dairy production is the backbone of Wisconsin's rural economy. The development of renewable energy sources, particularly feedstock for bioenergy production, will need to be incorporated into the state's dairy production infrastructure to ensure that both are economically viable and practical.

Need for the Project

There are potential synergies between bioenergy and dairy production that would benefit both Wisconsin's dairy and bioenergy industries (examples include feeding distillers' grain from ethanol production and producing methane from manure). The implications of new technologies and management decisions are often not apparent when examining a single part of this complex agricultural-energy system. This project will help us better understand the complex interaction between dairy production, energy use and energy-generation systems. Our aim is to identify practices that will provide benefits both at the individual farm and the state level.

This project grew out of discussions among many stakeholders. Progressive dairy producers understand the need to prepare for carbon trading and other opportunities created by concerns about energy security and the environmental consequences of energy use. State agencies such as DNR and DATCP can use the results to help provide regulatory or assistance programs for dairy farms moving toward more sustainable production practices. And UW-Madison faculty members want to expand research, teaching and outreach activities related to sustainable dairy production systems. All of these collaborators have provided input into the design of the project.

Project Goals

- Quantify how 'greenly' Wisconsin produces cheese and other dairy products.
- Compare the efficiency and environmental impact of different production systems (e.g. grazing vs. confinement) and specific energy generation and conservation technologies.
- Compare the energy efficiency and environmental impacts of Wisconsin's dairy production systems with those in other regions.
- Investigate synergies and opportunities to reduce energy intensity and environment impact of both dairy and bio-fuel production by integrating these two systems.
- Provide individual dairy farms guidance as to how to improve their energy efficiency, reduce environmental impact and prepare to take advantage of carbon trading markets.
- Provide policy makers a method to estimate the energy and environmental impacts of statewide policies and incentives.

Our model will include several components: Crops and soils issues (including energy used to produce feed and biofuel feedstock as well as nutrient implications of applying dairy manure), feed choices (in terms of milk conversion efficiency and nutrient outputs), on-farm energy use and production, milk transportation and dairy plant processing, and bio-fuels production and use of byproducts.

The project aims to develop two user interfaces. One will help farm managers estimate energy intensity and the GHG footprint of their operation and choose technologies and practices that will reduce energy intensity (Joules/kg of milk produced) and reduce environmental burden (kg CO_2/kg milk produced, kg N/P/K in waste streams/kg milk produced). The other will calculate the implications of large-scale use of specific technologies on the state's energy and GHG balance, using predictions of the distribution of herd size and penetration of technologies being investigated.

Prospects for Bioenergy Development in Wisconsin

This final section explores the prospects for a dynamic bioenergy sector in the context of Wisconsin's diverse agriculture from three perspectives. McCown highlights the diversity of the state's agriculture and offers examples of bioenergy projects and policies that take advantage of unique local conditions. Baye identifies factors that will shape the efficacy of institutions and contracts for biomass given diverse landowners and producers. Ventura reflects on future environmental outcomes related to bioenergy, agriculture, and climate change in Wisconsin.

Approaches to Using Sustainable Bioenergy Crops to Build on Wisconsin's Agricultural Diversity and Entrepreneurship

Brent McCown[14] (608 262-0574)

Introduction

At a 2007 Earth Day event sponsored by the UW-Madison Nelson Institute for Environmental Studies, DATCP Secretary Rod Nilsestuen commented on a report ranking Wisconsin among the highest of the 12 North Central states in bioenergy potential:

"This shows the diversity of opportunities for Wisconsin in new renewable biomass conversion to biopower and biofuels. The Wisconsin competitive advantage in agriculture and the bioeconomy has always been our diversity of products and feedstocks."

Wisconsin is, indeed, blessed with a wide variety of physical, biological and societal traits (see Wisconsin Academy, 2007). In traveling east to west or south to north in the state, one passes through at least three climatic/vegetation zones, some regions highly impacted by glacial activity and others escaping the most recent glacial advance; watersheds of two major river systems as well as the Great Lakes; and an assortment of native American and immigrant histories and settled regions. Such natural and cultural richness has nourished the comparable richness of our agriculture.

One measure of this diversity is the number of different types of crops. The 2002 Agricultural Census records 15 commodities that are produced on at least 1 percent of all Wisconsin farms (Illinois and Iowa have 10 or fewer of such crops). Another example is specialty cheese, which accounted for more than 16 percent of total cheese production in 2007 (Wisconsin Milk Marketing Board). Recent growth illustrates the power of the entrepreneurial spirit in Wisconsin agriculture. More than 70 percent of the state's cheese plants now produce at least one specialty cheese, seeking to exploit a growing value-added market.

Accommodating Agricultural Diversity in Bioenergy Development

How might the development of the bioenergy industry relate to our agricultural diversity? A recent article in Science (Jordan et al.) proposes two paths:

1. A diversity of entrepreneurial approaches to producing and harnessing bioenergy crops may enhance viability. Though regions of Wisconsin might find it difficult to compete in national or international bioenergy commodity markets, there may be options like the case of specialty cheese for pursuing a locally tailored, value-added energy strategy that is compatible with available resources, creativity, social needs and natural advantages and disadvantages.

2. Public recognition of the value of ecological and social services produced by perennial bioenergy crops would enhance a diverse bioenergy sector. Agricultural producers are both producers and land and ecosystem managers. As such they produce social benefits or "ecological services," (e.g. agrotourism scenery, clean water, carbon sequestration, wildlife habitat) as well as food, fiber and energy. Numerous studies have documented the potential social benefits of perennial bioenergy crops that avoid the costs and problems associated with yearly soil manipulation, planting and soil disturbance. But unless farmers' earnings reflect these benefits, most bioenergy crops will be unlikely to yield high value to the landowner, and the sector's performance will fall short of its potential.

Example Projects

Despite the widespread interest in perennial bioenergy crops, the sector is too new to offer well-documented cases of the benefits and costs of initiatives that encompass energy products and ecological services. However, following are some examples of intriguing initiatives underway in the Upper Midwest.

Madelia community project. The city of Madelia in southwest Minnesota is working with a variety of partners on a renewable energy project based largely on perennial biomass grass production. Key objectives are:

- Energy security from local production of mostly perennial biomass crops

- Increased economic and environmental sustainability of family farms
- Improved ecological health
- A strong community pride and vibrancy

Koda Energy plant project. The Koda Energy Project is in the lower Minnesota River Valley around the city of Shakopee, Minnesota. The Rahr Malting Company formed Koda Energy LLC to create a biomass co-generation system based on both locally produced agricultural by-products and new bioenergy crop production. Enough demand is anticipated to require 25,000 acres of locally grown energy crops. The idea is that biomass farming can provide both a viable income to local farmers and numerous environmental and social benefits. Multi-stakeholder teams are developing business plans and other community initiatives.

The Driftless Area Initiative. This is a collaboration of six non-profit Resource Conservation and Development Councils in Wisconsin, Iowa and Minnesota as well as other partners. The initiative aims to develop pilot projects that use perennial biomass energy crops. Entrepreneurial efforts by businesses, communities and utilities are seeking to utilize wood and grass for heat, energy or fuel needs depending on local resources and objectives.

Pelletization of biomass. A number of pelleting plants are operating or planned in Wisconsin. For example, Superior Wood Products hopes to construct a large plant in Bayfield County. Agrecol Corporation has documented the costs and potential of pelleting in the Upper Midwest. Smaller efforts are being supported by the Driftless Area Initiative. Pellet systems could provide a uniform product from an array of local and regional crops (trees, grasses, fiber waste) that could be used by homeowners, communities and industries to meet a diversity of local market demands and community goals.

All of these initiatives seek to strengthen the role of rural communities in the biofuel industry. Carolan et al. argue that this strategy may be one of the few practical ways to approach some of the major problems (i.e., bulkiness and high transport costs) with utilizing biomass for energy. Regional processing centers and local use could provide ways for farmers and communities to capture more of the market and social benefits associated with bioenergy and nourish rural development and entrepreneurial vitality.

Examples of policies to stimulate sustainable bioenergy

Incorporating the ecological services provided by biofuel sources such as perennial crops will require supportive public policies aimed at creating payment schemes for providing these services. Efforts in that direction are underway. One example is the Wisconsin Office of Energy Independence's initiative on community bioenergy vitalization, which helps communities develop ideas for using renewable resources to meet power needs. About 40 communities have passed resolutions to generate 25 percent of their electricity and transportation energy needs through these resources.

Another example comes from Minnesota, where in 2007 the legislature called on the state's Board of Water and Soil Resources to establish and administer a "Reinvest in Minnesota" clean energy program. In January 2008 the board recommended a tiered payment system that would encourage landowners to grow native perennial plants on suitable lands.

Finally, a survey co-sponsored by the Department of Natural Resources shows that Wisconsin woodland owners weren't all that interested in payments for woody biomass and biofuel, but were quite interested in receiving support for such ecosystem services as carbon crediting. Again, the melding of bioenergy yields with other services to the community and state seems to be key to the sector's development.

Summary

Developing bioenergy sources in Wisconsin could build upon the state's diversity and innovative history to create uniquely sustainable ventures. It makes sense to emphasize business and development models that combine elements unique to local and regional contexts and to seek policies that compensate landholders for the broader benefits of biomass cultivation. This combination could add to our diversity and put an array of bioenergy crops on the list of significant Wisconsin farm products.

References:

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Institutional Transition Issues in Bioenergy: Markets & Contracting

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Biomass Conversion Markets

One of the most difficult challenges of developing biomass energy systems is ensuring a reliable supply of biomass from a diverse set of producers while preventing environmental degradation. Biomass supply requirements vary by the firm's size and the type of technology it uses to convert raw material into consumable products and services.

To date, most U.S. biomass markets have relied on existing commodity markets for feedstocks. Corn, soybeans, wheat and rapeseed along with forest product and agricultural residuals have been the backbone of renewable energy feedstocks. Markets for these commodities have transparent, reliable pricing indicators and established logistic systems that have provided biomass converters with a working supply chain. But increasing demand for bio-power by electric utilities (driven by regulatory mandates) and the growing demand for biomass-based transportation fuels could overwhelm the existing biomass supply. Increasing demand for heat and power from homes and businesses adds additional pressure.

This suggests the need for innovative business models, sourcing and methods of contracting and pricing to ensure that supply keeps up with demand. The emergence of markets for cellulosic materials, for which there are no established pricing mechanisms, will require new types of business models.

Here's how some major sources of biomass are currently procured:

1. **Forest/woody crops**—whole tree, coarse and fine woody material—are purchased via bids or through contracts for land management/thinning.

2. **Materials grown specifically as biomass**—either silviculture (woody) or agricultural production (grasses) —are purchased directly from the producer or grown by a third-party on leased lands.

3. **Agricultural residuals**—corn stover, alfalfa stems, wheat and rice straw, etc.—are purchased via a voluntary drop-off system; there are few long-term contracts.

4. **Residuals from processing** of agricultural or forest products are purchased directly from processors under contracts, ranging from one-time transactions to continuous relationships

5. **Urban organic wastes, construction** and **demolition materials** are supplied via long-term contracts.

Role of the Landowner/Producer

The key to developing a sustainable biomass supply system rests in biomass converters being able to find reliable supplies of feedstock. Other than those contracting for urban wastes, biomass firms will have to draw from a land base adequate to meet their volume and quality requirements.

A key in this is to recruit property owners to commit their land to this purpose. Biomass production presents a new opportunity for property owners and a new set of challenges for both producers and purchasers.

Wisconsin landowners have numerous land-use options, each of which generates economic returns as well as aesthetic and environmental benefits. There are usually transparent methods for comparing economic benefits of alternative land uses. But biomass production is not typical. Introducing markets for which benefits are based upon BTU yield, longer-term contracts, and new cultural and management practices — to say nothing of the possibility of carbon or ecological service markets — presents a complex set of challenges.

Biomass Supply System: Business Model and Contracting Options

The biomass converter's primary challenge is to provide energy of consistent quality at competitive prices, while at the same time navigating the thicket of procuring feedstock. Customers expect bioenergy producers to behave like other, conventional suppliers of fuels and other forms of energy. They expect just-in-time deliveries, rigid fuel specifications, long-term contracts and performance warrantees, and assistance in budgeting and planning. But the biomass converter must also understand the methods and cultural environment of those who produce biomass as well as mechanics of transporting and storing it.

So far, firms seeking biomass have gone after the "low-hanging-fruit" — forest or agricultural processors selling residue generated by their core business. Some of these processors have added densification systems (pelletizing, cubing, etc.). In most cases, they sell their products to larger users or to commercial or retail customers through established distributors. Emerging industrial markets demanding large volumes of feedstock are placing new pressure on these suppliers. These markets will likely need dedicated or targeted sources of feedstock.

Business models involving large-scale aggregation of feedstock will require significant managerial, production and financial resources. Producers can collaborate (e.g., through cooperatives) to help manage risk by distributing the land base, and, if the cooperative also has an equity position in the fuel pre-processing, a hedge against price volatility. Other models will involve joint ventures among firms that already produce or convert biomass and want to vertically integrate. While business opportunities for the small producer will exist and likely grow, participation with a larger-scale aggregator will likely be common. The magnitude of financing for large-scale biomass conversion will require stable and reliable biomass suppliers. So far, such suppliers are not common. However, the industry is changing rapidly. Contractual innovations, governmental programs and volatility in prices for other commodities are, in part, fostering this activity.

Contracting with feedstock producers will likely involve many forms of agreements. In some cases, where the producer assumes all the risks, a daily spot market may reflect transaction prices. Land leases, under which the land is worked by a third party or by the biomass purchaser, may also be common. Forest biomass prices will likely be driven by prevailing prices in alternative markets such as pulpwood until loggers improve their ability to accurately assess BTU value of feedstocks. Dedicated biomass crops will likely require long-term contracts with pricing that reflects both the value of the fossil fuels being replaced and economic incentives provided by subsidies, tax credits or carbon markets.

Public Policy Considerations for Biomass Supply Business Development

The arrested development of biomass production has followed a chicken-or-egg scenario. Without broad and stable markets, there is limited incentive for potential biomass producers. Without stable and secure supplies of biomass, converters are hesitant to commit to biomass as a feedstock.

Recent federal and state policy proposals aim to address this problem. Minnesota and Missouri have attempted to provide incentives to establish dedicated biomass crops. The 2008 Farm Bill calls for the establishment of the Biomass Crop Assistance Program, which would provide cost-sharing for establishment of dedicated biofuel crops and subsidies for the first two years to offset opportunity costs of converting from conventional crops.

Market enhancements are also important policy options. One such enhancement is the "feed-in-tariffs" for electrical generation from renewable generators. This approach, commonly used in Europe, would set minimum prices paid to converters who sell their electricity to utilities or transmission firms. Feed-in-tariffs reduce the price risk for biomass converters, thereby diminishing the market uncertainty for biomass suppliers.

Conclusion

The importance of a reliable source of biomass as a raw material for energy sources is widely recognized by both industry and policymakers. Development of a sustainable biomass supply industry will require the formation of stable and secure markets, risk-taking behavior by producers and aggregators, and astute governmental policies that reduce obstacles to entering this industry.

Long-term Environmental Impacts of Agricultural Intensification and Use of Marginal Lands

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Intensification

Agricultural intensification refers to producing a higher value or volume of production from the same land base. Efforts to increase the volume of both food and fuel production require either agricultural intensification or use of currently marginal lands. Both processes raise concerns about long-term environmental effects that warrant further research.

Intensification frequently requires more inputs, particularly fertilizers and pesticides, and thus increases the risk of environmental leakage — transforming agricultural chemicals into nonpoint source pollution. Loss of soil organic matter and soil health are major concerns over the longer term as well. Intensification of biomass production is likely to require increased removal of plant material, leaving less to replenish soils. Rules of thumb for estimating proper levels of intensification are common but inadequate, because the rate of organic matter incorporation and breakdown is highly variable, dependent on topography, climate, soil conservation practices and soil erosion rates, soil fertility status, soil type, soil microbiota, and other factors. Research to establish viable economic and agronomic rates of biomass harvest under a wide variety of conditions could help to get us beyond rules of thumb and will be especially helpful if nascent carbon markets, such as a cap-and-trade regulatory mechanism, emerge. Jackson's research highlighted earlier in this article is one potential contribution to this knowledge gap

Marginal lands

With a land area of nearly 35 million acres and crop production from only 8.5 million acres in 2008, it seems that Wisconsin should have plenty of land available to grow more crops. To begin to understand how much marginal land there might be available for bioenergy crops, Garcia and Ventura developed an analysis tool that uses satellite imagery to detect all of the state's "open land" — undeveloped land without a closed forest canopy that is not currently in cropland. The satellite images are then paired with detailed soils data on these lands to identify which areas might be suitable for production of corn, switchgrass or willow (woody biomass managed in short rotations, essentially as an agricultural crop).[16]

The bottom line is that if every nook and cranny in the state were used, about 5 1/2 million acres of underutilized and marginal land are available for bioenergy crop production. Of course, most of this land currently has other purposes, often related to ecological services such as wildlife habitat, groundwater recharge, erosion control, flood protection, and so forth.

While this analysis indicates a potentially abundant supply of land available for energy crop production, the task of assessing the viability of these lands raised more questions than it answered. Key questions involved what crops to grow on marginal lands, how best to grow them, and under what conditions might economically and environmentally sustainable outcomes emerge. The highly variable conditions of marginal lands, and their underlying fragility, render general programs and rules too imprecise to offer much guidance. The potential diversity of conditions, practices and outcomes calls for a deeper understanding through careful research at experiment stations and on private farms.

This need for research on use of marginal lands rings particularly true when we consider the possibility of changing climatic conditions over the next 10 to 20 years, the potential effects of major negative weather events on marginal lands, and impacts of climate change on crop options around the state. It seems apparent that global climate change is affecting weather patterns in Wisconsin. Steve Vavrus at the Center for Climatic Research has shown not only that precipitation in southern Wisconsin has steadily increased in the last decade, but also the intensity of storms has increased substantially as well. This increase in the number and intensity of storms makes careful crop management imperative.

Of course, greater climate variability can also mean too little precipitation and excessive heat that may be detrimental to some crops. Cranberries and blueberries are obvious examples, but even corn and alfalfa, mainstays of Wisconsin agriculture, have limits on their temperature tolerances. Understanding how to manage these extremes under diverse conditions is another area for continuing agronomic, economic and ecological research.

Another interesting dimension is what climate change may do to agricultural production areas of Wisconsin. The short growing season of the northern one-third of Wisconsin currently inhibits widespread corn cultivation. However, if climate change trends of the last 20 years continue for another 20 years, all of Wisconsin may be available for corn production with the long-season varieties favored by growers for their productivity.

Summary

Agricultural intensification and increased use of marginal lands are both likely outcomes in the near to medium term in Wisconsin. Bioenergy demands, food and fiber demands from populations with rising incomes, and climate change are all potential drivers. For Wisconsin to have a healthy and productive agriculture that contributes to growing needs for food, fiber and fuel in the coming decades, we will need to deepen our knowledge about how our diverse landscape and diverse agricultural sector can be best integrated to meet the goals of farmers, rural communities, consumers, and future generations under what could be highly variable economic and environmental conditions.

Reference:

Garcia, C.H. and S.J. Ventura (2008). *Marginal Land for Energy Crop Production in Wisconsin.* Report to Wisconsin Department of Agriculture, Trade and Consumer Protection. Land Information and Computer Graphics Facility, University of Wisconsin-Madison.

Concluding Remarks

The growth of corn ethanol and other biofuels gives us the opportunity to look back and learn from experience. It is evident that many crop producers, processors and rural communities have realized economic benefits as a result of this expanding market. Beyond direct economic gains, bioenergy production offers a wide range of potential benefits, from increased national security to decreased carbon dioxide emissions. These benefits, reinforced by federal mandates to blend ethanol in gasoline, provide a strong draw. They have led to remarkable growth in production — and in research — to serve this promising evolving market.

At the same time, expanding bioenergy production has led to a deeper analysis of its potential impacts. A major concern at national and international levels continues to be the potential competition between food and energy crops. Work by Fortenbery and Park shows that although growth in ethanol production has had a positive effect on corn price, other factors drove most of the price increase (and decrease) witnessed in the past three years. This work leads to a broader understanding of ethanol and corn market dynamics that will give us insight into how future trends in bioenergy production will affect food prices, and ultimately allow for better public policy on this crucial issue.

Wisconsin's experience with corn ethanol plants reveals important community-level effects of bioenergy production and processing. Surveys of communities and ethanol processing facilities in Wisconsin conducted by UW-Madison rural sociologists indicate that community impacts and acceptance vary with the characteristics of the facility and the community in which it is located. Research by Tigges and Noble indicates that while bioenergy processing facilities add a number of high paying jobs to rural communities, the long-term viability of these facilities depends on ownership structure and product diversification. Robinson and Bell highlight how local ownership structure, site selection and community fragmentation affect community acceptance of processing facilities. Given the importance of a wide range of siting decisions in rural development outcomes, an improved understanding of these nuances will help to guide future bioenergy and other large-scale economic initiatives.

The environmental impacts are also a major concern. Ventura's article illuminates the tradeoffs between expanded crop production and environmental objectives. While generalizations about these tradeoffs provides some basis for dialogue, Ventura points out the need for deeper systems analysis that integrates agronomic, economic, ecological and social factors with spatially specific data.

Environmental concerns are likely to be increasingly central to economic outcomes. Consumers, government and other forces will encourage market and regulatory incentives to motivate producers to include goals beyond those related to production. How quickly, for what activities and in what combinations these incentives will emerge is uncertain. In anticipation of measuring synergies and tradeoffs associated with the integration of production and ecosystem objectives, research initiatives by Jackson, Reinemann and others lay the groundwork for incorporating ecological services into market mechanisms. Such an expansion of market factors could lend value to producers while improving the environmental performance of production systems. In turn, it may open opportunities for alternative production systems akin to how local, organic and pasture-based markets have created value-added options for a subset of Wisconsin farmers.

Regardless of how inclusive these environmental services are, opening future bioenergy markets to Wisconsin producers and consumers will require effective institutions and policies to reduce uncertainty and encourage landowner participation. McCown points to diverse examples of local institutions designed around small-scale bioenergy production systems. Baye notes that in the broader biomass market, producers, aggregators and processors will all incur substantial risks entering bioenergy markets and contracting schemes that require new crops, especially permanent groundcover or trees. Well-constructed institutions and policies can help to manage these risks and encourage budding markets to form, he argues. Ventura leaves us with the observation that future climate variability and potential markets for environmental services like carbon sequestration accentuate the importance of localized and dynamic environmental decision tools in constructing sustainable bioenergy production systems.

The emergence of the corn ethanol market has shown that there is both promise and potential risks in expanding bioenergy production. Given the continued demand for energy using a broad array of biomass sources, now is the time to glean what we can from the past and think critically about how to construct and nurture a bioenergy future that is most beneficial to Wisconsin's people and environment. Such an effort will require continuous systematic appraisal by a range of scientists who are able and willing to combine their specialized knowledge into integrated analyses. That kind of work is not easy, but the knowledge that results is critical importance to landowners, local communities, and other decision-makers concerned with how bioenergy and agriculture can be most appropriately combined.

Endnotes

[1]Barham is Professor and Chair, Department of Agricultural and Applied Economics; and Turnquist is an Outreach Specialist, Program on Agricultural Technology Studies, UW-Madison.

[2]In Part I of this document, both Tigges and Noble and Ventura discuss this subject.

[3]For an example of proposed production and processing systems, see: Carolan, Joseph E., Satish V. Joshi, Bruce E. Dale (2007). Technical and Financial Feasibility Analysis of Distributed Bioprocessing Using Regional Biomass Pre-Processing Centers. Journal of Agricultural and Food Industrial Organization. Vol. 5, Article 10.

[4]For a more detailed analysis of expansion and diversification in the diary industry, see PATS (2005). *Research Summary 7: Expansion, Modernization, and Specialization in the Wisconsin Dairy Industry.* http://www.pats.wisc.edu/publist.htm.

[5]Professor, Agricultural and Applied Economics and Director of the Renk Agribusiness Institute; and PHD candidate, Agricultural and Applied Economics, respectively.

[6]While the impact of petroleum prices on ethanol prices is a parallel concern, that is a demand-side factor of ethanol production that we do not address here. For an analysis of this issue by Iowa State University economist, Bruce Babcock, see http://www.card.iastate.edu/iowa_ag_review/fall_08/article1.aspx.

[7]Professor and Chair, Department of Rural Sociology; and PHD candidate, Department of Rural Sociology, respectively

[8]For examples of this discussion, see: Urbanchuck and Kapell, Urbanchuk, Swenson and Eathington, USDA-CSREES, RFA Ethanol Industry Outlook, Morris, and EAA.

[9]Agroecology PHD candidate, and Professor, Department of Rural Sociology, respectively.

[10]Because we conducted our study in tandem with a research team studying ethanol economics, our selection of sample communities was also constrained by the willingness of local ethanol plants to participate in both studies.

[11]Chair, Department of Soil Science; Professor, Environmental Studies and Soil Science, and Director, Land Information and Computer Graphics Facility

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[13]Professor, Department of Biological Systems Engineering. Participating researchers are: Thais Fonseca, Paul Thompson and KG Karthikeyan (Biological Systems Engineering), Louis Armentano and Victor Cabrera (Dairy Science), and John Norman (Soil Science).

[14]Professor, Department of Horticulture, and Director, Center for Integrated Agricultural systems

[15]Area Business Agent, Community, Natural Resources and Economic Development Program Area, Cooperative Extension, UW-Extension.

[16]Detailed county maps depicting the location of this acreage will be available at the Wisconsin Bioenergy Sites and Sources website: http://www.uwex.edu/ces/cced/bioeconomy/index.cfm.