Dynamics of Change: Industry Structure and Markets

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Abstract
Farm managers are exposed to economically-driven trends or forces that impact their businesses. They routinely must assess the characteristics, persistence, and implications of those trends, to determine how their businesses should react to them. In their strategies, managers can choose to either ignore, resist, or participate in current business trends. In this paper we identify five such trends: 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills. Understanding and embracing these trends should give farm managers an edge over those who choose to ignore or resist them. Key thoughts arising from this paper are as follows. The principal force underlying these trends is economies of size. Consolidation is here to stay, with fewer and larger farms and fewer and larger agribusinesses for those farms to deal with. Profitable farming always have been based on using the new technologies available, and using them sooner than others. Successful farm managers of the future would be wise to carefully weigh the benefits of value-added investment off-farm against the large and growing need for capital on their own farms. For growing farms, paperwork and computer only will increase as managers attempt to ferret out subtle opportunities for profit in large scale commercial production of agricultural products, in a world where government and private interactions become more complicated and offer more opportunities each year. More and more, farm managers will see a need for people with specialized skills, as farms look more like agribusinesses over time. If there is one theme that pervades this paper, it is the fact that farm managers will need to develop ever better people skills – because personal long-term relationships will become more valuable as the numbers of farms and agribusinesses decline.

BACKGROUND

As with managers in other industries, farm managers are exposed to economically-driven trends or forces that can profoundly impact their businesses. They routinely must assess the characteristics, persistence, and implications of those trends, as well as how their businesses should or will react to them. In their strategies, managers either can choose to ignore, resist, or participate in current business trends. Their choices tend to be based on a mixture of emotion, ideology, and objective assessment. Regardless, it probably is safe to say that the more persistent the trend, the more a manager should embrace it and learn how to profit from it. Certainly, assuming managers have more control over their businesses' actions than those of others, it should be easier to react to change than it is to garner the broad support needed to reverse it. More personally, it often comes down to attitude. Some view change as opportunity, a chance to increase profit and happiness,

while others view change, even inevitable change, as something that must be resisted, or at best, endured to survive.

This paper discusses several underlying trends or issues believed to be greatly influencing production agriculture today. The focus is on economic forces that seem to be firmly in place, ones that probably will not disappear soon and hence must be reckoned with in the next decade or two. We identify five such trends: 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills.

This paper builds upon a related paper by the same authors, entitled either Thinking About Farming in the Nearby Future, Especially Related to Size and Growth, or Dynamics of Change: Must I Grow My Farm? That paper, available on the www.agmanager.info website, discusses economies of size in commercial agriculture, which is an economic force that critically drives the various trends discussed in this paper. Hence, it would be beneficial to read that paper first.

1. Increasing Consolidation

Consolidation has been a long-term characteristic of production agriculture

Consolidation means that the same or an increasing amount of business is being conducted by fewer firms. Examples of consolidation abound, both historical and recent. Countless brands of automobiles existed in the 1940s, and far fewer by the 1970s. Many dry goods retailers and grocers existed even 10 years ago, but Walmart dominates today. Massive consolidation in tractor and combine manufacturing and sales has occurred over the last couple of decades, for example the Case-IH merger followed by the further merger with New Holland to become CNH Global. Adding CNH sales to those of John Deere would certainly capture the lion's share of U.S. tractor and combine sales. And the list goes on, with fewer meat packers, fewer cattle feeders, and fewer crop farmers. In fact, it is difficult to find examples of industries where consolidation has not been a strong trend over the last 10, 20, or even 100 years. At a more relevant level for farm managers, consolidation continues in machinery dealerships, grain elevators, crop and livestock input providers, just to name a few examples.

Consolidation among farms usually is noted graphically by showing average farm size and total number of farms over time, as in figure 1, corresponding to data from the U.S. Census of Agriculture for general farms in the U.S. Based on the Census data, the number of farms in the U.S. declined from 1920 through the 1990s where they stabilized and then increased slightly in 2002. This increasing number of farms in 2002 led to a lower average farm size, which marked the first time average farm size decreased from one census to another since the early 1900s. But, average farm size may not

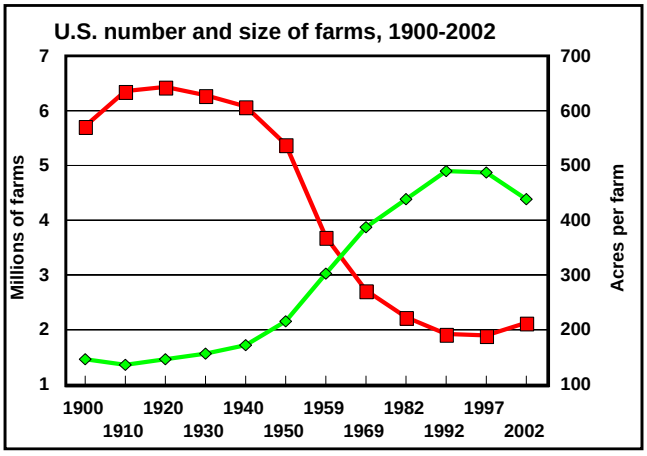

Figure 1

adequately convey the forces of consolidation, especially when the distribution of farm sizes is especially skewed. Such is the case in recent years when the definition of a farm (annual sales >$1,000) allows for an increasing number of small, lifestyle (hobby) farms. Hence, it may be better to ask the question, On what size farm does the typical acre in the U.S. fall? Put another way, If I selected a random acre, on what size farm would I expect it to fall? We might also be interested in dollars of sales, asking the question, On what size farm does the typical dollar of sales fall? Based on the authors' calculations, figure 2 shows these numbers since 1979. It is interesting to ponder the political power implied by the lines in the figure. Assuming farmers are active politically, the typical vote would come from roughly the same sized farm over the years. On the other hand, assuming political dollar-valued contributions are driven by farm sales, then the typical political contribution dollar would have been arising from much larger farms in recent years than even two decades ago.

For farms, consolidation has been an on-going process for many years, however, it has not necessarily happened at the same speed for all sectors. For example, consolidation in the broiler industry and cattle feeding industry has occurred more rapidly than the beef cow sector. As previously mentioned, consolidation among farms is demonstrated graphically by showing the number of farms and some measure of the average farm size over time. Figures 3 and 4 show this information for poultry (layers), swine, dairy, and beef cow operations for the years 1959, 1964, 1969, 1974, 1978, 1982, 1987, 1992, 1997, 2002 (U.S. Census of Ag).[1]

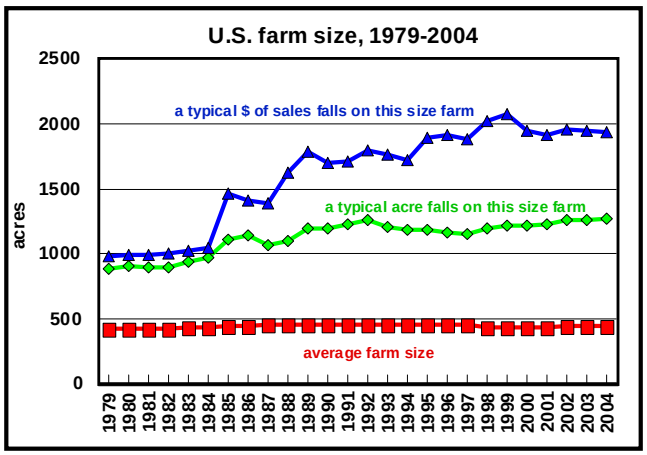

Figure 2

The annualized average growth rate for the number of poultry farms in the U.S. between 1959 and 1997 was a -8.9%. That is, the number of farms decreased an average of 8.9% per year over that 38-year time period. Consolidation also occurred quite rapidly in the swine and dairy industries, but at a slightly slower pace than the poultry industry. From 1959 to 2002, farm numbers decreased, on average, by 7.1% and 6.7% annually for the swine and dairy industries, respectively. The beef cow industry has seen considerably less consolidation, in terms of farm numbers, than the other livestock

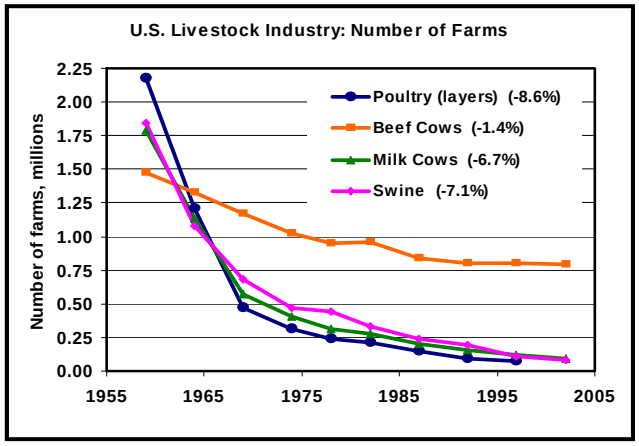

Figure 3

[1] 2002 data for poultry operations are not reported here. The authors believe that there was a change in how this information was reported in the Census and thus looking at trends with this time period makes little sense. If readers are interested in the information, they can contact the authors for the 2002 data.

industries – annual decrease in the number of farms of only 1.4% from 1959 to 2002 (the authors estimated the number of beef cow operations in 1959 as this value was not reported that year).

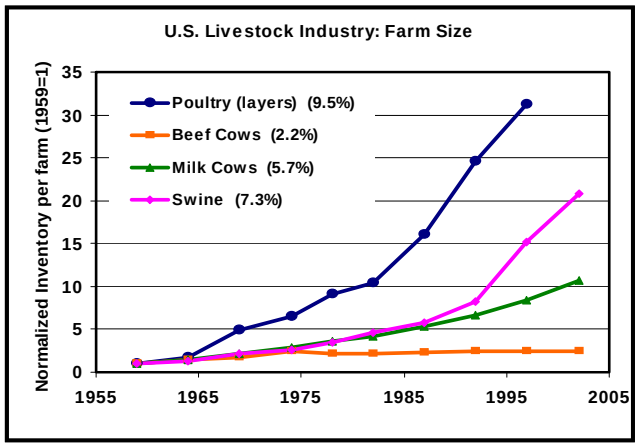

Figure 4

Figure 4 shows the average farm size for the four livestock industries displayed in figure 3. Average farm size is calculated as the total inventory in the U.S. divided by the number of farms. Because of the vastly different magnitudes of farm size, values reported in figure 4 are normalized to 1959 levels.[2] Thus, the average farm size for each industry equals 1.0 in 1959 and then each subsequent year is relative to that base year. The average farm size in the poultry industry increased the most rapidly, with an annual growth rate (from 1959 to 1997) in the inventory of layers per farm of 9.5%. This growth rate resulted in poultry farms in 1997 being over 30 times larger than they were in 1959. The average farm size in the swine and dairy industries also grew considerably, with annual growth rates of 7.3% and 5.7%, respectively. Average 2002 inventory levels of swine farms were almost 21 times what they were in 1959, whereas dairy saw an 11-fold increase in farm size over this same time. Much of the increase in the swine industry occurred from 1992 to 2002, i.e., average farm size went from 8 to 21 times the 1959 size in this 10-year time period. The annual growth rate in the size of beef cow farms was 2.2%. This growth rate resulted in the average beef cow farm being 2.5 times larger in 2002 than it was in 1959.

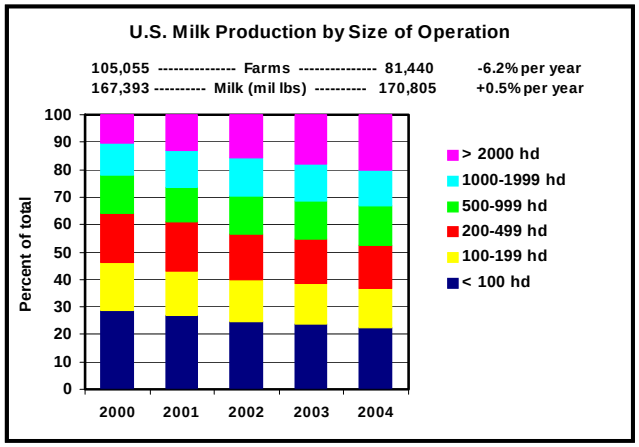

Figure 5

As previously noted, average farm size and farm numbers may not adequately convey the forces of consolidation, especially when the distribution of farm sizes is especially skewed. First, during consolidation, the number of larger farms usually expands while the number of small farms usually (but not always) contracts. The result is that the market share of production held by large farms is rising especially rapidly, which could have important implications for market and political power in agriculture. For example, figure 5 shows the percent of milk production in the U.S. by farm size from 2000 through 2004. Over this 5-year time period, the number of dairy farms decreased by 6.2% per year while milk production increased, on average, 0.5% per year. In 2000, dairies with less than 200 cows produced slightly less than half of the milk (46.1%) yet dairies of this size represented 92.4% of the total number of dairies. In 2004, dairies of this size

[2] The average farm sizes (head per farm) in 1959 were the following: Layers (162), Beef cows (17), Milk cows (9), and Swine (37).

produced only 36.6% of the total milk, but they still represented 90.6% of the total dairies in the U.S.[3] On the other hand, dairies with 1,000+ cows produced 22.1% of the milk while they represented only 0.9% of all dairies in 2000. By 2004, this size category accounted for 33.3% of the total milk production while only representing 1.6% of the total dairies. Thus, it is clear that while the trend shown in figure 4 pertaining to "average farm size" is clearly indicative of increasing concentration, it does not accurately depict the magnitude of concentration as it relates to production.

Figure 6 shows the U.S. hogs and pigs inventory by farm size for 1994, 1999, and 2004. The number of swine farms decreased by almost 10% annually from 1994 to 2004, but pork production actually increased almost 1.5% annually. In 1994, farms with less than 500 head represented 84.5% of swine operations and accounted for just under a fourth (24.5%) of the pigs. By 2004, 75.5% of the swine farms were still in this size category but they only had 5% of the total inventory. On the other hand, farms with over 5,000 head (less than 1% of all farms) accounted for just over a fifth (21%) of the total hogs in 1994, but over half (53%) of the hogs in 2004 with only 3.3% of all farms. As pointed out above for dairy farms, it is clear that data pertaining to "average farm size" do not accurately depict the skewness that exists with regard to the concentration of production.

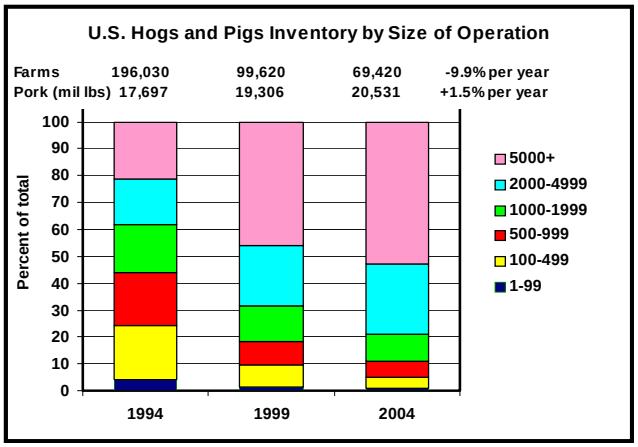

Figure 6

Figures 3 through 6 revealed the consolidation in the livestock industries. What about the crop industries? Are they going through the same consolidation patterns as the livestock industries? Figures 7 and 8 show information for wheat, corn, soybean, cotton, and tobacco farms similar to what was displayed for livestock farms in figures 3 and 4. The number of farms for all crop types reported here has been falling, with cotton and tobacco declining the fastest with annual rates of decline of 6.8% and 4.5%, respectively (figure 7). It should be noted that since the 2002 census, the number of tobacco farms has been declining quite significantly as government programs for tobacco currently (2005) are being phased out. The number of soybean farms has fallen the slowest, however, it is important to remember that there were not a lot of soybean farms in the 1950s as this was a relatively new crop. Figure 8 shows the normalized average farm size where 1959 is defined as 1.0.[4]

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[3] In 1995, dairies with less than 200 cows represented over 95% of the total number of dairies and produced 60.3% of the milk. Data for dairies with 1,000 or more cows were not reported until 1998 (i.e., prior to then, such dairies simply would have been placed in the 200+ category).

[4] Average acres per farm in 1959 are 60.1 (wheat), 35.2 (corn), 44.2 (soybean), 28.9 (cotton), and 2.7 (tobacco). Average acres per farm in 2002 are equal to value in figure 8 in 2002 times these 1959 averages.

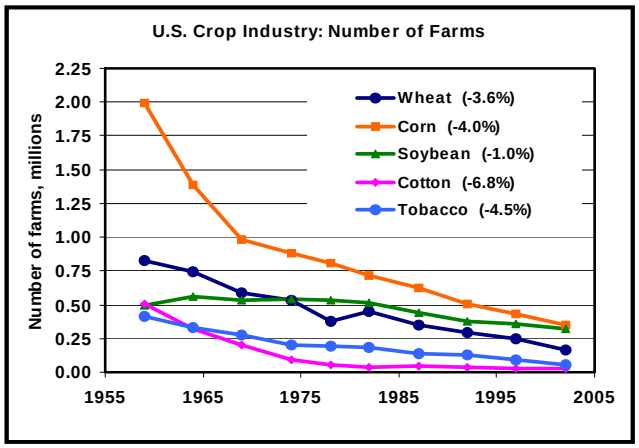

Figure 7

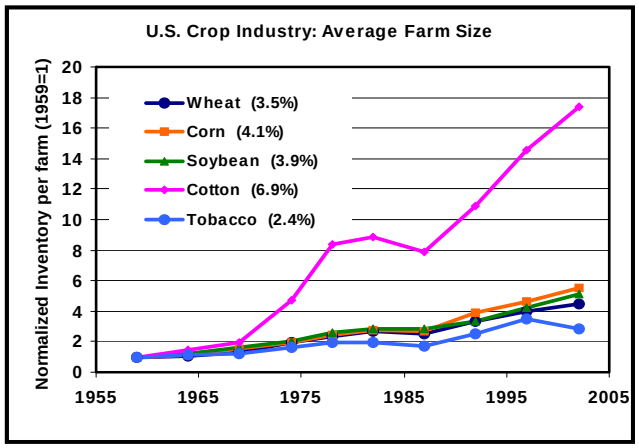

Figure 8

Figure 9 shows the distribution of farm numbers by farm size in acres for the different time periods. In 1959, approximately 30% of the farms had few than 50 acres and about 10% of the farms had 500 acres or more (remaining 60% had between 50 and 500 acres). In 2002, slightly over half (50.8%) of the farms were in these "small"(34.9%) and "large" (14.9%) categories. This provides some evidence that the middle-sized family farm is somewhat being squeezed out and replaced either by small or large operations. Figure 10 shows the distribution of acres by farm size. While those farms with less than 50 acres accounted for 34.9% of all farms in 2002, they farm less than 2% of the total acres in the U.S. On the other hand, farms with greater than 2,000 acres account for 47.3% of the total acres but yet they represent only 3.7% of all farms. These large farms represented 1.5% of the total farms in 1959 and 32.4% of the acres. The information in figures 7-10 makes it clear that consolidation is occurring in crop production similar to what is going on in the livestock industries.

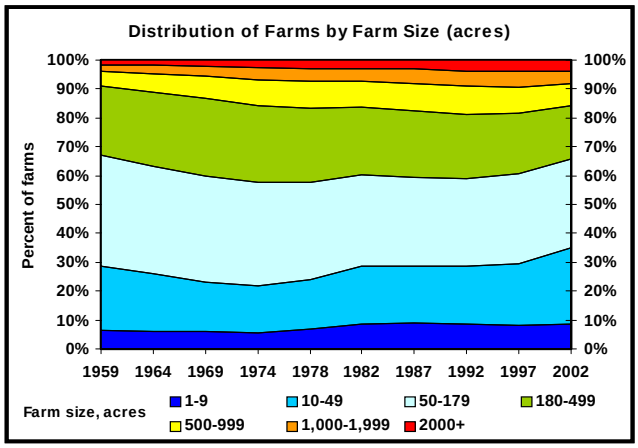

Figure 9

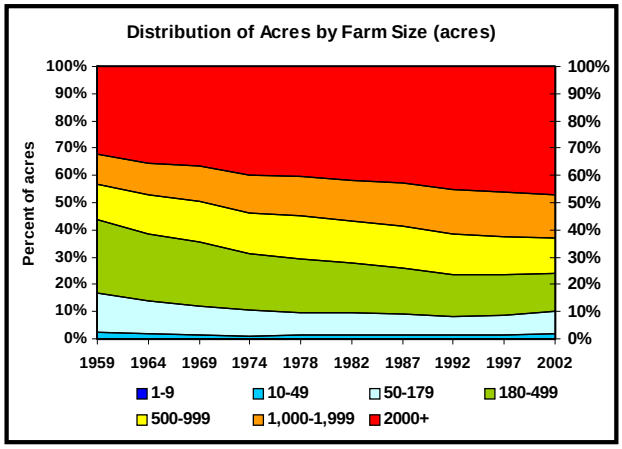

Figure 10

The driving force behind the consolidation trend principally is economies of scale, which is a phenomenon that occurs when per-unit costs are lower, or per-unit revenues are higher, for larger firms relative to smaller firms. For example, large factory farming techniques have lent themselves well to poultry and swine production. More recently, changes in feeding, milking, and housing dairy cows have been especially supportive of large factory farming dairy operations. Whether

firms view the situation reactively (I have to get bigger to survive) or opportunistically (If I get bigger I can lower my cost or increase my revenue and make greater profits), the end result is the same – firms get larger and fewer over time.

As opposed to gradual ongoing consolidation, rapid consolidation typically comes about because of new technologies that are especially scale dependent. How those technologies are captured is somewhat different for producers of animal products than for crop producers, but the end result is similar – larger farms.

In animal production, to capture scale-dependent technologies, existing businesses engage in substantial expansions and new, large, business startups occur as well, which increases the average farm size. Constrained only by biological limitations such as gestation length and age to sexual maturity, these expansions rapidly increase the supply of output to the market, which results in lower market prices. With falling prices, high cost producers exit the industry, that is, those that are too small to take advantage of the technologies. This exit of smaller farms from the industry then exacerbates the transition to larger average farm size.

In crop production, because acres of available crop land in the U.S. are more-or-less fixed, scale-dependent technologies generally are captured by existing farms becoming larger, not by new business startups. This comes about through cash rents and land values that are bid up by those farms that have lowered their production costs by using the new technologies. The result is larger average farm size. If the scale-dependent technologies also increase yield per acre or allow for more intensive farming (more crops raised per land acre), then there will be a price-lowering supply effect similar to the animal situation. When this supply effect is coupled with higher cash rents and land values, those farms that are too small to take advantage of the technologies exit the industry, which again exacerbates the transition to larger average farm size.

Rapid consolidation often induces dramatic changes in regional production, especially in animal agriculture. For example, large-scale hog production has caused North Carolina to become an important contender with Iowa for swine production. Figure 11 shows the number of farrowings and farm numbers for swine operations in Iowa and North Carolina from 1984 to 2004 (in 5-year increments). As recently as 1994, Iowa had twice as many farrowings as North Carolina and more than four times as many operations. By 1999, North Carolina had more farrowings than Iowa, and by 2004 it had over 25% more farrowings than Iowa, making it the largest state in terms of the number of farrowings. Both states saw large decreases in the number of swine operations over this 20-year time period – annual decreases of 7.6% and 9.9% for Iowa and North Carolina, respectively.

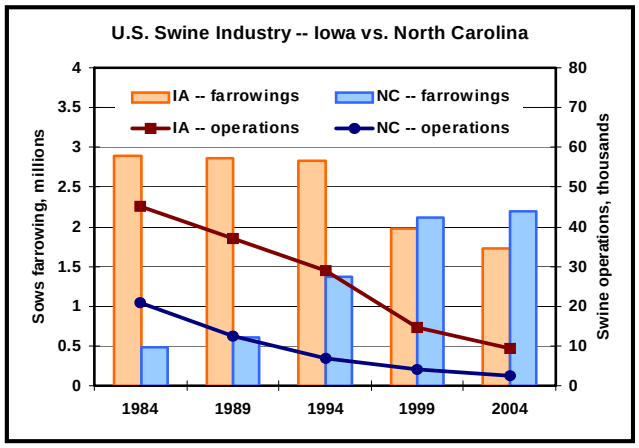

Figure 11

Figure 12 depicts a similar story for the dairy industry as was shown for the swine industry in figure 11. That is, as consolidation has occurred, there has been a change in production from the "typical" dairy state of Wisconsin to the more "large-scale" dairy state of California. In 1954, Wisconsin produced over 2.3 times as much milk as California, but by the early 1990s California surpassed Wisconsin and by 2004 Wisconsin produced only 60% as much milk as California. From 1974 until 2004, the average farm size – as measured by cows per farm – in Wisconsin increased from 32 to 74 cows (a factor of 2.3), whereas, average farm size in California increased 5.7 fold (from 124 head to 703 head).

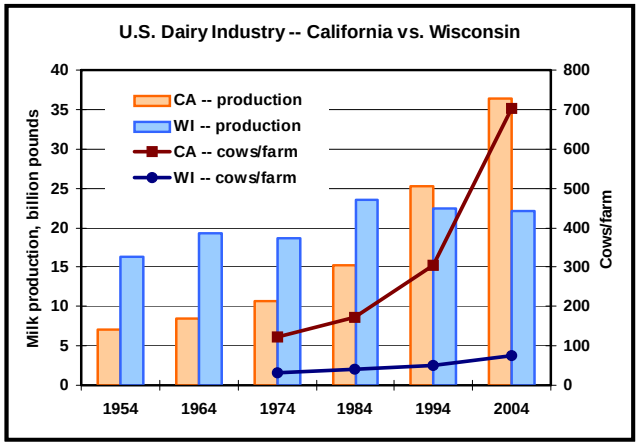

Figure 12

While figures 11 and 12 show dramatic regional shifts that have occurred across state lines, regional changes can, and do, occur at a more localized level. For example, the dairy industry in Kansas somewhat mirrors trends that are occurring nationally. The western third of the state historically produced less than 10% of the milk in the state. However, with the construction of several large dairies in western Kansas beginning in the mid 1990s, this region now produces approximately 67% of the milk in the state (figure 13).

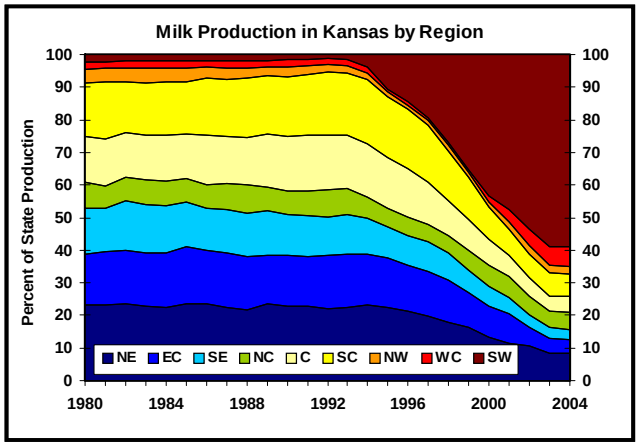

Figure 13

The previous figures clearly have indicated that there has been considerable consolidation in the livestock industry. First poultry and cattle feeding, then swine, and now dairies. A natural question is, Will the cow/calf sector follow suit? There are several reasons that suggest that the cow/calf industry will continue to be a little slower to consolidate than the other livestock sectors. First, cows depend heavily on native grass, a feed source that would be prohibitively expensive to harvest and dispense in a factory farming setting. Second, many small cow-calf operations are retained on principally crop farms as important symbiotic enterprises with crops – to use inexpensive off-season labor, for example, or inexpensive crop residue as a feedstuff. Such "small" operations would be stiff economic competitors of large sole-purpose cow/calf ranches designed around economies of size. Third, many people outside of agriculture prefer to own cows as a quasi hobby. Clearly, such hobby operations are hard to drive out with economic competition alone.

After pointing out potential advantages of smaller over larger cow/calf operations, it is important to note that there are economies of size associated with most aspects of cow/calf production. For example, an operator who gets out of bed at 3:00 am to check on first-calf heifers that may be calving might just as well be checking many heifers as checking only a few. Similarly, selling

calves in larger lots consistently has been shown to increase selling price. Further, as technologies such as grid pricing and electronic animal identification work their way through the cattle industry, there ultimately might be large selling-price advantages to volume, which would induce faster and faster consolidation of this sector. Nonetheless, it is probably safe to say that the consolidation in the cow/calf sector likely will occur at a slower pace than with poultry, swine, and dairy.

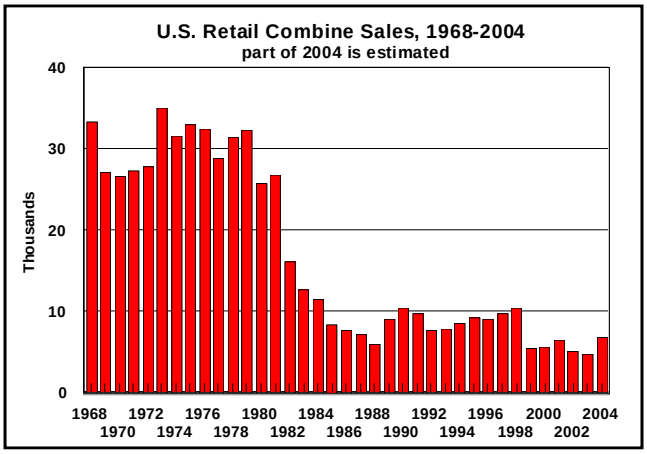

Figure 14

Perhaps even more interesting than the cow/calf consolidation question is the following. Will crop farming follow suit with the livestock sector, with a long term gradual consolidation (farms getting larger) followed by a rapid surge of consolidation? Certainly, a number of things point to at least an accelerated rate of consolidation for crop production. First of all, tractors, combines, and other machines are rapidly becoming especially complex in terms of new computer-based technologies. GPS-assisted steering (where the driver operates the steering wheel only on turnarounds) is one such example. Such technologies greatly add to the purchase price of these machines and hence the number of acres or hours required to justify their purchase. Certainly, fewer and fewer combines and tractors are needed to produce the same or more crops than in the past. This fact is demonstrated quite clearly in figure 14, which shows that annual new combine sales in the U.S. currently are only about 20% of what they were 25 years ago (data from the Association of Equipment Manufacturers).

But, what might cause a rapid change in the economies of size, and hence consolidation, associated with crop production? Frankly, we do not know! On the other hand, we did not know in the case of cattle feeding, poultry, swine, and dairy production either. That is, it would have been difficult in real time to say "*this* is the cause of the rapid consolidation." Rather, the consolidation in those sectors seemed to be based on a number of small technologies that appeared to combine to reach a threshold where the advantages to larger size became extremely obvious. Of course, the supply increase wrought by rapid expansions, as described earlier, surely helped with rapid consolidation in these areas. So far, we have not seen dramatic supply increasing technologies in crop production, which leads us to think that consolidation will simply continue, albeit at perhaps an increasing rate.

Implications of Consolidation

Consolidation means there will be less companies and less people for the farm manager to interact with. Traditionally, farmers could purchase inputs from many suppliers in their geographical areas and could sell their production to many buyers. Not "burning bridges" will become a more important maxim in years to come, meaning that farm managers will have to acquire ever better interpersonal skills. Fortunately, new information and transportation technologies have mitigated the problems associated with fewer buyers and sellers. Cell phones mean needless trips to distant machinery dealers can be avoided. The internet means that many inputs can be purchased from

companies that are many miles away. UPS routinely makes delivery in only a day or two. Farmer-owned semi trucks mean bulk goods easily can be shipped larger distances.

But, doing business over greater geographical distances brings problems of its own. For example, it may be more difficult to assess the credit rating and integrity of a company that is several states away than one the farmer has been intimately familiar with for decades. Further, that credit rating or integrity might become more important to assess when it is for a company with which the farm is conducting a large portion of its total business. In short, doing business with a company that goes broke can be devastating.

Although consolidation means fewer sellers and buyers to deal with, it does not necessarily mean fewer choices, rather, product differentiation is a natural outcome of consolidation. For example, John Deere and CNH dominate the tractor and combine markets but the choice is not merely between Deere and CNH. The relevant choice is among the numerous classes and features of a machine – even if the brand choice already has been made. Today's tractor has many more features to pick from than an M Farmall of the early 1950s or a Deere 4020 of the 1960s. Each feature comes with a separate price and must be evaluated against that price.

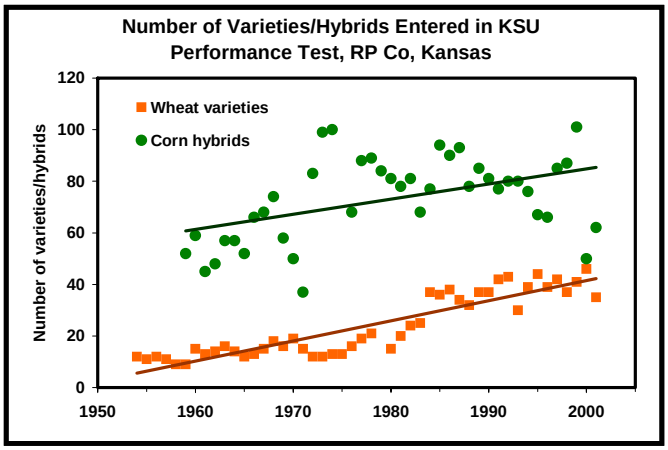

Figure 15

Similar to the increase in number of machine features, the number of feasible corn hybrids or wheat varieties has become large in recent years. Figure 15 shows the number of wheat varieties and corn hybrids that have been entered in the Kansas State University (KSU) Performance Test in Republic County for the last 40-50 years. While the number of companies may have decreased over this time period, the number of varieties and hybrids in the performance tests has been trending up.

Consolidation-induced product differentiation has appeared in other areas as well. For example, although there may be only a few grain buyers in an area, the number of grain marketing packages has grown immensely. Farmers routinely must choose among minimum price, hedged-to-arrive, flat price, and deferred price contracts, to name just a few, or any of the various cash-sales-combined-with-futures-and-options strategies. Likewise, there may be fewer bankers providing credit but there likely are more lending packages with interest rates and payments tailored to particular needs. The key point is that while the number of input providers (and output purchasers) may be decreasing, the choices they offer to producers are not necessarily decreasing.

Fewer buyers and sellers coupled with many choices means that transactional (market) prices will continue to become less transparent and less informative. A $75/cwt slaughter steer price reported in the local newspaper may not mean an individual farm's slaughter steers would have sold for that price on that day. It all depends on the characteristics of the cattle being considered. Knowing that a neighbor purchased a new tractor for $155,000 may not be particularly informative even if the brand and model are known. It all depends on the features included. Even a reported wheat price

of $3.50/bu may not be particularly informative unless one knows, for example, the wheat class (white or red?), its protein content, and the grading specifications. Once again, acquiring informative transactional prices will depend heavily on acquiring improved people skills. Farm managers will need to establish interpersonal relationships with other farm managers, so that reliable information on product prices, features, and availability can be gained through communication and consensus.

With fewer firms to do business with, and the associated increase in product differentiation, comes the need to acquire a better understanding of the businesses that remain. Car buyers have long known this, and established websites that improve understanding of dealer costs associated with cars and their features. Such information has become valuable for those negotiating automobile purchases, helping them establish effective starting points for negotiations. But, such information likely will be inadequate in the future. For example, it will become important to recognize the difference in dealer cost associated with volume purchasing by the dealer from the manufacturer; such kickbacks, rebates, and discounts are not particularly transparent today. So too, with single farm machinery items routinely costing in the $100,000 to $250,000 range, it will become especially important to garner a better understanding of "how much room" a machinery dealer has to work with when negotiating on purchase prices.

As noted or alluded to several times, the most important implication of consolidation in production agriculture is fewer, hence more valuable and more in depth, business and interpersonal relationships. With fewer relationships to go around, it will become both necessary and profitable to invest more time and effort in the relationships that remain. That will be true for all parties involved. Machinery dealers, lenders, and crop and livestock input providers will spend more time courting the smaller number of farms that remain. So too, those farms will spend more time cultivating long term trustworthy relationships with such businesses. Once again, possessing good communication and people skills will be an important part of such relationships.

2. Rapid Technological Change

It has long been known that early adopters of new agricultural technologies are the ones who profit the most. That is, technology-based positive economic profits related to crop production quickly are bid into land values and rents. Higher rents mean higher costs, which mean that many farmers find themselves either out of business or that they have to adopt the new technologies just to break even. More succinctly, the non-adopting farmer finds that he is not "holding his own" economically, but rather that he is steadily going broke in the face of what he views as rents that are too high.

In the economic technology treadmill of modern agriculture over the last couple of centuries, why is it that some technologies are adopted more quickly than others? The answer lies in the fact that different technologies vary greatly in terms of a) the magnitude of expected profitability associated with them, b) the degree of confidence an adopter assigns to that magnitude of profitability, and c) the size of the required investment in dollars (farms are more willing to gamble small amounts of money).

Technologies with small expected gains, but where those gains are very clear and distinct, such as Roundup-Ready soybeans, are adopted rapidly. That is, Roundup-Ready soybeans easily could be assessed by comparing well-known higher seed costs against well-known herbicide cost reductions. Figure 16 shows adoption rates for herbicide-tolerant soybeans, cotton, and corn in the U.S. Interestingly, USDA's Economic Research Service (ERS) behind the herbicide-tolerant study found that adoption was heavily dependent on farm size, with small farms adopting at much lower rates (not shown). This finding shocked the ERS since the technology is embodied in the variable inputs (e.g., seed), which makes it completely divisible and not particularly scale dependent. But, what the ERS possibly ignored was the fact that "getting educated" about new technologies is not scale dependent. Educational and informational costs associated with new technologies are essentially lower for large farms since they can be spread over more acres.

More colloquially, technologies such as those behind figure 16 are belly-button or "duh" technologies as everyone can easily calculate their advantages. To some extent, lightbars (GPS guidance) comprise a belly-button technology. Their potential advantages in either cost or accuracy are easy to assess against their competition of foam or mechanical markers. Tractor cabs also were adopted quickly, not necessarily because the gains could be easily quantified, but they probably were easy to qualify. That is, the reduced stress of tractor operation wrought by cabs was viewed as sufficiently worthwhile to merit the investment. It is likely that GPS-guided assisted steering devices also will be adopted relatively rapidly, at least by larger farmers (since the investment is substantial). That is, who can argue with savings associated with reduced overlap or even with the unknown-in-magnitude-but-clearly-positive reduction in operator fatigue and improved equipment monitoring associated with assisted steering devices? Any real (easier to get rented land?) or perceived (personal satisfaction) gain from straight rows is an added benefit.

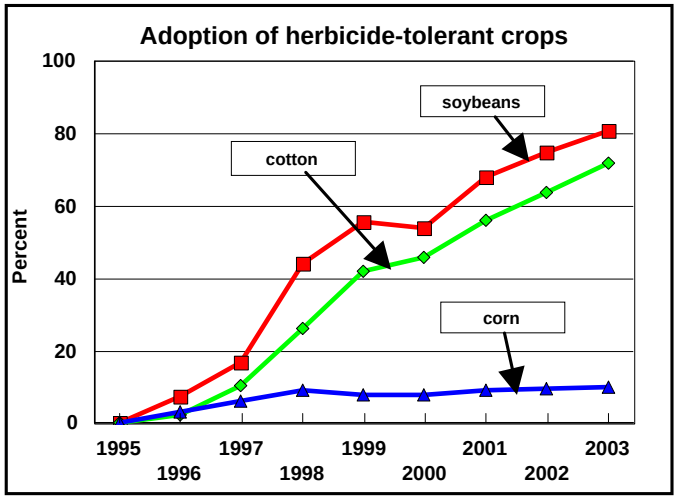

Figure 16

Just as the gains for some technologies are obvious, the gains associated with others are elusive. Though it might be hard to imagine from today's perspective, tractors and fertilizer are two such examples. Tractors had to evolve for many years before they were clearly superior to draft animals, causing tractor adoption to take nearly 40 years (see figure 17). It is interesting to note that in figure 17 there was clearly a trade-off between horses and tractors (and tractor size) from 1920 forward, however, the 2002 Ag Census showed an increase in both the number of horses and the number of tractors in

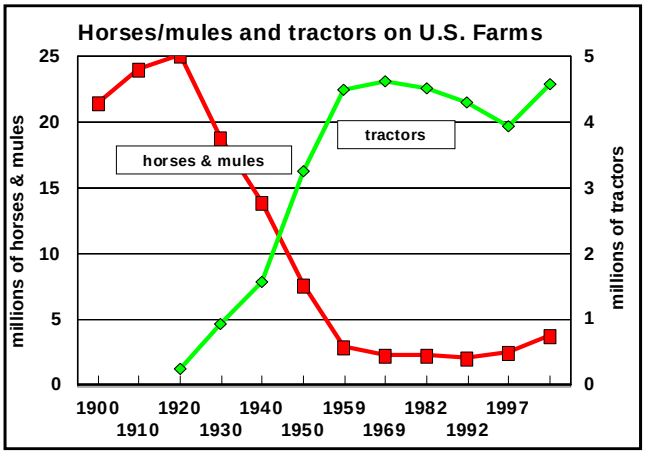

Figure 17

the U.S. This "change in trend" is consistent with the increased number of part-time and hobby farms.

In the early years of fertilizer, many fields still were adequately fertile for the existing crop potential at the time. That meant farmers would regularly debate for years about the gains to commercial fertilization. Because of low rainfall and relatively late breaking of the land out of native pasture, Colorado represents a good example. In figure 18, this "debating" phase can be seen to cover roughly the 1960s through the 1980s, with more rapid adoption following thereafter. A more recent example of such technologies is no-till farming. Many regions of the U.S. slowly have been migrating in the no-till direction for decades, as it becomes increasingly more obvious just where that technology might pay, and as herbicides and related machinery become ever better along the way.

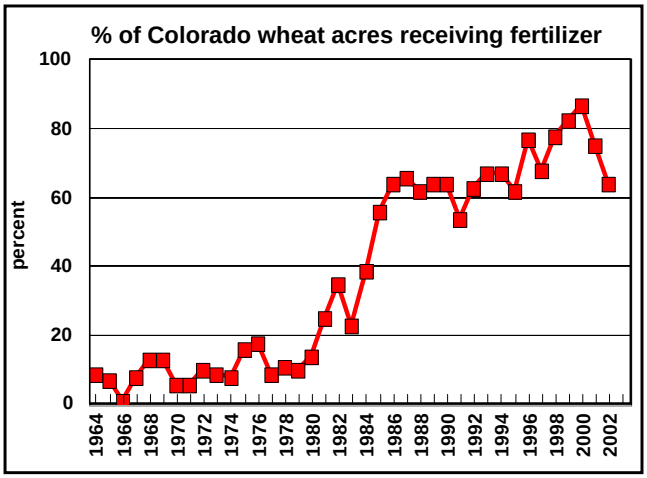

Figure 18

For many years production agriculture has been associated with substantial economies of size. That is, many of a farm's cost categories are associated with both fixed and variable costs. The per-unit (e.g., per acre or per bushel) cost of the fixed component always falls with increased farm size, providing an intrinsic economic advantage to larger farms over smaller farms. Over the decades, many agricultural technologies have been labor reducing (e.g., larger tractors). That means one operator has been able to farm more and more acres over the years, taking advantage of any other, non-labor, economies of size without increasing labor (e.g., volume discounts for input items). But, it also means that farmers generally have not gained experience in incorporating employees into their operations. Such discreet barriers (e.g., the reluctance to hire that first employee) lead to a vicious circle of giving preference to labor-saving technologies. Thus, for many farms, it is the labor-saving aspect of no-till farming that makes it appealing, rather than the higher yields or lower crop input costs. That is, farms move towards less tillage so that they can spread their "fixed" labor costs over more acres (by expanding their farms), thus reducing the labor cost per acre, and thereby allowing them to capture other non-labor economies along the way. Consequently, no-till adoption would be much slower yet were it not for the intrinsic labor savings. In short, technologies with associated labor savings tend to be preferred to those that might be labor increasing.

Two messages around technology adoption emerge for the successful farms of the future. First, rapidly moving technologies must be adopted very quickly – just to be able to survive and compete. Second, farms certainly should consider adopting slow-moving technologies – because they will result in a profitability edge that can go on for years. Thus, it especially should be valuable to consider labor-intensive technologies, precisely because so many farms seek to avoid them and the gains therefore should be long-lasting. An example of this is alfalfa production. While Kansas Farm Management Association enterprise data consistently show alfalfa to be one of the most profitable crops, many producers shy away from it likely because of the labor and management

requirements. Taken together, these messages mean that the successful farm of the future must become an astute judge of technology trends.

Unfortunately, consolidation, economies of size, and product differentiation can make it more difficult to identify worthwhile slow-moving technology trends. For example, only a few farms in the state or region might own a new specialized machine designed to capture new technologies, say, a particular class of no-till drills. That means one cannot simply drive around the neighborhood to assess such things, but rather must consider informational activities that are more immune to geography, such as the internet. Furthermore, such slow-moving technologies can get quite farm-specific (consider the myriad of crop rotations that might be considered within a no-till setting), making it difficult to assess a technology's advantage simply by observing other farms or university research.

Some new agricultural technologies require a substantial investment in infrastructure, not just by the farm, but also by the agribusiness industry. A classic case is hard white wheat in Kansas as an alternative to hard red wheat. Many grain elevators lack the physical ability to simultaneously take in both white and red wheat at harvest. A similar situation occurs when a new crop is just beginning to become popular in an area, for example sunflowers. In such cases it may actually be economically advantageous for those grain elevators to "talk down" the potential benefits of the new crop – at least until such point when they are ready to make a changeover to the new crop. The information arising from those elevators during the talking down phase easily might be construed as an indication that the new technology is merely a fad, not something to be taken seriously. Yet, these same elevators will quickly reverse their story after making a commitment to the new technology. The result is a threshold effect that makes technology assessment more difficult for the farm manager. Threshold effects also are common among farmers themselves, as they adopt new technologies. Here, the classic case probably is no-till farming. There is an obvious benefit for a farm to have its techniques considered "proper" by other farms and especially by landlords. Thus, it should not be surprising to see a farm talk down no-till one year and reverse its stand the next year after making an investment commitment in the no-till direction. The main point is that the astute assessor and adopter of technology must acquire the skills necessary to see through such threshold effects – which can only be acquired through objective observations of a new technology's outcomes.

3. More Opportunities for Non-ag Involvement

As farms get larger over time and look more like other businesses, and as informational technologies like the internet bring people closer together, there undoubtedly will be more interconnections between production agriculture and the outside world. Among the trends considered in this paper, this one is the most broad, capturing the idea that there will be more opportunities for farmers to invest off-farm, for non-farmers to invest on the farm, and for farms to sell services to non-farmers.

One class of off-farm investment by farmers most certainly is that which is known as value-added investment, where value-added usually means further processing, wholesaling, or retailing beyond the farm gate. In recent years, the farm press has contained numerous stories concerning such value-added investment, with stories describing both business successes and business failures. The

text of a recent article (Top Producer, Summer 2003, p.10) even suggests that there is a trend among larger farmers (i.e., those grossing over $500,000 annually) to invest more and more in off-farm investments such as value-added firms, implying that economies of size in production agriculture is waning. But, a closer look at that article might suggest otherwise. In particular, expected 5-year growth among corn and soybean farmers was 32%, which compares to answers of 25% in 1998 and 18% in 1993. In fairness, expected future growth in the livestock sector was down from prior surveys – which should not be too surprising given the wide-scale industrialization of especially the swine and dairy sector in recent years.

It is likely that value-added firms will continue to solicit investment funds from agricultural producers. Particularly popular investments of this nature today are ethanol and more recently biodiesel production plants. Certainly, there has been a large expansion in that area across the whole U.S., with new production records regularly being set. The Renewable Fuels Association reports that there currently are 87 U.S. ethanol plants, with a capacity of producing over 3.92 billion gallons annually (http://www.ethanolrfa.org/ – accessed August 3, 2005). Another 18 plants are under construction, which will increase production capacity almost another billion gallons. In the Great Plains, and Kansas in particular, another popular value-added investment is large commercial dairies, as alluded to earlier in this paper. Since both dairies and ethanol plants use feedstuffs grown by crop farmers, they are heralded as vehicles by which farmers can pick themselves up by their bootstraps.

In consideration of value-added investments, successful farms of the future will want to consider a number of issues. First of all, the question needs to be asked, Am I getting a higher commodity price with my involvement in a particular venture? More fundamental, Am I even passing my commodities to or through the firm? It should be remembered that today's value-added investments are a far cry from corn producers who decided in the past to add value by bringing a swine or beef finishing enterprise into their businesses. The more an off-farm investment is divorced from the actual farm itself the more important is the follow-up questions: Why would I trust a particular plant-promoting team with my investment money over a more professional investment team that likely would consider a broader set of investments? In particular, why should I invest in a commercial dairy or an ethanol plant when I could just as well invest in Microsoft or Walmart?

Likely, the most important question a producer considering off-farm investment should consider centers around whether the investment money would be better spent on the farm itself. Growing, successful farms often are in dire need of equity capital to fuel their quest to capture the economies of size intrinsic to production agriculture. Can such farms really spare equity capital to invest in a business that in all likelihood will return a lower rate of return than what can be achieved on the farm itself? Alternatively, should such farms convince their lenders to allow them to increase their debt so that they can invest off farm? These issues are discussed in Stock Market vs. Land vs. Farming Returns, a paper available on the www.agmanager.info website. That paper offers an extensive analysis of the impact of off-farm investment in ag-related stocks. Though not exactly the same as investing in a particular ethanol plant or a particular dairy, the conclusions are just as relevant. It is worth repeating one paragraph from that paper here:

> Should farm managers invest in the stock market? The answer is often no if it means taking on more debt to do so. Which farms are most likely to benefit from stock market investment? Those which are low- to mid-profit with no debt. That low-

profit no-debt farms would benefit is likely a statement that such farms are either hobby farms or that they will probably diminish anyway. Simply put, such farms would probably be better off (at least economically) if they had their capital invested elsewhere. Which farms are least likely to benefit from stock market investment? High-debt farms and high-profit farms. If the reason for stock market investing is principally risk reduction, it appears that paying down debt will accomplish the same task, while giving up only small amounts of profit. Especially high-profit farms, by definition, will not find stock market returns sufficiently attractive.

Interestingly, for tomorrow's successful farms it could very well be more important to solicit off-farm investment *in* their farms rather than to offer off-farm investment *from* their farms. That is, and repeating what has already been noted both here and in the related economies of size paper, growing farms often need equity capital beyond what their farms' profits will provide.

Historically, production agriculture has long been dependent on investment from those not directly involved in operating farms – in the form of landlord ownership of farm land that is operated (rented) by farmers (tenants). More recently, there seems to be a surge in investment from those further and further removed from agriculture, not just from those who once were farmers themselves or at least heirs of one-time farmers. In short, poor stock market and money market returns of recent years are causing investors to consider agricultural land in their investment portfolios. For those farmers willing to consider farming returns separately from land investment returns, this only can be construed as a positive. This is especially true given that farm land seems to be increasingly valued on the basis of its non-agricultural attributes, meaning that ownership of land could tie up substantial amounts of equity for growing farms – given that it may be valued at much higher prices than those supported by agricultural production alone. The key here is that a successful farm will not get hung up on the idea that it has to own land to be a successful farming operation.

To benefit from outside investment in farm land, successful farms must possess or obtain the skills to demonstrate to the investor expected returns from rental arrangements. Clearly, such investors will have different needs than traditional landlords who once farmed themselves. What is needed is a good understanding of farm land investment, and how it might compare to other investments considered by investors. To gain some insight into this area, readers can read the various land ownership and land rental papers available from the authors at the www.agmanager.info website.

As tomorrow's successful farms hone their skills on acquiring outside investment into the land they farm, for some, it will be a natural extension to consider outside investment into the farming business itself (the machinery and other non-land assets). Likely, this will not be easy given that outside investors may be minority shareholders in a closely held corporation or similar entity. Nonetheless, it would be wise to start thinking in this direction. One might start by considering only those outside investors who are extended family members, and then progress to others as success is demonstrated over time. Either way, those who become successful at acquiring outside equity likely will have an edge over other more traditional farmers, those whose quest for economies of size may be constrained by internal growth.

One class of opportunities involving the non-ag sector in one's farm has to do with capitalizing on the fact that non-farming persons value certain non-ag attributes of farm land. One such attribute is hunting habitat. Increasingly, urban people are willing to spend money to ensure successful hunting experiences. As that recreational activity matures, farmers are finding that they can be involved as little or as much as they would like. In Kansas, farmers who want minimum involvement can consider enrolling their farms in the state-run walk-in hunting program, which might garner $1 to $2/acre annually. Others might want to lease their land to sportsmen associations, or become involved with guiding hunts, outfitting, raising game birds, etc. Still others might wish to sell off their land that is the most suitable for hunting – to those willing to pay a premium. Regardless, successful farms of the future will need to be mindful of such non-ag recreational opportunities for their land. After all, those who choose to ignore these opportunities may end up no better off than those who choose to ignore distinctively agricultural technologies. That is, they will find themselves steadily going broke in the face of land values and rents they perceive as being "too high."

4. More Paperwork (Computer Work?)

As farms become larger and more like agribusinesses, the amount of paperwork, or more appropriately computer work, undoubtedly will increase. Farm managers who recognize the value of these activities will have a comparative advantage over others. We believe there are at least four major areas that will benefit from increased computer activity: 1) improved accrual accounting, 2) better capital asset management decisions, 3) better day-to-day decisions around complex problems, and 4) improved production data management and analysis.

One area of paperwork/computer work that can especially benefit farms of the future is increased accrual accounting, in terms of detail and in terms of frequency. Accrual accounting (which is a must) means that changes in inventory values, machinery values, and growing crop values are tracked to better reflect net worth, as are accrued assets and liabilities. Otherwise farm managers and lenders will focus on changes in cash position (i.e., changes in debt) as their indicators of profitability – which most certainly is a mistake, and especially for growing farms that routinely are purchasing production inputs for more acres than are currently being harvested.

Once a farm has committed to accrual accounting, the next step naturally should be more frequent accounting and reporting, preferably monthly, but at least quarterly. With frequent analysis of financial net worth comes a more accurate picture of how a year is progressing economically. In years when poor yielding crops are expected during the growing season, it should be informational to "write down" the crop values if needed, of course allowing for expected crop insurance indemnities at the same time. That way there are no surprises and the manager can react appropriately in real time. An additional benefit is that the lender will know the current status of its line of credit with the farm. Similarly, it should be beneficial to know how much government payments and disaster payments are expected to be, well in advance of receipt. Such information helps with cash flow planning. Additionally, frequent accrual accounting reports should help acquire preferential treatment with lenders, both in terms of interest rates and in terms of money needs. Finally, it is difficult to overstate the reduced mental stress that comes with frequent accrual accounting. And, reduced mental stress helps a farm manager cope with and eventually embrace

the idea of substantial leverage. All in all, frequent accrual accounting probably is one of the best uses of increased expenditures in the clerical area.

A second area of increased computer work is the area of capital asset management. The impact of machinery purchase and trade decisions on a farm's profitability is becoming greater and greater as individual machines become larger, more technologically advanced, more specific to the task they are intended for, and more expensive to purchase. The added complexity of new machines, along with the fact that there are fewer and fewer owners of a particular machine with particular features, means that intuition and common sense will become less useful in assessing the economic differences among the machines being considered. So, too, will land purchase decisions become harder to assess as land will increasingly be valued on the basis of both ag and non-ag characteristics. In particular, subtle distinctions in capital asset investments can make a large difference in a farm's profitability. Consistent with the critical need for accrual accounting, successful producers of the future will recognize the difference between economic costs associated with capital assets versus cash flow requirements. That is, when they consider capital investments they will recognize the importance of considering concepts such as the time value of money and income tax implications and how they relate to the purchase decision.

Fortunately, there are calculators, often in the form of computer spreadsheets, to aid capital ownership decisions. Several of these are available on the www.agmanager.info website, and also on other websites from universities and private companies. However, these calculators still require substantial involvement on the part of the user. Consequently, farm managers who are willing to make investments in their own education or that of their employees will have an edge over those who merely purchase based on "gut feel" or based on neighbor recommendations. Once again, it is fortunate that today's information technology, especially the internet, can greatly aid the farm manager wishing to expand his/her education. Also, education is becoming more of a continuum, where managers are not forced to choose between the extremes of a short meeting/training session and a full blown college-credit program. The MAST program currently offered at K-State is one example of such in-between educational experiences, involving two days on campus, followed by several months of web-based home-study modules, followed again by two days on campus.

A third area of increased computer work is in the area of day-to-day decision making that is becoming increasingly complex. One example of increased complexity is the crop insurance purchase decision. Each year it seems as though there are more policies with more nuances being offered under the federally subsidized crop insurance program. Again, just asking neighbors what they are doing will be less than adequate for optimizing such decisions for one's own farm. Similarly, the land renting decision is becoming more complex as traditional share renting agreements become inappropriate for new tillage and crop rotation systems, and as combinations of cash and share renting agreements are being considered. Clearly, managers who will be able to objectively and numerically analyze these decisions will have an edge over those who cannot.

A fourth area of increased computer work is the area of production record keeping, which is along the lines of precision agriculture technology, but not limited to it. As production systems become ever more unique to one's environment and economic circumstances, it will become less and less appropriate to rely on traditional university-provided production guidelines. In short, a farm manager will become more reliant on information collected on his/her own farm. At some point, as

a farm expands and as its data are collected at an ever finer scale, a computer becomes an absolute necessity for data collection and storage alone. Furthermore, analyzing those data will be nearly impossible without the aid of a computer. In addition to collecting, storing, and analyzing data for use in making operation-specific production decisions, computer records likely will become increasingly more important from a compliance issue (e.g., pesticide application, individual animal identification). Once again, farm managers who embrace and value the benefits of additional paper work and computer work surely will have an edge over those who do not.

5. More Reliance on People with Specialized Skills

As farms become larger, more like agribusinesses, and more complex, it is only natural that there will be more reliance on people with specialized skills. Financial management (agricultural economics and accounting), crop production (agronomy), and livestock production (animal science) skills will certainly be of key importance. But, specialized agricultural engineering skills also will be needed from time to time, as managers struggle to understand the workings of modern complex machines. Also, specialized computer skills may be needed to keep the necessary computers working productively. Lawyers to help with all of the legal issues involved with farming also will become increasingly more important.

The best way to make clear the need for people with specialized skills probably is with examples. Consider the decision to move from conventional tillage to no-till. The farm manager (or someone advising the manager) first must determine whether the change will be positive to profitability, which only can be assessed after obtaining reliable expected cost and crop yield information. If the goal is to be an early adopter, then one must be able to read and interpret research results around no-till farming. The farm press and conversations with neighbors will help, but probably will not be adequate for the early adopter, who must rely on his/her theoretical understanding of agronomic principles. Suppose the decision has been made to change to no-till. The natural question is, Do I hire my spraying or bring the activity in-house by purchasing a sprayer. Suppose the decision is to purchase a sprayer. The next decision is brand, model, new vs. used, etc. Market forces work to make many of the decisions nearly a wash. That is, if certain choices had obvious advantages over others they probably would have already occurred. In short, decisions like buy vs. custom hire or lease vs. purchase often are subtle, with intuition or gut feel being a poor aid to the process. Nonetheless, it is the farms that capitalize on subtle differences among management decisions that will have the greatest edge in coming years. Many small advantages, added together, and especially when associated with large farms, become substantial differences in profitability.

The first step to benefitting from specialized skills is to recognize their need. But, that recognition is not enough, as various questions immediately follow. Should I, or someone else in the business, get trained to make these more complicated decisions? If yes, should that come about by dedicating time to studying books or articles in print or from the web? Should it come about via a non-degree training program, or a formalized advanced degree? On the other hand, do specialized consultants exist who might cover the tasks for me? If so, are they worth their cost and who should I hire? At what point should I consider hiring persons with specialized education, for example, with an M.S. degree in agricultural economics? After all, it is our preference that we do not “send young adults back to the farm” without a masters degree – at least if they will be expected to make management

decisions when they get there. With much less than a masters degree the educational edge over one's neighbors soon will dissipate.

We have no pat answers to the many questions asked in this section, only some conjectures. First, growing successful farms will be too large and complex for one person to solely make the related financial and production management decisions, even if the farm contains a bevy of laborers with no specialized skills. But, that probably could be done with a sole manager who depends on advice from various consultants. Second, because it is costly to hire and train new employees, one probably should consider developing the skill set of existing employees – by allowing and encouraging them to attend educational workshops, programs, etc. Third, and perhaps most important, successful managers will be those who learn to empower, encourage, expect, and reward employees to make business decisions. Micro-management most certainly will doom a farming business to stagnant size as the manager's time becomes swamped with small decisions.

Summary

This paper identified five trends believed to be important in production agriculture over the next decade or two. The trends are 1) increasing consolidation, 2) rapid technological change, 3) greater connections to the non-agricultural world, 4) increased requirement of paperwork and computer work, and 5) more reliance on people with specialized skills. Understanding and embracing these trends should give farm managers an edge over those who choose to ignore or resist them. The principal force underlying these trends is economies of size, and the topic of a sister publication by the same authors. Thus, it should be helpful to first read the economies of size paper noted at this paper's outset.

Key thoughts arising from this paper are as follows. Consolidation is here to stay, with fewer and larger farms and fewer and larger agribusinesses for those farms to deal with. Profitable farming always has been based on using the new technologies available, and using them sooner than others. Successful farm managers of the future would be wise to carefully weigh the benefits of value-added investment off-farm against the large and growing need for capital on their own farms. For growing farms, paperwork and computer only will increase as managers attempt to ferret out subtle opportunities for profit in large scale commercial production of agricultural products, in a world where government and private interactions become more complicated and offer more opportunities each year. More and more, farm managers will see a need for people with specialized skills, as farms look more like agribusinesses over time. The trick will be to figure out whether those skills should be hired out in the form of consultants, or developed in-house through educational training or new hires. If there is one theme that pervades this paper, it is the fact that farm managers will need to develop ever better people skills – because personal long-term relationships will become more valuable as the numbers of farms and agribusinesses decline.