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Understanding, assessing, and managing risk

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Introduction

In order to manage risk, producers must first have a concept of what risk is and is not. Animal industries operate in an ever increasing world of risk. This risk has lead some managers to believe their task is one of eliminating, or at least reducing, risk. However, it must me realized that profits are a return to risk. Usually, the more profit desired the more one must risk. Risk and profit can be viewed as opposite ends of a balance scale. Risk cannot be eliminated if we desire profits—and I believe this is an objective of most operations. The primary emphasis must be on managing risk in order to earn acceptable profits.

What is risk and what does it matter?

It seems each risk expert has a differing definition of risk. The classical definition is tied to variability. I would like to ask, though, how many of you are concerned with the risk that hog prices may be \$50/cwt. next month? That would certainly vary greatly from the current price level. How many of you are concerned with the risk that prices may be \$20/cwt? In the real world, managers aren't concerned with "good" variability, only "bad" variability. Since \$20/cwt. represents a losing proposition for all, it is what we are concerned with.

My definition of risk is: *the chance or probability of an adverse outcome*. If we assumed risk to be simply the range of outcomes, with wider ranges being more risky than smaller ranges, then as managers, we would manage the range of outcomes. But, if risk is about unfavorable outcomes, then we would concern ourselves with managing only those outcomes that adversely impact operations. These are two profoundly different management ideas. Implicit in my risk definition is the identification of adverse outcomes and of the likelihood of adverse outcomes under differing management strategies.

The way in which we manage risk can be thought of as an *ART*—Assume what you can, Reduce what you can, and Transfer the rest! It may also be useful to catalog the live-stock operation risk sources that must be managed. One catalog of risk might be:

Variable cost	+
Family living expenses	+
Total fixed cash commitments (Debt + payments, contract payments etc.)	+
Depreciation MINUS principal payments	-
Sustainable Net Worth Loss	=

Market risk

The chance of loss resulting from unfavorable input or output prices.

Production risk

The chance of loss resulting from unfavorable production changes (usually results in higher cost per lb.).

Financial risk

Risk added through the use of fixed payment instruments such as debt financing or fixed contract payments (i.e., leverage).

Human risk

Risk resulting from such events as death, divorce, injury, poor health, or retention of principal labor and management.

Legal/institutional risk

Risk resulting from policy or regulatory rules or changes in such rules.

While it is helpful to separate the risk categories, it is important to remember that it is the total risk of all categories which counts.

Management of market risk

Market risk factors include: input and output price risk, market access, and output quality factors. Market risk is usually the major risk area for well-managed animal operations. In fact, most studies show that market changes are about twice as important as are production changes in explaining farm income variability. It is in the market risk area (and principally the price risk area) that most astute farm mangers "balance" the farm's total risk through trans-

fer. Research shows that highly leveraged farms are more likely to manage market risk. Typically, market risk management strategies involve the use of futures, options, or cash contracts. Long-term marketing agreements may be aimed at market risk management. The "ledger" type agreements are merely alternative ways to secure financing in bad markets, although they can reduce the risk of market access. Market access risk is a growing risk concern for many producers.

Traditional market risk management strategies such as enterprise diversity have been tougher for producers to pull off. In order to reduce risk through diversity, the added enterprise must relate negatively in production or price to the current enterprise base. Since most agricultural enterprises tend to move together in price or production, the choices are limited. The traditional corn hog/farm of the Midwest was usually considered to have the advantage of reducing risk. However, during the 1990s, corn and hog prices have been positively correlated, meaning that this combination tended to amplify good and bad years rather than to offset them.

Given the last two years of livestock prices, the future of market risk management is likely to be filled with more vertical alignments on the part of producers. Rather than market agreements, the new wave of market risk management will likely be in processor/producer partnerships or cooperatives with total profit share arrangements tied to the more stable wholesale or retail prices. The federal government may also shape this side of the market if acceptable livestock revenue insurance products are offered. A likely scenario for livestock insurance will be products which enhance the producers ability to use existing markets. The current dairy option market pilot program is an example. Participants in this program are provided with a portion of a put option premium cost if they use the option market to set a floor for their milk price.

Management of production risk

The more important production risk factors are: feed efficiency, productivity, mortality, and morbidity. Production risks are usually either assumed and/or reduced through the management of the operation. Large scale operations are able to reduce production risk through multi-site and/or multi-unit production. Production contracting is one of the few ways to shift some of the production risk in an operation. True vertical alignments through which actual production costs are shared are likely to be one of the emerging ways through which production risks are transferred up the market chain.

Management of financial risk

Financial risk is incurred through the use of fixed cash payment commitment in order to acquire capital goods used in the operation. The major financial risk source is the principal and interest payments incurred from debt

financing. However, fixed payments may also be incurred through long term leases, through some types of production contracts or through long term rental agreements.

Financial risk is usually assumed by the operation as the fixed payments are typically set by the financial structure of the operation. Usual management strategies include: equity reserves, ledger marketing contracts, and production contracting. Since interest rates (along with the principal borrowed) explicitly determine debt payment and implicitly determine other types of fixed payments, the level of interest is a factor in determining the level of financial risk. It is for this reason that refinancing of debt is a risk management strategy when moving into lower interest rates. Financial risk is lower for the same size of operation when interest rates are at low levels.

Legal, institutional, and human risk

Legal, institutional, and human risk are usually thought of as a part of the business risk of an operation. However, the growing importance over the past several years in animal agriculture means these factors should be considered separately. Legal and institutional risks are usually assumed or managed by reducing the risk as much as possible. The legal structure of the operation and the environmental management are often methods to reduce the operator's risk. Production contracting has been a way to transfer such risk although environmental regulatory changes in many states hold both parties of a production contract liable for environmental damages. The sudden and unpredictable ways in which many states are changing the environmental laws related to concentrated confined animal feeding units are a risk that cannot be managed by individual operators. Membership in proactive industry organizations that monitor and act on the behalf of large groups of producers at the federal and state level is a form of risk management in this area.

Human risk, the risk incurred through the loss of management or labor, is typically reduced through labor and safety management. These risks are usually transferred through legal structure, insurance, or production contracting.

Risk management and critical risk levels

If risk is the chance of an unfavorable outcome, then risk management begins by defining unfavorable outcomes for the firm. Unfavorable outcomes may be defined differently based on the goals and objectives of the manager. Some typical selections are: the chance of prices not covering full cost, the chance of not covering out-of-pocket or variable cost, or the chance of bankruptcy.

Most farms operate with some idea or goal of survivability. Survivability is the ability to obtain financing year after year. One way to measure the survivability of a farm

is to determine how much (if any) of the farm's net worth could be lost in a year without jeopardizing financing for the following year. A sample calculation to determine critical farm cash needs consistent with farm survivability might be:

Critical cash farm needs

Once some dimension is given to the risk-bearing ability of the firm through the development of a critical risk level, various risk management strategies can be compared and the more efficient strategies selected.

Measuring efficient risk strategies

The definition of risk we have selected also indicates that we must be able to measure the chance or probability of adverse outcomes. If we are to manage risk, we must be able to measure it. If we cannot measure the risk of alternative strategies, it is not a risk at all but merely an uncertainty that cannot be acted upon. This moves the discussion into probability and statistics, on which many good books (and many more not so good) are written. The bottom line on risk measurement is that (either through a computer program or by hand) a risk manager must be able to calculate (1) the true probability-weighted outcome from a particular strategy and (2) the probability or chance that the outcome will be less than the critical income level for the farm. Estimates can be calculated from the decisionmaker's best judgment as to the probability of various outcomes. These estimates may be based on historical farm records or subjective judgment. Any reasonable estimate will provide better results than ignoring the reality of risk in the production and marketing process. If these two calculations can be made, then efficient risk strategies can be selected. An efficient risk strategy is one that maximizes returns for a given level of risk.

As an example of measuring risk and selecting risk management strategies, consider the alternatives an actual Georgia farm considered in May of 1999 for hogs to be sold in October of 1999. In middle May, our producer observed that he could hedge the four loads of hogs he

expected to deliver in October for roughly a \$40/cwt. live (futures and options are traded in carcass weight and the conversions are not shown) net or he could purchase a put option for \$2.2/cwt. live. The put option purchase would provide a floor price of \$37.8/cwt. He realized that a 6 month futures forecast has a standard error of about \$9/cwt. so that based on the \$40/cwt. futures forecast prices in May, the actual October cash price has about a 1/6th chance of being higher than \$49/cwt. or about a 1/6th chance of prices lower than \$31/cwt. The extreme worst and best price would be about 2 times the standard deviation or \$22/cwt and \$58/cwt.

If he hedges, he has only the variability between the futures price and cash price (basis) to worry about. Again, he calculated his basis standard deviation at about \$1.5/cwt (1/6th chance of 38.5 and 41.5, worst and best \$37/cwt. and \$43/cwt.).

By purchasing the put option, he has only basis risk to contend with on the lower side of \$37.8/cwt., but he has the same upside potential as in the cash market less the \$2.2/cwt. cost of the premium. So the option outcomes mirror the cash (only lower) above \$40/cwt. and the futures hedge below \$40/cwt. The following pay-off table (**Table 1**) was calculated based on the information. Note that the points selected correspond with the probability points calculated from the roll of two die. The expected outcome is the sum of each outcome multiplied by the probability of occurrence.

Since this producer had calculated a critical income level for October as \$37/cwt., he compared the probability of a price below \$37/cwt. to the expected price from each strategy. He first noted that the cash and futures hedge alternative had the same expected outcome. But the chance of a price below his critical \$37/cwt through the hedge is only about 3 out of 36 while the cash alternative chance of falling below \$37 is about 15 out of 36. The option market has a higher expected price but the chance of a price below the \$37 is about the same as the futures hedge.

Table 1. Pricing outcomes and their chance, May 1999

Chance	Cash Market	Futures Hedge	Put Option Purchase
1/36	\$22	\$37	\$34.8
2/36	\$26.5	\$37.75	\$35.5
3/36	\$31	\$38.5	\$36.3
4/36	\$34	\$39	\$36.8
5/36	\$37	\$39.5	\$37.3
6/36	\$40	\$40	\$37.8
5/36	\$43	\$40.5	\$40.8
4/36	\$46	\$41	\$43.8
3/36	\$49	\$41.5	\$46.8
2/36	\$53.5	\$42.25	\$51.3
1/36	\$58	\$43	\$55.8
EXPECTED	\$40	\$40	\$40.30

Such a calculation led this producer to hedge his four loads of October hogs at \$40/cwt. in May.

The preceding example is the same analysis performed on the University of Georgia Risk Rated Budget System (<http://www.agecon.uga.edu>). Another useful computer tool for such calculations is the @RISK spreadsheet attachment. @RISK is used in the National Pork Producers's Return on Equity model. Both of these tools (and these are just two examples) use descriptive statistics such as the mean, median, standard deviation, and skewness to define distributions of likely outcomes.

Summary

Producers must take risk if they are to have a chance to make profits. Risk is the chance or probability of adverse outcomes from decisions. Decision implies choice among alternatives. An alternative with no risk implies an alternative with no profit. Minimum risk strategies may provide unacceptable profit potential while maximum profit strategies may be too risky. The risk of returns below critical minimum levels may be too great to insure reasonable chances for survival.

Thus, the decision maker usually must choose some middle ground between maximum profits and minimum risks. Such decisions are never easy. The balance between acceptable prospects for profits with acceptable risks of loss may be difficult to achieve. But a strategic approach (as described in this paper) to decisionmaking can improve the chance of success.

A colleague of mine who has conducted extensive research into the success of poker players put it this way: always consider the odds, don't risk a lot to gain a little, and don't risk more than you can afford to lose!

References

Harwood, J. et al., *Managing Risk in Farming: Concepts, Research, and Analysis*, 1999, United States Department of Agriculture, Economic Research Service, Agricultural Economic Report 774.

