PURDUE AGRICULTURAL ECONOMICS REPORT

FEBRUARY 2004

Agricultural Outlook for 2004

Happy days could be here again as Indiana farm income prospects appear to be favorable in 2004. Higher incomes are expected to be led by higher corn, soybean, and wheat prices both for old crop in storage and for 2004 crops as well. Even though costs of grain production will be up sharply, strong crop prices are expected to more than offset rising input prices. Key to the strong grain prices will be rising demand due to the rapid growth in the U.S. and world economies, low interest rates, and a weak U.S. dollar which will stimulate agricultural exports. The fortunes will not be as positive for animals industries however. The beef sector will continue to be impacted by BSE, and continued large hog and milk production in combination with higher feed prices may prohibit positive returns.

Economy Roars to Life

Larry DeBoer

The 8.2 percent surge GDP for the third quarter of 2003 was probably the beginning of a more rapid recovery pace. However, much depends on upcoming willingness of businesses to invest in plant and equipment. Their 18 percent annualized increase in spending in the third quarter provides evidence of the strong potential. Other indicators that point to favorable business investment are continuing low interest rates and growing orders for capital goods. There is still excess capacity in factories and equipment that are not being used, but capacity utilization has already begun to recover which is a positive sign. Also since technology has changed rapidly, plants that reopen may require considerable upgrades of new equipment. Overall, growing business investment is expected to be an added stimulus to the economy in 2004.

Consumers lead the economy and their growing optimism remains the most important aspect for the improving outlook. In addition, housing construction continues to boom and defense spending is likely to rise, although Federal domestic spending and state/local spending will not. The declining value of the dollar and greater economic growth in economies of Europe and Japan should help increase exports and cause the trade deficit to fall a little. These positive factors are expected to result in growth in the Gross Domestic Product of four percent above inflation in 2004.

The unemployment rate should fall with GDP growing at this rate. It is likely to fall, but rising productivity and industry restructuring could slow employment growth compared to past recoveries. The unemployment rate should fall to 5.5 percent by late in the year. Core inflation—not including food and energy prices—should remain around 1.1 percent. But increases in energy prices will add to the overall inflation rate. Expect inflation of two percent over the next twelve months.

What about interest rates? The Federal Reserve is done cutting interest rates for now. With an increasing growth rate in the economy we expect increases sometime during the year. Expect the 3-month Treasury interest rate to rise to 1.5 percent by December 2004 (up from about .9 percent currently). More rapid expansion and Fed rate hikes should put upward pressure on long term rates as well. The 10-year Treasury interest rate should be about 4.5 percent by the end of the year compared to 4.1 percent now.

In This Issue

Potential for Record Ag Exports

Philip Paarlberg and Philip Abbott

The current forecast for the value of

U.S. agricultural exports for 2003/04 is very uncertain due to the loss of beef export due to BSE. Prior to December 23, 2003, it appeared U.S. agricultural exports might reach $60 billion. That level would have matched the previous high reached in fiscal year 1995/96. With the halting of U.S. beef and cattle exports due to BSE, U.S. agricultural exports will be closer to $58 billion. The remaining strength in exports is largely due to increases in both price and export volume for cotton, export volume for wheat, and prices for soybeans and products. For most other commodities, prices and export volumes are forecast to be moving in offsetting directions which dampens the effect on value. While short U.S. crops are a major cause of higher prices, another contributing factor is the weakening U.S. dollar.

Higher prices and a strong U.S. economy also boost U.S. agricultural import value to around $49 billion. In contrast to exports the effect of a weakening U.S. dollar should be to dampen imports, but that effect is not yet apparent. Imports of $49 billion would leave the U.S. agricultural trade balance at $9 billion.

As an alternative to the failed World Trade Organization (WTO) agreements, last fall in Cancun, the United States is expanding its use of regional and bilateral trade agreements, termed "competitive liberalization." One of the major regional trade agreements pursued by the United States has been the "Free Trade of the Americas (FTAA)." The FTAA talks however have made little headway on agriculture.

With both the WTO and FTAA negotiations facing problems, the United States sought trade agreements with other nations. Negotiations with several nations were completed or underway, including Morocco, Australia, and nations in Latin America. An agreement with four Latin American nations was reached in late December. About half of U.S. agricultural exports will be duty free at the beginning. For sensitive commodities the phase in of duty reductions varies from 5 to 20 years.

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Some Changes in 2004 Farm Programs!

Allan Gray

For 2004 to 2007 crops there are

slight changes for corn and wheat compared to 2003 crops. The corn target price rises by three cents per bushel to $2.63, while county loan levels will drop by three cents. For wheat, target prices rise by six cents per bushel and county loans rates fall by three cents per bushel in Indiana. These changes have two impacts. First the increase in the target price makes the level of government support slightly stronger (particularly if prices are low), and second, they increase the odds that greater payments will come from the government in the form of Counter Cyclical Payments. The soybean target price and loans are unchanged for the 2002 to 2007 crops.

Other important policy issues for 2004 include provisions for COOL, the Conservation Security Program, Equip, the energy bill and ethanol use, and a study on changing payment limits.

Country Of Origin Labeling (COOL) provisions contained in the 2002 Agriculture Act have been delayed until 2006, except for specific fish species. In addition, the budget bill caps spending for the new **Conservation Security Program** (CSP) at $41 million which is substantially below the anticipated program needs and will thus, greatly limit the number of producers that can be reached in fiscal year 2004. The bill also limits spending in the **EQIP** program to $975 million dollars for fiscal year 2004 which is about $25 million less than was authorized. The program does not impact commodity support payments such as loan deficiency payments, Counter-Cyclical payments, or Direct payments.

Last fall, the joint House and Senate conference committee reached a compromise on the **Energy Bill**. The House has approved the compromise bill. The Senate has not approved the bill as Democrats have blocked a vote on the bill through the use of filibuster rules. The Senate Democrats want concessions in the bill to allow companies that produced MTBE to be sued for higher liability amounts. Until these concessions are made it is unlikely that the Energy bill will reach a vote in the Senate.

The bill can be important for corn and soybean producers because of its targets for use of biofuels. The bill targets the use of 3.1 billion gallons of biofuel by 2005 and 5 billion gallons by 2012 in the nation's fuel supply. The bill also extends the current subsidies for ethanol to 2012. Finally, the bill introduces an excise tax credit to blenders of biodiesel. The tax credit would be $0.01 per gallon for each percent of biodiesel blended with diesel. For example, a blender that blends two percent biodiesel with regular diesel, commonly known as B2, would receive a $0.02 per

gallon credit towards their excises taxes. This should increase the demand for biodiesel.

The 2002 Farm Bill contained language authorizing a **Payment Limits** Commission. One of their major findings was that current payment limit policies drive producers to choose certain organizational structure in order to avoid the payment limits. They recommend that Congress eliminate the entity rule for payment limits. This would effectively tie payments directly to a person and not to a particular entity. Other findings from the commissions study were that current enforcement of payment limits is erratic, as lack of data to attribute payments to individuals makes it difficult to fully understand the impacts and that the Farm Service Agency needs more manpower to credibly enforce any payment limit structure. Finally, the commission could not agree on whether to eliminate generic certificates as an option when the producer reaches the payment limit for loan deficiency payments with half the commission for, and half against elimination. In any case, the commission recommended that no changes be made to the current payment limit system until the 2007 Farm Bill and any changes made at that time should be phased in over a 3 to 5 year period.

Crop Costs Turn Higher

Alan Miller

Indiana crop production costs will increase for the second year in a row in 2004. Average production costs per acre are forecast to increase almost seven percent for corn and soybeans grown in a 50-50 rotation as much as 7-10 percent. Fortunately, expected higher revenues will outpace rising costs providing the opportunity for an additional $18 or more per acre of net returns relative to our forecast a year ago in January.

The high price of natural gas has created unprofitable operating conditions for U.S. producers of ammonia-based nitrogen fertilizers. Ammonia producers are likely to idle plant capacity and reduce product inventories. More of the ammonia product used in the U.S. this year will likely be imported.

Farm prices for nitrogen fertilizers appear to be up about 26 to 31 percent relative to a year ago in early January and will likely stay there given high natural gas prices.

Phosphate fertilizer is in tighter supply this year. Prices appear to be up about ten percent from a year ago. Potash is also up about eight percent. As a result of higher N-P-K prices, the fertilizer cost for corn grown in a 50-50 corn-soybean rotation on average quality Indiana land is expected to be up about $11 per acre in 2004 relative to a year ago.

Seed prices are moving upward as well. The price of Roundup Ready© soybean seed varieties, which are planted on about 90 percent of the state's soybean acres are up around eight percent. This change is primarily due to an increase in the royalty fee associated with the Roundup Ready© trait. Corn seed prices appear to have increased overall, although that certainly isn't true for all varieties. Farm chemical prices will be a mixed bag depending on products and formulations. Individual product price increases are expected to range from 0 to 5 percent. Higher production costs will also increase the interest expense of producers who borrow money to purchase inputs. In addition, the cost of renting farmland is expected to be up slightly once again in 2004.

The variable costs of growing corn in a 50-50 rotation on average yield land are expected to be about $17 per acre higher than last spring. The costs of growing rotation soybeans are expected to be about $7 per acre higher.

Specific estimates for 2004 costs for various land qualities and rotations can be found in the *Purdue Crop Cost and Returns Guide January 2004 (ID-166).* This is available on the Internet at http://www.agecon.purdue.edu/extension/pubs/ or from any County Extension office in Indiana.

Crop Rotations for 04: More Beans?

Alan Miller and Craig Dobbins

Part of the benefit of higher crop prices is being lost to higher production cost, especially for corn. For average soils, forecast per acre return above variable costs on average soils is $154, $176, $152, and $156 for rotation corn, rotation soybeans, second-year soybeans, and wheat, respectively. These estimates indicate that a corn and soybean rotation continues to provide the best returns. Second year soybeans provide a return that is $2 less than rotation corn. For high productivity soils, second year soybeans are forecast to have a $1 per acre greater return than rotation corn. For low productivity soils, wheat provides the greatest net return followed by rotation soybeans, and rotation corn. These forecast net returns indicate that Indiana growers will have economic incentive to plant soybeans in 2004 despite the disappointing soybean yields in parts of Indiana; however, this incentive isn't nearly enough to justify messing up a good rotation.

This aforementioned forecast assumes that soybean yields will continue in 2004 to be approximately one-third of corn yields on a given piece of ground. Where bean yields have fallen below the 1 to 3 ratio, both rotation corn and second–year corn will be relatively more attractive. Assuming this relationship holds true in 2004, rotation beans show a pretty significant premium to the rotation corn grown in a 50-50 corn-soybean rotation.

Some Hoosier producers are questioning whether bean yields have lost ground relative to corn yields in recent years. One could argue that the long term upward trend in Indiana soybean yields has become pretty flat over the last ten years. The current uncertainty about where soybean yields are headed in the future increases the difficulty of trying to adjust cropping plans for

year to year fluctuations in prices and production costs. One recommendation is that producers estimate crop costs and returns using a range of possible yield outcomes that reflect best and worst case scenarios, as well as the expected, or the most likely outcome. Also, it is wise to remember that good rotations and good agronomic practices have economic "staying power" over time.

On lower yield land in Indiana, wheat may once again be an economically attractive alternative to corn and soybeans. And, wheat double cropped with soybeans always looks economically attractive in those parts of the state where double cropping is a viable activity. You can study our forecast crop returns and costs and the yield relationships used in our analysis in ID-166 referenced in the previous section.

Crop Outlook is Bright

Chris Hurt

Despite rising costs of production, crop prices are expected to rise by more than enough to compensate providing prospects for rising incomes from corn, soybeans, and wheat in 2004. There are many positive fundamentals including rising U.S. and world incomes, the rising buying power of foreign currencies, surging Chinese demand, record tight world stocks for corn and wheat, and volatile weather. The surplus problems of the 1998 to 2001 crops appear to be behind us as we are in a period of much tighter stocks and as a result crop prices are expected to be higher and more volatile.

Soybeans steal the headlines with U.S. stocks of soybeans growing dangerously small as a result of the tiny 2003 U.S. crop and record usage this past fall. Prices will need to be high through the winter, spring, and into the early summer to get users to cut-back sufficiently. The question of just how high prices will have to be is much more difficult.

The rate of reduction in use during the rest of the marketing year has to be about 15 percent for crush and 18 percent for exports.

This level of "rationing" is more severe than was required in 1997 when futures moved to a high of about $9 per bushel in the late March to May time period. Actually, the level of rationing required this year is closer to 1988 when futures prices reached highs near $11.00 per bushel. The difference this year is the huge size of the South American crop compared to previous years. But, futures price highs at $9.00 per bushel, or higher, still remain a possibility.

Old crop prices are not expected to drop rapidly. High cash prices, of $8.00 or higher, may be required for several months to accomplish the rationing required.

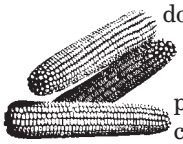
Prospects for the 2004 crop would suggest some additional bean acres drawn from reduced winter wheat acres and from corn acres. However, this may represent only 1 to 2 percent more bean acres than in 2003. Production prospects with national yields near 40 bushels per acre are about 2.9 billion bushels, and a crop of that magnitude would substantially overcome the current shortage. Harvest price prospects, given normal 2004 yields are expected to be in the $5.50 to $6.00 per bushel range given current information.

Producers who have a substantial portion of their old crop beans may want to consider a scale-up pricing strategy as current prices are rare. On the other hand, those who are comfortable holding old crop beans face the distinct possibility of even higher prices. The tightness of beans means that basis levels will likely be strong, so holding beans in storage is the preferred strategy. Pricing soybeans in the February through May period is the best bet of when price highs will be made this spring.

New crop futures may be able to reach $7.00 or higher this winter and spring as well. This would provide excellent pricing opportunities, as the "normal weather scenario" suggests cash harvest prices at $6.00 or lower. Again some pricing of new-crop could be considered in the February through May time frame.

Corn price prospects improved sharply in January as USDA reduced the size of the 2003 crop and increased fall usage to record high levels led by record industrial use and near-record feed use. Record tight world stocks and the lower value of the U.S. dollar are expected to keep export business growing throughout the winter and spring even in the shadow of higher corn prices. Anticipated ending stocks on August 31, 2004 are expected to be near 900 million bushels signaling potential growing concerns about supply shortness this spring and summer.

For 2004, corn acreage could be down 1 to 2 percent and a normal yield of about 141 bushels per acre across the country will only produce a crop of 10.1 billion bushels, smaller than expected usage for the 2003 crop. In addition, expect upward pressure on usage as 15 new ethanol plants are under construction (January 2004 Renewable Fuels Association: www.ethanolrfa.org) with capacity of about 200 million bushels, and with the weak U.S. dollar. This means that ending stocks could tighten even more for the 2004 crop with prices averaging higher than for the 2003 crop, perhaps around $2.40 to $2.80 per bushel for the marketing year.



Old-crop corn prices still appear to have additional upside potential this winter and into the spring. This may move May futures to near $3.00 per bushel. Basis levels should also improve, so holding old crop in storage makes the most sense.

Corn may well be more bullish than soybeans in 2004 since there is no major Southern Hemisphere crop. Forward pricing opportunities could be considered with December futures at $2.80 or higher. Continued strong exports this winter, or weather concerns this coming spring and summer could drive new crop corn to new highs. Generally, the best new crop pricing opportunities are expected in the February through May time period.

Winter **wheat** acreage is down three percent and concern remains for dry conditions in the west central plains, plus world wheat stocks are at record tight levels. However, last

year's world wheat crop was greatly reduced by drought in Australia, Canada, Europe, and the Former Soviet Union. A return to more normal world crops in 2004 would help reduce the world tightness and greater seeding of spring wheat could still result help compensate for small winter wheat acreage in the U.S. If normal weather develops for U.S. wheat, prices are expected to move lower into the spring and early summer, therefore pricing of old crop wheat and forwarded pricing some new-crop could be considered as this winter.

Animal Enterprises Head in Various Directions

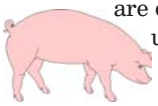
Chris Hurt

Demand for animal products is expected to be led by strong domestic and foreign income growth and by the lower exchange rate of the U.S. dollar which will stimulate exports. By species, total supplies are expected to be as follows: Pork (-.1%); Beef (+1.3%); Broilers (+3%); Turkey (+.2%); eggs (+.5%); and milk production (+.9%). Prices for all species are expected to be higher in 2004 except for beef cattle and milk.

In the **beef** sector, consumer demand is not expected to change much even in light of the December 23rd announcement of BSE. However, beef exports will be largely shut off for what we assume will be the first-half of the year. It is also assumed that beef imports will be down about 15% for the same time period. We export about ten percent of our beef and import a slightly higher percentage. Thus, domestic consumers will need to eat about 8.5 percent more beef for the first-half of the year than they would have in the absence of BSE. This will result in retail beef prices dropping about 10 to 12 percent.

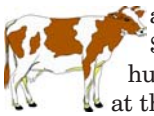
Finished cattle prices dropped from about $93 prior to the announcement to the very low $70, but recovered to the mid $70 currently. For the first quarter of the year, cattle prices are expected to average in the very high $70s or low $80. Summer prices are expected to move lower, perhaps pushing back to the lower $70's by the end of summer but finish the year with a move back into the low $80's. If these prices are achieved, the yearly average will be in the higher $70's and could still be the second or third highest annual cattle price in U.S. history.

Calf prices averaged near $1.00 per pound in 2003, and will be lower this year due to lower fed cattle prices and higher feed costs. Expect calves to average in the very high $80 to mid $90.



For **hog** producers, pork supplies are expected to be nearly unchanged in 2004, although they will be somewhat higher in the first three quarters before dropping in the fourth quarter as a result of fewer farrowings in the spring quarter.

Prices are expected to be near $40s for an average in the first quarter, and move to the mid-$40's in the spring and early summer. Summer prices are expected to average a few dollars lower, with the fall quarter average in the very high $30's. For 2004, prices are expected to average about $42, which is $2 higher than in 2003. Unfortunately, costs are expected to rise by about $2.50 per live hundredweight. So, given current hog price and costs estimates, the industry would have about a $2.00 per live hundredweight loss for the year. The spring and summer quarters are expected to be profitable with losses in the first and the last quarters of the year.



USDA expects **milk** prices to average in a range of $11.95 to $12.75 per hundredweight (or $12.35 at the mean) in 2004. Milk cow numbers are expected to increase by 1.7 percent with milk production increasing 2.6 percent. There remains a surplus of butter and cheese that will continue to depress prices. With high soybean meal, corn, and energy prices, many dairies will continue to feel the costs-price squeeze. This will be the third year that prices have been in the $12 to $12.50 range, the lowest prices for milk since 1980. Currently futures prices are reflecting more optimism for 2004 milk prices as rising incomes are creating better demand for milk products.

Broiler production is expected to rise by three percent with prices moving upward by three percent to 64 cents per pound. **Turkey** production is expected to be unchanged with prices also about two percent stronger to 63 cents for wholesale turkeys in Eastern U.S. markets. **Egg** production is expected to be stable with prices reaching 91 cents per dozen (New York). This would be an increase of three percent over last year.







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The Role of Combine Yield Monitors in the Choice of Crop Genetics

Hernán A. Urcola and Jess Lowenberg-DeBoer

On Midwestern farms, profitability is heavily influenced by the choice of crop genetics. Every year, growers must decide among the hundreds of hybrids and varieties on the market. Further, biotechnology and market pressures have reduced the product cycle of corn and soybean seed. In the past, a corn hybrid might have been marketed for eight or nine years before being replaced. Today the average corn hybrid is only on the market for three years. Thus, farmers need to make seed decisions, and they need to make them quickly. Keeping that "tried and true" hybrid or variety may make them uncompetitive in today's highly competitive farm economy. This article reports on a recent study of how Indiana growers use yield monitors to help make seed decisions.

Worldwide, the use of combine yield monitors has been growing steadily for the last 10 years. In the US, estimates indicate that 46 percent of the corn acres and 36 percent of the soybean acres will be harvested with combines equipped with yield monitors in the 2003 harvest. Some studies suggest that if yields can be increased one bushel per acre by better choice of genetics, the cost of the yield monitor and global positioning systems (GPS) can be repaid with the first year of yield data.

Manufacturers, agribusinesses, and researchers have made many suggestions about how farmers *should use* their yield monitors, but there is very little information on how farmers *actually use* yield monitor information in choosing hybrids and varieties. Recently, we did 10 cases studies of Indiana farmers to better understand the role of yield monitor information in hybrid and variety selection. We were particularly interested in identifying differences in the seed decision-making between farmers using and farmers not using yield monitors. We chose to do case studies, instead of a random survey, to facilitate a detailed look at farmer practices. Case study results cannot be generalized, but they provide in-depth information that helps us better understand why people do certain things.

Farmer Collaborators

We identified several potential

Indiana farmer collaborators through Purdue Extension county educators. Then, we conducted a preliminary telephone interview was conducted to find out whether their farming operations fulfilled the conditions required for the study. We selected five farmers using combine yield monitors and five not using them. All yield monitor users in the study also had Global Positioning Systems (GPS).We conducted a semi-structured interview with each of these 10 farmers. The interview covered five main topics: 1) information used in seed selection, 2) aids to the decision, 3) decision timing, 4) yield stability assessment, and 5) yield monitor role in seed decision-making. A section of the interview was open to allow farmers to raise issues they believed relevant. Some characteristics of the farming operations studied are presented in Table 1.

In our study, farms with and without yield monitors were very similar, although yield monitors tended to be used on slightly larger farms where the cost of monitoring could be spread over more acres.

Table 1. Some Features of the Farms Studied

	Using yield monitor	Not using yield monitor
Average corn acreage	1,110	876
Average soybean acreage	990	876
Average nitrogen fertilization rate	172	173
Total # of farmers	5	5

Information Used in Choosing Hybrids and Varieties

All case-study farmers depended on seed dealer recommendations to help them identify hybrids and varieties worth considering. They all used public yield information from university trials and other demonstration plots to help narrow the list of candidates, albeit to different degrees. One important difference was relevant distance from their home farm. Most of the case study farmers used data from neighboring areas of the nearest state to compare hybrid and variety performance, but all of them assigned the most weight in decision-making to trials close to their farms and operated under their farm conditions. Some producers gave an absolute priority to on-farm performance. For example, if a given variety had a low yield on their farm, they would not purchase it again regardless of how well it performed elsewhere. In situations like these, the main value of yield monitor information is that it shows variety performance in farmers' own environment.

Decision Aids

Producers looked mainly at ranking of averages within trial sites to identify top-performer hybrids or varieties for that location. Average yields can be obtained in a variety of ways: scale, scale tickets, and weigh wagons. However, these methods can become time consuming during the busy harvest days. This is especially true when farmers do not own a weigh wagon and have to

wait several days to use one from a local agribusiness. Farmers noted that a yield monitor can provide information with little disruption to harvest progress.

Decision Timing

Farmers interviewed order most of their seed, especially corn, before December 31. Several of them order seed for the next year even before the current year's harvest. This gives them priority in obtaining both hybrids in high demand and substantial seed price discounts. Another motivation for early ordering is that the purchase becomes a tax deduction for the current year. Most university and other trial results are not posted before mid November. For the earliest orders, yield monitor data is not of much use, but yield monitors can provide information about variety performance immediately after harvest, when most publicly available trial results are yet to be published.

Yield Stability Assessment

All 10 farmers were concerned about yield stability of the hybrids and varieties they choose for their operations, yet none of them had a formal method to evaluate it. At most, they eyeballed the frequency at which each hybrid or variety is at the top of the rankings in test plots. Yield monitors can provide information on yield variability within fields and between fields within a farming operation.

Yield Monitor Role

In the farms we studied, yield monitors played an important role in measuring on-farm variety trials. Most of the farmers using yield monitor have dropped the use of other methods to measure trials (e.g., weigh wagons, scales and scale tickets). Probably, this is because yield monitors are more time efficient than these other methods, and any lost of time during the harvest period can be costly. Most producers in our sample preferred to conduct on-farm trials laid out in the form of big blocks, rather than strip trials. They explained that blocks were less time consuming.

Farmers using yield monitors complained about yield maps. Producers said that yield maps were confusing to interpret and that they find it difficult to draw conclusions useful to crop management based on those maps. Often, visual map interpretation is of limited use in choosing hybrids and varieties. Default color code increments are often not small enough to detect important yield differences. Yield mapping software facilitates calculation of average yield and moisture for areas within fields (e.g., soil types). The case study farmers rarely took the time to do such calculations, but in some areas this is done by crop consultants or seed dealers as part of their customer service.

"Most of the farmers using yield monitor have dropped the use of other methods to measure trials (e.g., weigh wagons, scales and scale tickets)."

Almost all of the farmers using yield monitors identified their on-farm trials as one of the main sources of quantitative information for seed decision-making. However, none of the five producers not using yield monitors mentioned their own trials as an important source of quantitative information. With the use of yield monitors, case study farmers saw on-farm trial results as more valuable. This is probably because producers using yield monitors are able to collect more yield observations which tends to make their trial results seem more reliable.

Doing Better

The case studies suggest how the seed decision making process could be improved. First, an easy-to-use method for assessing yield and return stability for alternative hybrids and varieties is needed. This method should incorporate use of yield monitor data. It should also help growers put the data from their farms into a larger context. Some farmers drop a variety if it gives a low yield the first year on their farm, but this absolute preference for on-farm data may lead to new hybrids or varieties being dropped because of unusual conditions. Recent research suggests that estimation of yield and return distributions using public data from demonstration plots and university trials, as well as yield monitor data, and comparison of those distributions using risk analysis tools may help growers get a handle on yield and return stability.

Growers need better ways to extract crop management information from trials laid out in the form of large blocks. They prefer large block comparisons because they facilitate planting logistics, but they question the reliability of the information because of the lack of replication. Possibly, taking into account the spatial structure of the observations from the yield monitor can help distinguishing yield differences due to true genotype effects from those due to the internal variability of the blocks.

A remote sensing-based "early warning system" with yield estimates in August might help those farmers who ordered seed before harvest. Finally, yield map interpretation remains a constraint to better use of on-farm information. Farmers interviewed often mentioned that yield maps create more questions than answers. Better software can help, but the key to yield map interpretation is developing spatial analysis skills. Some farmers will decide to learn these skills themselves; many more will probably hire that expertise.

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The Indiana Equine Industry

Megan Garrett and Kevin T. McNamara

Indiana Equine Industry Structure

The Indiana equine industry (IEI) is comprised of 160,000 equine located on 34,000 operations around the state (2002 Indiana Equine Survey). Equine in Indiana serve a variety of needs and uses, including racing, showing, recreation, or work. Indiana equines are also used in breeding as either broodmares or stallions (Table 1).

About 44 percent of the total Indiana equine population is used for trail or recreation activities. Horses classified as trail and recreation equines are generally used for pleasure riding. If an animal is kept for the intention of racing, whether in pari-mutuel or other racing events, its primary use is racing. Four percent of the Indiana equine population is used primarily for racing activities. A show or competition equine is one used primarily for showing, polo, eventing, and other equestrian sports other than racing. Nearly 15 percent of the Indiana horse population is used for showing or competition. Horses used for work, hauling, or transportation are classified as work equine. These horses generally perform agriculture related work tasks, such as hauling hay or pulling farm equipment for crop production. Work horses represent 11 percent of Indiana's equine population. A broodmare is a female horse kept primarily for breeding. Broodmares account for 14 percent of the total Indiana equine population. Stallions are male horses kept primarily for breeding. Stallions account for 3 percent of the total Indiana equine population. All equine not classified as broodmares, stallions, show or competition, work, trail and recreation, or racing were classified as other. This category includes, but is not limited to, equine used for commercial carriage rides, police patrols, teaching, and retired horses. Nine percent of the Indiana equine population is classified by operators as equine for other uses (Figure 1).

Horses are bred and classified by breeds. Thirteen primary breed categories were identified by the Indiana Agriculture Statistics Service to classify the IEI. The breed categories are: Quarter Horse, Grade Horse, Draft Horse, Standardbred, Pinto or Paint, Pony, Arabian, Appaloosa, Thoroughbred, Donkey or Mule, Saddlebred, Morgan, and Warmblood (Figure 2).

Equine Operations

A horse or equine operation is an establishment that has at least one resident horse. There are 34,000 equine operations in Indiana averaging 4.7 equine per operation. Operations are classified into four categories; Show or Competition, Work, Trail or Recreation and Other Use, and Racing (Table 2).

Trail or recreation operations are the most common type of equine operation in Indiana. Trail or recreation and other operations represent 65 percent of the 34,000 operations in Indiana (Figure 3). Fifty-three percent of the total Indiana equine population is on these operations (Figure 4).

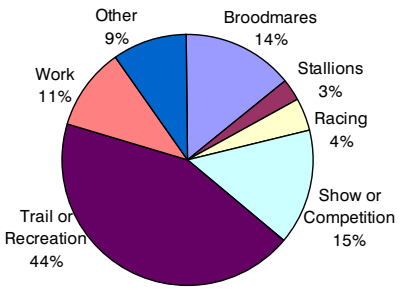
A show or competition operation is one primarily used for showing, polo, eventing, or any of the non-racing equestrian sport competitions. Show or Competition operations represent

Table 1. Equine Primary Use, By Breed, Indiana, January 1, 2002

Breed	All Horses	Brood Mares	Stallions	Racing	Show or Competition	Trails or Recreation	Work	Other
Quarter Horse	43,700	6,000	1,160	380	10,190	22,060	480	3,430
Grade Horse	22,300	870	160	0	1,340	15,050	2,510	2,370
Draft Horse	15,400	2,900	500	0	1,290	1,410	7,850	1,450
Standardbred	15,300	3,220	230	4,430	130	1,010	4,860	1,420
Pinto or Paint	11,700	2,280	580	20	1,820	6,070	50	880
Pony	10,000	830	250	60	1,520	4,880	890	1,570
Arabian	9,200	1,340	380	60	1,820	4,620	50	930
Appaloosa	5,900	600	190	10	860	3,800	60	380
Tennessee Walking	5,400	470	150	20	560	3,910	0	290
Thoroughbred	5,300	1,280	170	1,770	720	820	50	490
Donkey or Mule	4,000	750	150	0	220	1,790	270	820
Miniature	3,400	1,460	390	0	420	580	0	550
Saddlebred	2,600	340	80	10	910	890	100	270
Morgan	1,700	260	70	0	360	800	50	160
Warmblood	1,200	100	20	0	670	240	30	140
All Other Breeds	2,900	320	100	40	390	1,770	40	240
Total	160,000	23,020	4,580	6,800	23,220	69,700	17,290	15,390

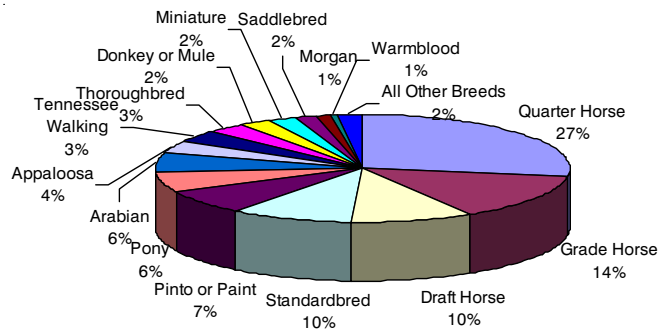
Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

Figure 1. Indiana Equine Primary Use, January 2002



Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

Figure 2. Indiana Equine Inventory, by Breed, January 2002



Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

18 percent of the state's equine operations (Figure 3). There are 6,120 show or competition operations in Indiana. Thirty-eight thousand, nine hundred seventy equine, 24 percent of the equine in Indiana, are located on show or competition operations (Figure 4).

Work operations have equine used for work, hauling, or transportation. There are 4,850 work operations in Indiana. Work operations account for 14 percent of the state's operations (Figure 3). These work operations account for 26,470 equine. It is a common practice for work operations to also breed stock for sale into other equine sectors, such as racing. About 17 percent of total Indiana equines are located on work operations (Figure 4).

Racing operations keep horses primarily for the intention of racing, whether for pari-mutuel or other events. Of the Indiana horse farms, 1000, or 3 percent, are racing operations. Racing operations make up the smallest portion of operations, representing 3 percent of Indiana's operations (Figure 3). These 1,000 racing operations have 10,360 horses, 6 percent of the Indiana equine population (Figure 4).

Equine Industry Spending

The Indiana equine industry purchases a variety of goods and services in the Indiana economy. These purchases stimulate economic activities throughout Indiana. Total general expenditures for Indiana equine operations were $282,929,000 in 2001 (Table 3). Over 93 percent of general expenses were incurred within Indiana. Boarding and Training Fees were the largest general expense. The second largest general expense was hay. Ninety-six percent of hay expenses were incurred by operations with resident equine (Figure 5).

Total capital expenses came to $265,652,000 in 2001 (Table 3). Capital expenses included purchase of equine, equine land purchases, and equine buildings and equipment purchases. Most capital expenses, 62 percent, were equine building and equipment related. Operations with resident equine incurred 90 percent of the total capital expenses. Indiana equine operations reported total expenses in excess of $548 million in 2001.

Indiana Equine Industry Economic Impacts on the Indiana State Economy

Equine operations breed, train, recreational ride, raise, and race horses, all activities which result in economic activity. Equine operations pay fees, employ labor, and purchase feed, veterinarian services, and other goods and services to support their enterprises. This initial, or direct, economic activity stimulates spending in the economy as equine industry suppliers make purchases to support their businesses. Additionally, households that earn income from horse operations or their suppliers spend money in the economy creating impacts.

Indiana Equine Spending by Operation Type

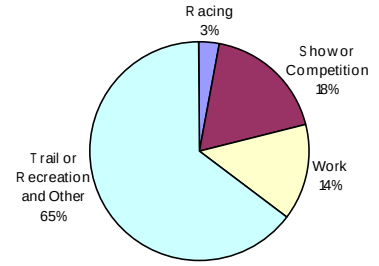
Purchases made by owners, breeders, and trainers to support horse racing,

Table 2. Indiana Horse Operations and Inventory, by Use, January 2002

Item	Racing Operations	Show or Competition Operations	Work Operations	Trail or Recreation and Other Operations	All Operations
Operations	1,000	6,120	4,850	22,030	34,000
Equine	10,360	38,970	26,470	84,200	160,000
Equine per Operation	10.4	6.4	5.5	3.8	4.7

Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

Figure 3. Percent of Indiana Operations, by Type, January 2002



Total = 34,000

Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

Table 3. Total Expenses for Operations with Resident Equine and Owners with All Equine Boarded Elsewhere: Indiana, 2001

Expense Category	Expense For Operations with Resident Equine	Expenses for Owners with All Equine Boarded	Total Expense	Average Expense per Operation with Resident Equine	Average Expense per Operation with All Equine Boarded
General Expenses					
Concentrates	25,475,000	1,661,000	27,136,000	867	509
Hay	27,320,000	1,099,000	28,419,000	877	544
Health	23,856,000	4,047,000	27,903,000	752	672
Grooming equipment	17,179,000	3,832,000	21,011,000	639	738
Farrier/Hoof care	18,104,000	3,261,000	21,365,000	611	526
Payroll	17,099,000	337,000	17,436,000	14,309	13,480
Contract labor expenses	4,978,000	1,146,000	6,124,000	2,559	9,550
Value of non-cash items	2,223,000	7,000	2,230,000	4,194	127
Breeding fees	6,329,000	369,000	6,698,000	1,037	1,190
Maintenance & repair	26,114,000	953,000	27,067,000	1,141	977
Insurance premiums	6,079,000	826,000	6,905,000	552	423
Utilities	6,499,000	108,000	6,607,000	404	338
Fuels	6,565,000	676,000	7,241,000	489	501
Taxes	9,405,000	86,000	9,491,000	663	430
Interest	3,693,000	196,000	3,889,000	2,581	1,120
Rent/lease	4,588,000	1,070,000	5,658,000	2,521	1,597
Fees & payments	7,059,000	1,728,000	8,787,000	405	492
Shipping & travel	5,950,000	1,602,000	7,552,000	908	913
Boarding & training	7,507,000	23,376,000	30,883,000	1,203	4,513
Miscellaneous	3,047,000	461,000	3,508,000	335	278
Depreciation	6,909,000	110,000	7,019,000	4,486	2,000
Total General Expenses	235,978,000	46,951,000	282,929,000	6,941	6,930
Expenses Incurred Out of State	12,459,000	6,163,000	18,622,000	2,436	4,466
Indiana Expenses[1]	223,519,000	40,788,000	264,307,000	6,574	6,020
Capital Expenses					
Purchase of Equine	31,252,000	10,999,000	42,251,000	3,632	6,214
Equine Land Purchases	59,552,000	0	59,552,000	68,846	0
Equine Buildings & Equipment	149,022,000	14,827,000	163,849,000	11,100	13,358
Total Capital Expenses	239,826,000	25,826,000	265,652,000	13,972	10,426
Total Expenses	475,804,000	72,777,000	548,581,000	13,994	10,742

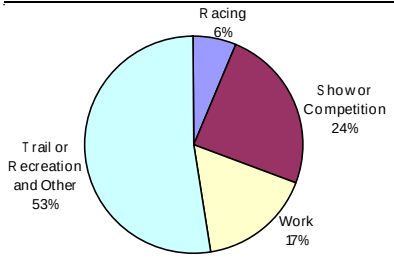
Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

1 General expenses incurred within Indiana

show or competition, work, or trail or recreation and other operations make up the direct economic impact of the equine industry on the state's economy. Total expenditures (Table 4) on equine operations (excluding labor) by operation type were surveyed to be $28,719,000 for racing; $135,293,000 for show or competition; $18,618,000 for work; and $158,063,000 for trail or recreation and other. The total expenditures for all operations with resident equine were $475,804,000 (Table 3).

Labor payments make up nearly 5 percent of the horse industry's total expenditures. Total reported labor payments (Table 4) were $3,128,000 for racing; $10,097,000 for show or competition; $1,551,000 for work; and $7,301,000 for trail or recreation and

Figure 4. Percent of Indiana Equine, by Use, January 2002



Total = 160,000

Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

Table 4. Indiana Equine Spending, by Operation Type, January 2002

Operations	Expenditures[1]	Labor Payment[2]
Racing	$28,719,000	$3,128,000
Show or Competition	$135,293,000	$10,097,000
Work	$18,618,000	$1,551,000
Trail or Recreation and Other	$158,063,000	$7,301,000
Totals	$340,693,000	$22,077,000

Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

1 Expenditures associated with impact are all expenditures excluding Payroll, Contract Labor, Value of non-cash items, Taxes, Interest, Depreciation, Purchase of Equine, and Equine Land Purchase.

2 Labor payments associated with impact include Payroll and Contract Labor.

Table 5. Total Spending Impacts

	Income Impact	Jobs	Annual Salary
Agriculture	$23,555,697	1,899	$12,403
Construction	$94,838,197	3,333	$28,453
Transportation/Utilities	$10,105,199	323	$31,333
Retail	$28,823,867	1,569	$18,368
Services	$32,447,079	1,497	$21,668
Public Administration	$7,696,985	239	$32,190
Totals	$197,467,025	8,861	-----

other operations. Total labor payments by equine operations in 2001 were $22,077,000.

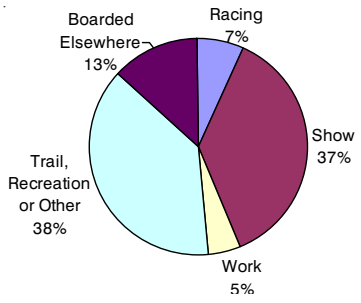
Equine Operation Income and Employment Impacts, Spending and Labor

The horse operation spending, the direct impact, stimulates additional spending in the economy as suppliers make purchases to supply horse operations, and retail and consumer service firms make purchases to service household spending income earned from equine operations. The direct impacts and the additional spending combined are the total impacts. Total income, and employment impacts associated with all equine operations in Indiana are estimated to be $197 million in total income and 8,861 jobs. These amounts represent the spending by the horse industry (direct impacts) plus the indirect and induced impacts. The annual salary earned per industry associated with these impacts is seen in Table 5.

Indiana equine operations have an estimated annual payroll of $22,077,000. Households earning this money use it to purchase household goods and services. Household spending of income earned in the horse industry stimulates a total impact of $9,763,021 in personal income and 361 jobs (Table 6).

Adding the impacts associated with the horse operation spending and the impacts associated with household spending of income earned from horse operations, the estimated annual impacts associated with the equine industry are $207,230,046 in total income and 9,221 jobs (Table 7).

Figure 5. Indiana Horse Expenses, by Operation Type, January 2002



Source: Indiana Agriculture Statistics Service, Indiana Equine Survey, January 2002

Table 6. Total Labor Impacts

	Income Impact	Jobs
Agriculture	$29,899	6
Mining	$16,075	0
Construction	$191,325	5
Manufacturing	$1,701,654	34
Transportation/Utilities	$884,121	21
Wholesale	$520,314	12
Retail	$2,067,461	125
Services	$3,657,893	137
Public Administration	$694,279	21
Totals	$9,763,021	361

Table 7. Annual Economic Impacts Associated with Equine Operations

	Income Impact	Jobs
Operation Spending Impacts	$197,467,025	8,861
Labor Household Spending Impacts	$9,763,021	361
Total Impacts	$207,230,046	9,221

Conclusion

The Indiana equine industry is an important component of Indiana's agriculture. The equine industry is a diverse agriculture sector that benefits the state's economy through direct spending and job creation throughout Indiana. For more information on the Indiana Equine Survey see http://www.nass.usda.gov/in/equine/procs.pdf.

Megan Garrett (l) is a Graduate Student in the Department of Agricultural Economics at Purdue University and Kevin T. McNamara (r) is a Professor in the Department of Agricultural Economics at Purdue University.

What Landowners and Their Lawyers Should Know About Negotiating Coal, Oil and Gas Leases

8:30 a.m.- 3:15 p.m. EST, March 11, 2004
Gasthof Amish Village

Registration is required by March 5. You may register by mail or at the Davies County - PCES Office, Washington, Monday - Friday, 8:00 a.m.-4:00 p.m., EST. Daviess County contact and program hostess is Jan Wahl, Extension Educator, Phone: 812-254-8668; Fax: 812-2547472; E-mail: <jwahl@purdue.edu>. For questions about the subject matter, and a registration flier, contact Gerry Harrison; phone: 765-494-4216 or E-mail: harrisog@purdue.edu>.

Gasthof Amish Village is ½ mile north of Montgomery, on CR 650 E. Montgomery is located on Hwy 50 between Loogootee and Washington, Indiana.

"Manure" Happens: The Future for Indiana Animal Agriculture

Stephen B. Lovejoy

While everyone knows that animals produce manure, we have often neglected the fact that improper handling or disposal of that manure leads to degradation of water resources. This source of water pollution is increasingly being viewed as a point source of pollution and therefore appropriate to control through regulatory action rather than purely voluntary measures as evidenced by the CAFO/AFO regulations being debated. However, those regulations only cover a small minority of animal producers, while many believe that the problem is much more widespread in the livestock production sector. As these guidelines, rules, and regulations are expanded to cover more and more of the sector, the implications for Hoosier animal producers may be quite significant in terms of operational considerations as well as economic impacts.

A recent USDA report, "Costs Associated with Development and Implementation of Comprehensive Nutrient Management Plans" indicates that the American animal agriculture system of farms and ranches needs to spend nearly $20 billion dollars to design and implement comprehensive nutrient management plans (CNMP) over the next 10 years. While many are aware that CAFO/AFO regulations require larger producers to obtain NPDES permits, which include nutrient management plans, smaller producers have been viewed as exempt unless they cause some type of observable environmental problem (e.g., fish kill from a spill). Then, even small producers would be required to submit a manure management plan.

However, the new guidelines released by USDA suggest that many animal producers will need comprehensive nutrient management plans; over 250,000 livestock producers were identified as needing a CNMP out of a total of over 1 million farms and ranches that raise livestock. The criteria for deciding whether a production unit needs a CNMP is primarily related to size. Those operations with only a few animal units will not need a nutrient management plan*. However, the vast majority of those that will not require a CNMP raise only a few poultry, two or three cattle, or a few swine. While the proposed EPA regulations for CAFO/AFOs would only affect either 11,000 producers nationally (using the 1000 EPA animal criteria) or 44,000 producers (300 EPA animal units), the CNMP suggests that over 250,000 animal production farms and ranches need to do a better job of managing their manure and protecting water resources by designing and implementing better management of their manure waste stream. In essence, USDA suggests that all production facilities that produce 11 tons of manure per year as well as some other speciality animal production units need a CNMP.

Indiana has approximately 32,000 farms that produce livestock. Nearly two-thirds of those farms are small producers who have only a few animals. However, 12,000 Hoosier farms produce sufficient manure (i.e. 11 tons per year) that USDA suggests that they need a CNMP to adequately handle and dispose of their manure waste stream in order to avoid polluting water resources.

Elements of a CNMP

A CNMP addresses the following elements with specific criteria for successful management.

➤ Manure and Wastewater Handling and Storage.

This element addresses activities associated with the production facility, feedlot, manure and wastewater storage and treatment structures and areas, and any areas used to facilitate transfer of manure and wastewater. Generally, a combination of conservation practices and management activities are needed, such as manure storage, clean and contaminated water diversions, manure collection and transfer, runoff storage ponds, and mortality management.

➤ Land Treatment Practices.

This element addresses activities associated with fields where manure and organic by-products are applied. Generally, this element deals with the establishment of erosion control practices, such as residue management, contouring, and terraces, on land receiving manure.

➤ Nutrient Management.

This element addresses activities associated with land application of all nutrients and organic by-products to meet crop needs and minimize potential adverse impacts to the environment and public health. Generally, this includes planning and applying nutrients with consideration of form of nutrient and the geographic aspects of the site of application.

➤ Recordkeeping.

This element addresses the documentation of management and

** The USDA report suggests that even 77 percent of those operations they classified as small would still need a CNMP. The small category consists of those operations that produce less than 4 tons of phosphorus manure per year. Their estimate is that 4 tons of manure phosphorus would be produced annually by those operations with 250 animal units of beef or dairy cattle, 165 animal units of hogs for slaughter, or 75 animal units of poultry. This translates, for a hog finishing operation, into about marketing just over 600 hogs per year.*

implementation activities associated with a CNMP. Typically, this includes recording soil tests, manure tests, manure and wastewater field application dates and rates, acres applied, manure transfers, and operations and maintenance activities.

Costs of Developing and Implementing CNMPs

Total costs over a 10 year implementation period were estimated to be nearly $20 billion or about $76,000 for each of the 257,000 animal producers needing a CNMP. These costs included development costs (e.g., alternatives development and evaluation, design, implementation assistance, and followup) and direct costs of implementing the plan (e.g. nutrient management, off-farm export of manure, land treatment to control soil erosion on acres receiving manure, manure and wastewater handling and storage, and record-keeping). While some technical and financial assistance may be available through existing government conservation programs, ultimately, the producer will be expected to develop and implement a CNMP for his or her individual operation.

These average figures suggest that Hoosier animal producers will need to spend over $80 million over the next 10 years to develop and implement CNMP's. While this only affects a third of Hoosier animal producers, it includes most of our hog operations, dairies, and poultry operations. USDA estimates that national average costs for swine operations will be $44 per animal unit per year**. This translates into an additional production cost of $4.40 per CWT or about $11.44 per marketed hog (260 pounds). However, the average profit (dollars remaining after subtraction of all labor, land, and capital costs) for raising hogs over the past eight years has been $1.79 per CWT or about $4.65 per marketed hog. Clearly, when additional costs are nearly 3 times the historic profit, there is a problem reconciling our environmental and economic goals, and this certainly presents a dilemma for Hoosier swine producers.

Conclusion

This cursory analysis suggests that while only a third of Hoosier animal producers will need to develop comprehensive nutrient management plans, paying for the development and implementation of those plans will be problematic given the present assistance programs and the present price structure in the livestock industry. Those Hoosier farmers who do need a CNMP will not likely forego all profits over the next 10 years. In fact, they will likely suffer real losses and reduction in net worth if they remain in the business of producing animal products! Can these programs be structured so that they achieve both society's environmental goals and producer's economic goals? That is the question that must be addressed. If not, what trade-offs are we willing to make among water quality, economic activity, and domestic production of animal products?

Stephen B. Lovejoy is a Professor in the Department of Agricultural Economics.

*** USDA is utilizing a formula whereby 1000 pounds of live weight is defined as an animal unit.*

Who will benefit from GPS Auto Guidance in the Corn Belt?

Matt Watson and Jess Lowenberg-DeBoer

Guidance systems have played a major role in development of mechanized agriculture. Disk markers are a technology almost as old as mechanized planting. Knotted wire was a key part of the cross-check corn planting system that improved mechanical weed control for corn in the early 20th Century. Foam markers were crucial to improving accuracy of chemical weed control in the late 20th Century. Global positioning system (GPS) based lightbars were introduced for ground based equipment in the late 1990s and quickly became standard practice for many farmers and custom operators. GPS auto guidance is the next step in this process.

GPS auto guidance goes one step beyond lightbars to entirely take over steering within the pass. The equipment operator still needs to turn at the ends. GPS auto guidance is widely used for furrow and drip irrigated crops in the Central Valley of California, and for controlled traffic in wheat, canola and other non-row crops in Australia. Auto guidance manufacturers are now ramping up to sell their products in the Corn Belt. The article summarizes a study recently completed at Purdue that looks at which Corn Belt farmers are likely to benefit from this technology.

Like other precision agriculture technologies, the profitability of GPS auto guidance depends on reducing costs or increasing yields. In the Central Valley of California the fact that auto guidance gives growers greater flexibility in labor hiring has been a key to profitability. For example, in the past only a few skilled drivers could operate the listers to create the straight, evenly spaced ridges for furrow irrigation. Those skilled drivers command high wages and are not always available. With auto guidance California growers can chose from a wider range of drivers, without reducing the quality of the work. In addition, with auto guidance they can work longer hours, at night and in fog.

In Australia, the economics of auto guidance seem to be driven by controlled traffic. Because many of their soils are prone to compaction and because most of Australian cropland does not experience freezing

and thawing, compaction is a key issue. Australian farmers and researchers report up to doubling wheat and canola yields when wheel traffic is limited to pre-established lanes. Manual "tramlining" has been done for years to control traffic. Essentially, tramlining involves creating a set of equipment tracks with initial tillage and/or planting operations which are followed for all other operations. It requires that all equipment widths match. For example, tramline systems often use a sprayer boom that is three times the seeder width, so that the sprayer can drive down the center track of three seeder width passes. Typically, the entire field is tilled before a new crop and new tramlines are created each year. Auto guidance can limit traffic to an even smaller portion of the field than tramlining, with year-to-year consistency, and with less stress and fatigue for the operator. Australians are also using auto guidance to facilitate mechanical weed control in chickpeas and other row crops.

"Estimates indicate that lightbar guidance would allow the 1800 acre operation to expand to about 2600 acres with the same 12 row planter and other equipment, while maintaining timeliness of operations. GPS auto guidance would allow that grower to expand to about 3100 acres with the same set of equipment."

While some Corn Belt soils are susceptible to compaction, there are other "spatially sensitive" practices that might benefit from greater driving accuracy and repeatability (e.g. ability to return to the same place for subsequent operations and from year-to-year). In the Corn Belt, those spatially sensitive practices might include: strip tillage, sidedress nitrogen application, and mechanical weed control. This study used controlled traffic as an example of a spatially sensitive practice that Corn Belt farmers might use.

Technology on the Market

Auto guidance technology is on the market with two accuracy levels: differential corrected GPS (DGPS) with about a 4 inch (10 centimeter) accuracy, and real time kinematic (RTK) GPS with about 1 inch (2 centimeter) accuracy. The major providers of auto guidance for farm equipment are John Deere, IntegriNautics, Trimble and Beeline. Deere, Trimble and Beeline offer, or are planning to offer, both DGPS and RTK systems, while IntegriNautics sells only RTK systems. IntegriNautics and Trimble are strictly after-market suppliers. The Beeline technology is available factory installed on AGCO Challenger tractors and as a retrofit on other makes of equipment. Most agricultural auto guidance is currently installed on tractors, but technology for sprayers, fertilizer applicators, combines and other equipment is being developed.

Depending on the GPS technology the grower already has, and the level of accuracy desired, costs range from $10,000 for entry level DGPS technology to almost $60,000 for a top of the line RTK system. The Deere product utilizes its Greenstar system and Starfire position receiver. Upgrading the tractor with the Greenstar already installed includes an AutoTrac keycard and a vehicle steering control kit. A major part of the RTK system cost is the base station, which can be either fixed or mobile. Ideas for reducing RTK system cost includes developing wireless Local Area Networks (LAN) through which several farmers could share an RTK correction signal.

The economics of both lightbars and auto guidance are different from most other GPS based technologies because their benefits do not depend on information analysis and changing agronomic practices. To benefit from auto guidance, equipment must be driven more accurately, more consistently and/or for longer periods every day. GPS guidance is an information technology in the sense that it depends on digital information and computerized data processing, but in many ways it has more in common with traditional farm mechanization than with yield monitors, variable rate application and other precision agriculture technologies.

GPS Guidance Scenarios

The profitability of auto guidance depends on farm size and cropping practices. The Purdue study looked at three auto guidance scenarios:

1. Improving field efficiency, and reducing skip and overlap on an 1800 acre farm,

2. Using auto guidance to work longer hours and expand farm size with the same set of equipment, and

3. Controlled traffic on an 1800 acre farm.

The 1800 acre farm on a 50/50 corn-soybean rotation was chosen as a typical size crop operation in west central Indiana using a 12-row planter. The estimates assume that planter size is the limiting factor in getting field work done and that with current technology 12-row is the largest planter that is workable given field size & shape, and rolling topography. For farmers that can use larger equipment (e.g. 16 row, 24 row), the benefits of GPS auto guidance would be greater than those estimated here because the cost of auto guidance is the same regardless of equipment size.

The estimates assume that the grower currently uses disk markers for planting and foam markers for spraying. Three GPS guidance alternatives are considered: 1) lightbars, 2) DGPS auto guidance, and 3) RTK auto guidance. The study assumes that the foam markers would be eliminated if any GPS guidance is used, but disk markers would be retained as a stand by technology on the planter. The estimates are based on technology

prices of: lightbar, $4050; DGPS auto guidance, $15,000; and RTK auto guidance, $50,000. The DGPS annual subscription cost is $800.

The estimates assume a corn price of $2.23/bu. and a soybean price of $5.49. Variable crop production costs were taken from the 2003, Purdue Crop Cost and Return Guide. Harvesting was assumed to be done by a custom operator at $21/acre. Rent was set at the Indiana average of $116/acre. Labor was valued at $8.29/hour. Returns to management were calculated using a spreadsheet farm model.

The 1800 Acre Farm

The results indicate that the lightbar technology is the most profitable option for the farmer who is not expanding and who does not use any "spatially sensitive" technologies (Table 1). In this case the benefit of any GPS guidance is reduced skip and overlap, as well as increased field speeds. The estimates indicate that lightbars allow a 13 percent increase in field speed and auto guidance allows a 20 percent increase. Most of the reduction in skip and overlap is achieved with the low cost light bar technology. The additional reduction in skip and overlap due to auto guidance is small relative to substantially higher cost of auto guidance.

While estimates indicate that auto guidance is not the most profitable technology for the 1800 acre scenario, it does result in some time savings. The estimated field time for the base case is about 496 hours per season, not counting harvest. The time with lightbar technology is about 11 percent less, at 439 hours. With either DGPS or RTK auto guidance the time is cut another 6 percent, to about 411 hours. These time savings may mean greater timeliness in field operations or more leisure.

Farm Expansion

Estimates indicate that lightbar guidance would allow the 1800 acre operation to expand to about 2600 acres with the same 12 row planter and other equipment, while maintaining timeliness of operations. GPS auto guidance would allow that grower to expand to about 3100 acres with the same set of equipment. The base case assumes a 14 hour workday. With a lightbar this is increased to 18 hours per day and with auto guidance 20 hours per day. The ability to farm more acres with the same equipment is the combined effect of more work hours per day, higher field speeds and reduced overlap.

For the expanding farm operation DGPS auto guidance is slightly more profitable that the lightbar option (Table 1) because it allows the grower to farm substantially more acreage with the same equipment. In this case RTK auto guidance is more profitable than the base case (foam and disk markers), but less profitable than the lightbar or DGPS auto guidance.

Because the farm operation is expanding it is important to look at whole farm profits. The DGPS auto guidance allows the farm to increase returns to management by about $9,700. The lightbar technology increases returns to management by $5,800 and the RTK auto guidance by $4,500. If farm family members are supplying labor, the labor income from those added acres would also increase family income.

One of the key assumptions of this farm expansion analysis is that lightbar and DGPS guidance is good enough for corn planting. If all fertilizer is applied pre-plant and all weed control is chemical, a 4-inch wobble in the row may not be a problem. If there is side-dressed nitrogen, mechanical weed control or other spatially sensitive practice, the 4-inch accuracy of lightbars and DGPS auto guidance may not be good enough. In that case, RTK auto guidance would provide some benefits over the foam and disk-marker technology.

Controlled Traffic

The controlled traffic example used estimates of compaction effects on yields from northern Ohio. It assumes that with soils that are moderately susceptible to compaction, average corn yields would be 150 bushels/acre in uncompacted soil, and 139 bu./acre in compacted soils. Soybean yields would be 46 bu./acre in compacted soils and 49 bu./acre in uncompacted soils. With traditional random traffic about 90 percent of the soil surface receives wheel traffic every year. The estimates assume that with lightbar controlled traffic this can be cut to 30 percent, with DGPS auto guidance to 20 percent and with RTK GPS to 15 percent. The estimates are long run in the sense that they assume that all equipment matches the width required for controlled traffic. This study did not deal with the transition costs of moving from random to controlled traffic.

On the 1800 acre base case farm with controlled traffic on soils moderately susceptible to compaction, the DGPS auto guidance is the most profitable guidance technology. The lightbar follows close behind. The RTK auto guidance is more profitable than random traffic, but not as profitable as the other options. With soils highly susceptible to compaction, both auto guidance technologies show more benefit and the profitability gap between DGPS and RTK auto guidance narrows to about $2/acre. If manual tramlining were able to reduce traffic to 50 percent of the surface, the increase in the return to management would be about $15/acre.

Auto guidance is a new technology and the price is relatively high. As the auto guidance market matures, many observers expect the price of the

Table 1. Increased Returns to Management Per Acre Under Three GPS Guidance Scenarios[1]

Scenario	Lightbar	DGPS Auto Guidance	RTK Auto Guidance
1800 acre Farm	$1.95	-$0.26	-$7.13
Expanding Operation	$6.93	$7.36	$3.41
Controlled Traffic, 1800 a. Moderate Compaction	$22.07	$24.49	$18.84

1 Compared to management returns on a farm using foam and disk markers.

technology to drop. If the price of auto-guidance technology were to drop by 50 percent, RTK auto guidance becomes the preferred choice for controlled traffic on soils highly susceptible to compaction.

Conclusions

The Purdue GPS auto guidance study leads to the conclusion that DGPS auto guidance will be profitable for a substantial group of Corn Belt farmers in the next few years. This will primarily be growers who are now farming as many acres as they can with a given set of equipment. The initial benefit for many growers will come from being able to expand farm size with the same equipment set. A $15,000 investment in DGPS auto guidance is a relatively inexpensive way to expand equipment capacity by several hundred acres.

In the longer run, as farmers become more comfortable with auto guidance technology, they will probably find a variety of spatially sensitive practices that could benefit from greater driving accuracy and repeatability. This study used controlled traffic as an example of a spatially sensitive practice, but in the Corn Belt: strip tillage, side- dressing nitrogen, and mechanical weed control may also show benefits. As with other precision agriculture technologies, the benefits of fine-tuning operations will be higher with high value crops.

At current equipment prices RTK auto guidance is more profitable than foam and disk marker systems for expanding farm operations and for those with soils subject to compaction, but it is not as profitable as lightbars or DGPS auto guidance. If the price of auto guidance drops as the market matures, RTK auto guidance will become a competitive technology.

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2004 Top Farmer Crop Workshop

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Howard Doster has officially retired and the Top Farmer Crop Workshop is continuing under the leadership of Jess Lowenberg-DeBoer. Jess hopes to make this nationally known workshop even better. The computerized budget analysis, exciting speakers and opportunity to network with some of the most innovative producers in the world will continue. Additions to the workshop in 2004 will include:

- **GPS auto steer** – Use the B21 Model to find out if autosteer or other new technology would make your operation more profitable.
- **Yield monitor data analysis** – Limited to 10 fields for the 2004 workshop on a first-come-first-serve basis. Call Jess (765 494-4230) or check the website below for more information on how to get your data in the hopper for analysis.

For more information see the website: www.agecon.purdue.edu/topfarmer/

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