PLANNING AN INTEGRATED APPROACH TO FARM RISK MANAGEMENT

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A major obstacle to effective risk management in most farming operations is the failure of the operator(s) to use an integrated approach to whole-farm planning. The development of a detailed plan and updating that plan on an annual or more frequent basis provides a mechanism for farm managers to estimate the effect of risk reducing strategies on their ability to survive and prosper. Many models have been developed to study the effect of risk management strategies for specific farm situations (1). For the most part these models are rather complex, both statistically and computationally. Managers of ongoing businesses are unlikely to have adequate time to use these models in direct analyses of their business unless they have a research staff to aid with the effort. The approach suggested here is relatively unsophisticated as risk analyses go, but is a potentially effective means of developing an integrated approach to risk management.

The first section of this discussion mentions several components of an integrated approach to whole-farm planning and the set of statements that can be used to effectively summarize the financial characteristics of the planning process. Then the discussion turns to the major types of risk and describes how they can be analyzed. The final section mentions several risk management alternatives that can be considered.

Whole-Farm Planning

An integrated approach to whole-farm planning must consider the production, marketing and financial aspects of the organization in developing a plan. Production planning includes selecting the production system to be used for each crop and livestock enterprise. This involves selecting the combination and timing of inputs, including seeding rates, pesticide applications, tillage and harvest operations, breeding schedules and rations to be fed by stage of livestock growth. A detailed production plan indicates the estimated volume and time of input requirements, as well as the levels of output and the time at which the product(s) will be available to move into the marketing channel.

The detailed production plan provides the basis to develop the operator's market plan. The market plan should consider the operator(s) marketing goals and price projections in developing a procedure to price the inputs and products. The market plan also includes selecting when, where, and in what form products will move into the marketing channels. The development of a market plan provides insight into the expected prices and the range in prices for use in whole-farm planning.

Production and marketing decisions have implications for the acquisition of funds and the use of those funds in the farm business. Decisions to purchase operating inputs, such as feeder livestock, fertilizer and hiring seasonal labor involve the commitment of working capital. A decision to use the futures market to hedge an input or product requires that funds be available for margin requirements and potential margin calls. Decisions on the appropriate means of providing the machinery, equipment, breeding stock and real estate have important implications for the cash flow and the size of the business that can be financed. Thus the production and marketing decisions must be integrated with the financial decisions of where funds will be obtained, with what terms they will be acquired, for what they will be used and how they will be repaid. An integrated approach to whole-farm planning must consider the interrelated nature of the three areas.

The farm operator(s) and others concerned with the success of the business (including the spouse and the loan officer) are concerned with many aspects of the plan. They may have many goals including some that are personal, social, community, and financial in nature. Space does not permit dealing with the full range of goals and objectives. The discussion is limited to three financial objectives that are almost always of importance. They are liquidity, profitability and solvency. The likely effect of a plan on the ability of the firm to achieve these three objectives can be measured by projecting three financial statements -- the cash flow, the income statement, and the balance sheet (2).

The cash flow statement, also known as the sources and uses of funds or a flow-of-funds statement, summarizes all cash transactions affecting the business during a given period of time. Estimating the sources and uses of cash on a monthly or quarterly basis over the planning period provides a basis to determine if planned sources of cash (3) will meet the planned uses of cash (4). A monthly cash flow typically should be projected for the first year of the planning period to reflect the more detailed production, market and financial planning that can be done for the near term.

When a plan is being prepared for a longer period, however, it may be more realistic to project sources and uses of cash for the second and subsequent years on a bimonthly, quarterly or perhaps even annual basis reflecting the difficulty of planning in detail for more distant time periods.

The income statement is based on the accrual method of accounting to reflect the production and expense commitments made during the accounting period. This measure considers both the appropriate cash and noncash items to reflect the actual value of outputs produced and the cost of inputs used during the accounting period. Obviously, there may be significant differences between the net income and the net cash flow of the farm business in any time period because of inventory changes, delayed sales, prepaid expenses and other noncash adjustments that are part of the accrual accounting system.

In addition to liquidity and profitability, the operator is also concerned with the impact of a plan on the composition of assets and liabilities and the implications for equity or net worth. The balance sheet systematically lists all assets and liabilities of the business on a particular date. A comparison of the balance sheet at the time of planning with the balance sheets projected for the end of the first, second and subsequent years in the planning horizon illustrates the implications of the plan for both the financial structure of the business and the operator's equity position.

The projected cash flows and other financial statements that are being prepared typically use average or "most likely" values. Average yields expected over a five-year period, costs based on typical levels of inputs, expected input prices including the most likely interest rates, and commodity prices based on the latest market outlook are commonly used. Using expected or most likely values results in estimates of the expected or most likely cash flow, expected net farm income and the expected change in net worth. It also would be desirable to evaluate the risk associated with liquidity, profitability and solvency. Managers and loan officers can develop a rough measure of the risk associated with a plan by making several sets of projections - one with expected prices and yields and several others using plausible combinations of yields and prices - to trace the effects of each set of prices and yields on the financial characteristics of the firm. We will return to this topic after discussing the alternative types of risk to consider in the analysis.

Types and Sources of Risk

The many and varied sources of risk affecting the farm business contribute to one or more of the following three types -- production risk, price risk and financial risk. The variation in the production level resulting from factors beyond the manager's control -- including weather, pests, genetic variation, changes in governmental regulations on the use of pesticides and feed additives, and the timing of production practices -- is referred to as production risk. It is reflected in the variability of yields per acre, weaning weights, rate of gain, death loss, and other measures of physical production.

The many factors leading to unpredictable shifts in the supply and demand for inputs and products are sources of price risk. Many governmental actions including fiscal and monetary policy, advancing credit to importing countries, changes in commodity programs and trade policy affect the uncertainty of prices.

Financial risk is the added variability of net returns to owner's equity that results from debt financing. Subtracting a given interest and principal payment does not change the absolute variability, but does increase the relative variability. For example, suppose the expected net returns to capital for family operation in 1985 are $20,000 and the outlook for prices and yields in the coming year suggest this may range from a low of $10,000 to a high of $35,000. If the business is financed using all equity (and no debt) capital, the expected net return to equity is $20,000 and the range in net returns is $25,000. If the operator uses some debt capital and a fixed principal and interest payment of $10,000 is required, however, the expected net return to the (lessor) amount of equity capital is $10,000 and the range is still $25,000 (from 0 to $25,000). The range is the same for both cases, but the variability relative to the expected return is greater with debt financing. Financial risk also includes uncertain interest rates and uncertain loan availability, which increase both the absolute and the relative variability to owner's equity. The events of the last several years have emphasized the importance of each of these aspects of financial risk on the total risk a farmer faces.

The 1984 operation of a 320-acre corn-soybean farm in southwestern Minnesota was simulated to illustrate the impact of the three types of risk on the range in net cash flow (5). This farm has average yields of 101.6 bushels of corn and 34.10 bushels of soybeans per acre. Farm level prices expected at harvest -- $2.50 and $6.50 for corn and soybeans -- were used. The farm is participating in the 1984 feed grain program, making the operator eligible to obtain a CCC loan on the corn and receive deficiency payments. Ten sets of yields and prices were selected at random from the appropriate distributions and operation of the farm was simulated with each set of yields and prices. The net cash flow for each of these debt-asset ratios is shown in Table 1. The range in the annual net cash flow for an owner-operator with no debt is from $6,799 to $33,296 (Table 1). This range results from the variability in yields and soybean prices characteristic of the area. Given the low market price projected, the amount received for corn is determined by the CCC loan rate and the deficiency payment. Thus the variability of corn prices does not contribute to the range

of net cash flow shown. Our work suggests the relative magnitude of price risk varies by the particular pricing strategy followed (6). Pricing corn and soybeans on the cash market at harvest was assumed here. This pricing method has a lower expected price and less variability than many alternative pricing methods, such as storing the crop and selling later in the year. Thus, the range in net cash income would be greater for many other pricing strategies that could have been simulated.

Raising the debt-asset ratio from zero to 0.25 lowers the net cash flow by the amount of the annual debt servicing requirement less any tax effects. Raising the debt-asset ratio to 0.50, a rather common debt-asset ratio in 1984, results in further downward adjustment in the range of net cash flow, reflecting the larger debt servicing requirements. Including the variability of interest rates would extend the range in net cash flow to somewhat lower and higher values for any debt-asset ratio greater than zero.

As one considers the range in net cash flow shown in Table 1, the question arises, what do we mean by risk. There are two ways of conceptualizing risk commonly used in the literature. The amount of dispersion (measured as the range, standard deviation or variance of the outcome) is one concept. The range in net cash flow for the 320 acre farm is approximately the same ($25,785 to $26,497) for the three debt-asset ratios, but it is unlikely the operator and the lender would consider these equally risky situations. They would be more concerned with downside risk. This second approach conceptualizes risk as the difference between the operator's objective and the amount and associated probability of downside dispersion.

Suppose the operator of this farm has the objective of avoiding a negative net cash flow after taxes, family withdrawals and debt servicing. The risk associated with this objective apparently is quite low when the debt-asset ratio is zero, since all 10 iterations resulted in positive net cash flows. However, the risk of missing the objective is obviously greater when the debt-asset ratio is 0.25. Two of the iterations resulted in negative net cash flows and several others are positive, but relatively small. All ten iterations resulted in negative net cash flows when the debt-asset ratio was raised to 0.5. Farmers and lenders are likely to consider this as a high risk situation. If one is willing to assign probabilities to the alternative price and yield combinations that go into each iteration, more definite statements can be made about the probability of achieving the objective. For example, if the 10 iterations are considered equally likely, the probability of achieving the objective is 1.0, 0.8 and 0.0 for debt-asset ratios of 0, 0.25 and 0.5, respectively.

The concept of downside risk also can be applied in evaluating the risk associated with achieving the desired objectives in net farm income and change in equity. This second way of conceptualizing risk is the one I place major emphasis on in developing an integrated approach to risk management for farm operators.

Incorporating Risk Into The Planning Process

A farm operator (or someone working with the farm operator) can incorporate one, two or all three types of risk into whole-farm planning by developing a limited number of scenarios and projecting the three financial statements over the planning period for each scenario. Consider the problem of planning for a one-year period as illustrated in Table 1. The operator can use historic data on production levels to identify a likely range of outcomes and the frequency with which yields have occurred in various parts of the total range. Data on the range in U.S. average commodity prices is available from USDA supply and demand estimates. For example the national average price for the 1984-85 marketing year is expected to fall within the $2.65 to $2.95 range for corn and the $5.75 to $7.25 range for soybeans. This range can be converted to a local price for the marketing channel and pricing method used by the operator. Similarly, a range in interest rates can be obtained. Several plausible combinations of these production, price and interest rate events can be developed and the financial statements projected for each combination. Some operators may wish to assign probabilities to the price and yield combinations selected so that a probability distribution of the net cash flow, net farm income and change in equity can be developed. Procedures to use in developing the probabilistic combinations of prices and production levels are presented elsewhere.

In many cases it is useful to plan for more than one year to trace the impact of a set of decisions over time. This may be particularly important if we are dealing with major changes in the business, such as shifting the enterprise mix or making major investment (disinvestment) decisions.

A simple example of a disinvestment decision on the financial performance of the 320-acre Minnesota farm over the 1984 to 1989 period illustrates the type of analyses that might be made. Several aspects of the economic environment assumed in the analysis are described in Table 2. The expected commodity prices represent localized prices for sale at harvesting assuming continuation of the current feed grain program. Short-term interest rates are projected to remain in the 12.2 to 14.3 range throughout the six-year period. New farm machinery prices are expected to escalate 6.0 to 6.5 percent annually, while the prices of other inputs are projected to increase in line with the general economy. Withdrawals for family consumption are $15,300 in 1984 and they increase to reflect changes in the Consumer Price Index during later years. The model calculates the appropriate income and self employment taxes given the current tax law.

The first part of the analysis simulates continuing as an owner-operator of the 320-acre corn-soybean farm over the period

1984 through 1989. The debt-asset ratio is 0.53 in early 1984. Operation over the six-year period was replicated 10 times. Each replication began with the initial financial situation. The prices and yields were selected from the appropriate distributions. The results of only two replications -- those with the lowest (the less favorable prices and yields) and highest ending equity (the more favorable prices and yields) are shown in Table 3. The remaining eight replications are omitted to simplify the presentation.

The operator has assets on December 31, 1983 of $847,901 including nonfarm assets of $8,730. The liabilities are $448,595 resulting in an equity of $399,306. Under the less favorable case the equity declined to $149,332, while in the more favorable case it declined somewhat less to $284,132 by the close of 1989. The corresponding net cash flow and net farm income are also presented as an indication of liquidity and profitability, respectively. Other measures of liquidity, profitability and solvency could be presented, but perhaps these three are sufficient for illustrative purposes.

The comparison assumes the operator sold 80 acres at the close of 1983 and realized a net price per acre approximately ten percent below the "market price" used to value land for net worth purposes. The proceeds were used to retire debt resulting in equity of $384,657 and a debt-asset ratio of approximately 0.44. The analysis also assumes the operator leases the 80 acres back after sale for an annual rent of $100 per acre. The same yield and price scenario was simulated. The cases having the lowest and highest ending equity were listed in Table 3 to illustrate the effect of the sale-leaseback on these three financial outcomes. Reducing the debt and renting the land improves the net cash flow and net farm income somewhat. The equity position does decline in both the more and less favorable replications, although not as rapidly as when ownership of the entire land base is maintained. The operator may want to analyze whether selling a larger proportion of the land base will further improve the financial results projected for the five-year period.

The evaluation of the sale-leaseback alternative is highly dependent on many assumptions concerning the economic environment. For example, assuming a resurgence of inflation in land values would make the sale-leaseback less attractive, while an assumption of further land value declines would have the opposite effect. Reduced interest rates would improve the relative performance of maintaining ownership of the entire 320 acres, while an increase would make the performance of continued ownership less favorable.

Risk Management Alternatives

The whole-farm planning framework described can be used to evaluate a wide range of production, marketing and financial strategies to manage risk. Consider a few examples.

One of the most effective ways to reduce downside risk in many farming operations is to improve production efficiency. This can be accomplished by increasing the production per unit (e.g. increase the milk production per cow, pigs sold per sow per year and yield per acre) and/or by reducing costs. In some cases production can be increased and costs can be reduced by carefully reviewing the system of production and modifying it to utilize the appropriate technology and management techniques.

Diversification has long been touted as an effective method to reduce risk. The key to effective diversification is to combine enterprises that spread the use of labor, facilities and equipment while maintaining favorable returns to land and other fixed resources. Diversifying with low return enterprises may reduce the range of outcomes, but it is unlikely to reduce downside risk.

Investing in risk reducing facilities, equipment and improvements may be an effective means of reducing risk the operator faces. For example, tiling to improve drainage has been an effective means of reducing downside risk for farmers with poorly drained soils in southern Minnesota. Investments in livestock facilities that tend to reduce death loss and improve feed efficiency may reduce downside risk. In both examples, production variability may be reduced, and production levels increased, but the investment will result in higher debt servicing during the short and intermediate run. Thus it may be important to evaluate the investment in a whole-farm context to calculate its impact on risk.

Several financial strategies including liquidity management, restructuring of debt (with refinancing over a longer term), partial asset liquidation, the sale and leaseback of land, and outside equity infusions could be analyzed using this approach.

The effect of these and other strategies on the risk a farm operator faces can be analyzed using the procedure described. While the analysis may not be as mathematically and statistically refined as much of the published research noted earlier, the results have the advantage of considering the characteristics and peculiarities of the individual farm operation.

Conclusions

The integrated approach to farm risk management suggested here has several parts. First, integrate the production, market and financial aspects in planning the farm business. Such an approach will involve projecting the cash flow, the income statement and the balance sheet as well as the supporting statements for each year in the planning period. These projections should be prepared for the expected production, price and policy conditions. Second, make comparable projections for favorable and

unfavorable production and price conditions to provide an indication of the likely range of net cash flow, net farm income and change in equity. The three projections provide an estimate of the expected outcome and the range in possible outcomes for the planning period. (When more detailed data on the distribution of outcomes is desired, projections can be made for a larger number of alternative price and yield combinations and probabilities can be assigned to each combination. Then a cumulative distribution can be developed for solvency, profitability and liquidity measures.) Third, study the projections made in parts 1 and 2 to identify risk management strategies that may help in achieving the operator's objectives. Then project the three financial statements with the changes identified to evaluate their effect.

One might ask if this approach is technically feasible and whether it has sufficient payoff to justify the effort. The availability of computers at reasonable cost and spreadsheet programs allow farm operators and others to develop the type of planning procedures described. Software packages are being developed by several academic institutions as well as private vendors to project the three financial statements for those not wishing to use general spreadsheets. Thus the approach is technically feasible. Some will argue, however, that the procedure is too complex and time consuming. In my experience, the farmers and lenders making the argument appear to have a great deal to gain by implementing the process. It is very difficult to argue that projecting the three financial statements with expected or most likely values is not justified. After that projection has been completed, developing projections with favorable and unfavorable conditions requires a modest amount of additional effort. Projections for more than the three sets of price and yield conditions should only be made if the value of such work is expected to exceed the effort required. Furthermore, the approach is practical for most commercial farming situations - new operators as well as those that have farmed for many years, and farmers in all financial situations. It is an effective way to help farmers in financial difficulty evaluate ways to deal with their situation. The same planning process can help operators in a better financial situation prosper in the years ahead.

Finally, it should be noted that the planning approach described provides a set of standards to use in monitoring the operation. An operator can compare the actual performance over time with the values projected during planning and adjust implementation of the production, market and financial plan to changing conditions. Thus, integrated planning also provides the basis for control of the operation. A discussion of control procedures is beyond the scope of this paper. The use of such procedures, however, can be an effective way of managing risk as the plan is implemented.

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References and Notes

(1) See Peter J. Barry (ed), Risk Management in Agriculture, Iowa State University Press, Ames, 1984 for a current overview of the conceptual issues and modeling approaches to analyze risk in farm businesses.
(2) Examples of the three financial statements can be found in any basic text in farm management and agricultural finance. For example, see Michael D. Boehlje and Vernon R. Eidman, Farm Management, John Wiley and Sons Inc., New York, 1984, Chapter 2.
(3) The general sources of cash are beginning cash, cash receipts from sale of crops and livestock, sale of capital items, nonfarm income, reduction in savings, new borrowings and outside equity in the form of gifts, sale of stock, etc.
(4) The general uses of cash includes farm operating expenses, capital purchases, proprietor withdrawals, principal and interest payments on farm debt, increase in savings and ending cash.
(5) Net cash flow in this example is equal to gross farm income from the sale of corn and soybeans, plus government payments, plus off-farm income, plus capital sales, minus cash operating expenses, minus cash overhead expenses of the business, minus capital purchases, minus interest on farm loans, minus operator withdrawals for family living and payment of income and self employment taxes, minus scheduled principal payments on intermediate and long-term loans, minus the principal owed on the annual operating loan.
(6) Richard N. Weldon, Jerry L. Thompson, Vernon R. Eidman, Maryline R. Gois and Gregory A. Bauer. Management of Farm Business and Financial Risk. Staff Paper P84-27, Department of Agricultural and Applied Economics, University of Minnesota, September, 1984.
(7) Michael D. Boehlje and Vernon R. Eidman. Farm Management. John Wiley and Sons, Inc., New York, 1984, pp. 450-458.

Table 1. 1984 Annual Net Cash Flow For A 320 Acre Minnesota Farm Resulting From Ten Sets of Randomly Drawn Yields and Prices

	Beginning Debt-Asset Ratio		
Iteration	0.00	0.25	0.50
	- - - - - - dollars - - - - - -		
Highest	33,296	13,279	-7,316
2nd	28,647	8,631	-11,964
3rd	25,559	5,543	-15,053
4th	25,632	5,616	-14,980
5th	23,361	3,345	-17,251
6th	21,136	1,120	-19,476
7th	21,048	1,031	-19,564
8th	20,857	841	-19,755
9th	13,426	-6,590	-27,186
Lowest	6,799	-13,218	-33,101
Range	26,497	26,497	25,785

Table 2. Some Assumptions For The Analysis Of The 320 Acre Farm

Item	1984	1985	1986	1987	1988	1989
	dollars					
U.S. Average Corn Price	2.85	2.65	2.65	2.75	2.80	2.90
U.S. Average Soybean Price	7.00	6.50	6.55	6.75	7.10	7.25
Minnesota Local Corn Price	2.50	2.30	2.30	2.40	2.45	2.55
Minnesota Local Soybean Price	6.50	6.00	6.05	6.25	6.60	6.75
Loan Rate For Corn	2.55	2.55	2.55	2.55	2.55	2.55
Target Price For Corn	3.03	3.03	3.03	3.03	3.03	3.03
Acreage Set Aside Proportion	.10	.15	.20	.20	.20	.20
Inflation Rate For Farmland	-7.1	0	0	0	0	0
Inflation Rate For New Machinery	6.2	6.4	6.0	6.5	6.5	6.1
Consumer Price Index	314.7	335.0	350.1	366.9	385.2	405.2

Table 3. Annual Net Cash Flow, Net Farm Income and Ending Equity Level For The 320 Acre Corn-Soybean Farm

A. Maintain Ownership of 320 Acres. Beginning Debt-Asset Ratio = .53

	More Favorable Prices and Yields			Less Favorable Prices and Yields		
Year	Net Cash Flow	Net Farm Income	Equity	Net Cash Flow	Net Farm Income	Equity
			dollars			
1983			399,306			399,306
1984	-11,964	12,397	353,368	-17,251	7,111	349,147
1985	-42,703	-15,027	322,356	-50,347	-23,784	309,225
1986	-32,888	-1,776	308,946	-51,033	-22,399	271,959
1987	-21,081	9,984	299,064	-58,643	-28,075	223,255
1988	-30,019	-2,944	281,938	-52,616	-24,644	181,811
1989	-10,063	19,732	284,132	-45,747	-14,696	149,332

B. Maintain Ownership of 240 Acres. Sell 80 Acres and Lease it Back

	More Favorable Prices and Yields			Less Favorable Prices and Yields		
Year	Net Cash Flow	Net Farm Income	Equity	Net Cash Flow	Net Farm Income	Equity
			dollars			
1983			384,657			384,657
1984	-5,012	16,743	351,372	-10,298	11,456	347,689
1985	-36,065	-9,386	326,133	-43,188	-18,143	313,550
1986	-23,009	4,635	319,333	-41,537	-15,919	282,954
1987	-9,441	18,353	313,760	-47,782	-20,433	242,109
1988	-20,248	6,740	305,389	-40,417	-15,888	209,665
1989	3,350	30,104	314,036	-33,013	-4,852	187,809