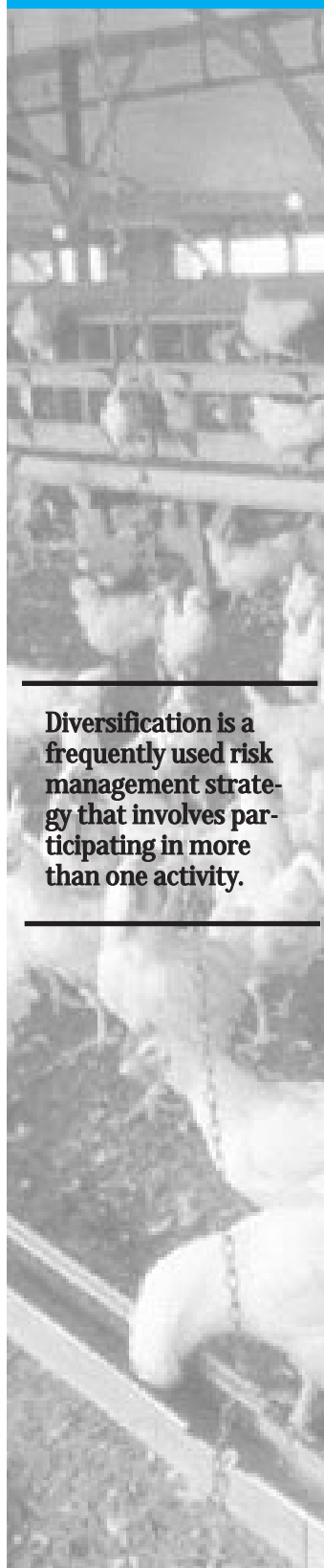


How Farmers Can Manage Risk⁵



Diversification is a frequently used risk management strategy that involves participating in more than one activity.

Farmers have many options in managing agricultural risks. They can adjust the enterprise mix (diversify) or the financial structure of the farm (the mix of debt and equity capital). In addition, farmers have access to various tools—such as insurance and hedging—that can help reduce their farm-level risks. Indeed, most producers combine the use of many different strategies and tools. Producers must decide on the scale of the operation, the degree of control over resources (including how much to borrow and the number of hours, if any, worked off the farm), the allocation of resources among enterprises, and how much to insure and price forward.

The price and yield risks discussed earlier, along with a farmer's attitude toward risk, have a major impact on the choice of risk management strategies and tools. In analyzing the risk-return tradeoffs associated with different approaches, a producer must consider his or her expected return to different choices and the variance in returns. Economists have used several approaches to capture these tradeoffs, which vary in how they describe a farmer's "world view" and how flexible they are in specifying risk attitudes (see appendix 2 for details).

Enterprise Diversification

Diversification is a frequently used risk management strategy that involves participating in more than one activity. The motivation for diversifying is based on the idea that returns from various enterprises do not move up and down in lockstep, so that when one activity has low returns, other activities likely would have higher

returns. A crop farm, for example, may have several productive enterprises (several different crops or both crops and livestock), or may operate disjoint parcels so that localized weather disasters are less likely to reduce yields for all crops simultaneously.

Many crop farms in the Corn Belt, for example, produce both corn and soybeans. By producing both crops instead of only one, the farm is less at risk of having low revenues because revenues from the two crops are not perfectly positively correlated. In some years, low corn revenues may be counterbalanced by relatively high soybean revenues. Diversification in farming has many similarities to the management of financial instruments. Mutual fund managers, for example, tend to hold many stocks, thus diversifying and limiting the losses of a particular stock doing poorly.

The extent of farm diversification in U.S. agriculture is a difficult concept to measure. USDA analysis has measured diversification using an entropy index, which accounts for both the mix of commodities and the relative importance of each commodity (measured by its estimated value) to

⁵The ordering of topics in this section does not reflect their relative importance. In addition, the length of discussion associated with a particular topic is not meant to indicate importance, but reflects the complexity of the topic and diversity of the literature.

farm businesses (Jinkins). The entropy index spans a continuous range from 0 to 100. The value of the index for a completely specialized farm producing one commodity is 0. A completely diversified farm with equal shares of each commodity has an entropy index of 100. These entropy indexes for individual producers can be aggregated to provide weighted average entropy indexes by farm type, farm size, and other classifications.

Based on the Agricultural Resource Management Study (ARMS), USDA's entropy index work indicates that cotton farms (with an average index of 50) are among the most diversified, producing substantial quantities of cotton, cash grains, fruits and vegetables, and in some cases, livestock (table 3). Poultry farms, where 96 percent of the value of production was from poultry in 1990, were the least diversified, likely in part due to the importance of production contracts. Such contracts can reduce producers' risk, reducing income variability and lessening producers' interest in diversification as a risk management tool (Dodson). In the Northern Plains and Corn Belt, farms tended to be less diversified than in other parts of the country, particularly when compared with farms in the Southeast (Jinkins).

In addition, data from the ARMS survey indicate that a large portion of commercial farming operations specialized in one or two enterprises during the period 1987-91.⁶ On average, one-third of all commercial U.S. farms received

⁶Commercial farms in this specific paper were defined as those that received at least \$50,000 in annual sales, and where the operator supplied at least 2,000 hours of labor annually and designated farming as his or her primary occupation. This definition is more restrictive than is commonly assumed.

nearly all production from just two enterprises during that period. Further, about one-third of aggregate farm production on commercial farms was from those engaged in only two enterprises (Dodson).

Many factors may contribute to a farmer's decision to diversify. The underlying theory suggests that farmers are more likely to diversify if they confront greater risks in farming, are relatively risk averse, and face small reductions in expected returns in response to diversification. Other factors may also be important. Continuing the corn and soybean example discussed earlier, planting corn after soybeans may reduce the need for fertilizer because of the nitrogen-fixing properties of soybean plants, and planting both corn and soybeans may spread out labor and machine use over critical times in the planting and harvesting seasons. In situations where livestock is part of the enterprise mix, the operator may be kept busy throughout the year, and crop and animal byproducts may be used more fully (Beneke).

Depending on the farm's situation, however, the costs of diversifying may outweigh the benefits, and specializing may be the preferred strategy. Diversifying often requires specialized equipment (for example, different harvesting attachments), and may be limited by managerial expertise and labor, the productive capacity of the land, and the market potential in the surrounding area (Dodson). Diversifying requires a broader range of management expertise than does producing only one commodity, and does not typically allow for intensive management. As technologies become more complicated, such intensive management and greater farm specialization may well be increasingly important (Beneke).

Based on USDA research, cotton farms are among the most diversified, while poultry farms are among the most specialized.

The benefits associated with diversifying arise through the potential offsetting revenue interactions among enterprises, and the complementarity of equipment and activities that are used within the farming operation.

Table 3—Diversification measurement using entropy indexes, 1990

Commodity	Extent of measure of diversification	Value of production from major commodity	Average enterprises in the operation
	<i>Entropy index</i>	<i>Percent</i>	<i>Number</i>
Cotton	50	62	2.5
Tobacco	42	76	2.2
Cash grains	39	76	1.9
Vegetables, fruits, and nuts	39	80	1.9
Nursery, greenhouse	32	57	1.2
Beef, hogs, and sheep	25	85	1.8
Dairy	24	85	2.4
Poultry	9	96	1.5

Source: Excerpted by ERS from Jinkins, John, "Measuring Farm and Ranch Business Diversity," *Agricultural Income and Finance Situation and Outlook Report*, AFO-45, U.S. Dept. Agr., Econ. Res. Serv., May 1992, pp. 28-30.

As a result, farmers face tradeoffs when examining diversification as a strategy versus specialization. Specializing can refine the expertise needed for a particular productive activity, and may also lead to the economies of scale that lower per unit production costs, increasing the profitability of the operation. Indeed, a producer's decision to specialize (or diversify) may be motivated purely by expected profits, with no consideration given to reducing risk. Conversely, the benefits associated with diversifying arise through the potential offsetting revenue interactions among enterprises, and the complementarity of equipment and activities that are used within the farming operation (Scherer).

Empirical analyses of diversification in farming have usually focused on factors influencing enterprise choices. As an example, a study of over 1,000 crop farms in the San Joaquin Valley of California examined the relationship between diversification and such variables as farm size and wealth. The authors were interested in the tradeoffs between risk reduction and potential size economies in a given activity. They found that wealthier farmers are more specialized, perhaps because they are less risk averse than farmers having lower net worths (Pope and Prescott). Similarly, they

found that corporate farms (with diversified ownership and limited liabilities) are more specialized, as are operators of smaller farms (as measured by cropped acreage) and younger (or less experienced) operators. Young farmers may start small and specialized operations, and perhaps become more diversified as they expand their operations. Farm size (measured by acres cropped) had a positive effect on diversification.

The effects of multiple enterprises on reducing risk have also been analyzed. Schoney, Taylor, and Hayward examined crop enterprise mixes for Saskatchewan farmers, and found that the gross incomes among crops were highly correlated. As a result, they concluded that little risk reduction was gained by diversifying beyond two or three crops. In addition, they found that, although several crops typically had a risk-reducing effect on the portfolio, these benefits were typically outweighed by the lower gross incomes associated with such levels of diversification.

Several diversification studies have also looked at combining livestock and crop enterprises on an operation, with the results depending on the time period of the analysis and other factors. Held and Zink, for example, found that adding livestock to a hypothetical

eastern Wyoming irrigated crop farm could increase gross margin by 7 percent and reduce the coefficient of variation from 0.63 to 0.42. Woolery and Adams indicated that diversified land use, combined with livestock, could increase net income and reduce relative income variability for South Dakota and Wyoming farms. Other studies have reached mixed results as to the risk-return tradeoff (see Persaud and Mapp; Sonka and Patrick). Despite any benefits that may accrue to enterprise diversification, the opportunities are often limited by resources, climatic conditions, market outlets, and other factors (Sonka and Patrick).

Geographical diversification (farming at several noncontiguous locations) may also mitigate risks in crop production by reducing the chances that local weather events (such as hail storms) will have a disastrous effect on income. Nartea and Barry examined this form of diversification using Illinois corn and soybean data, and found that risk was not reduced significantly until land parcels were separated by at least 30 miles. They accounted for the costs associated with farming across widely dispersed plots (for example, moving equipment and people and monitoring crop conditions), and concluded that widely dispersed tracts typically create unfavorable risk-return tradeoffs for producers. When widely dispersed parcels are observed, it is likely because of farmers' desire to expand their operations, and their difficulty in finding additional tracts of farmland that are close to their farming bases. Those most likely to gain from geographic dispersion of parcels are institutional investors with large acreages who do not have to transport equipment and who use tenants to farm their holdings.

Vertical Integration

Vertical integration is one of several strategies that fall within the umbrella of "vertical coordination." Vertical coordination includes all of the ways that output from one stage of production and distribution is transferred to another stage. Farming has traditionally operated in an open production system, where a commodity is purchased from a producer at a market price determined at the time of purchase. The use of open production has declined, however, and vertical coordination has increased as consumers have become increasingly sophisticated and improvements in technology have allowed greater product differentiation (Martinez and Reed; Allen). A vertically integrated firm, which retains ownership control of a commodity across two or more levels of activity, represents one type of vertical coordination (Mighell and Jones).⁷

There are many examples of vertical integration in farming. Farmers who raise corn and hay as feed for their dairy operations are vertically integrated across both crop and livestock production. Similarly, cattle producers who combine raising a cow-calf herd, backgrounding the animals to medium weights, and feeding cattle to slaughter weights

Opportunities for diversification can be limited by resources, climatic conditions, market outlets, and other factors.

⁷Other types of vertical coordination reflect differing degrees to which a firm at one stage of production exerts control over the quality or quantity of output at other stages (Martinez and Reed). When production contracts are used, for example, the contractor (or integrator) typically retains control over the commodity and most inputs, and the farmer usually receives an incentive-based fee for production services. In this case, the producer retains little control over production decisions. When marketing contracts are used, in contrast, a firm commits to purchasing a commodity from a producer at a price formula established in advance of the purchase, and the producer retains a large degree of decision-making control. Both production and marketing contracts are discussed in subsequent sections in this report.