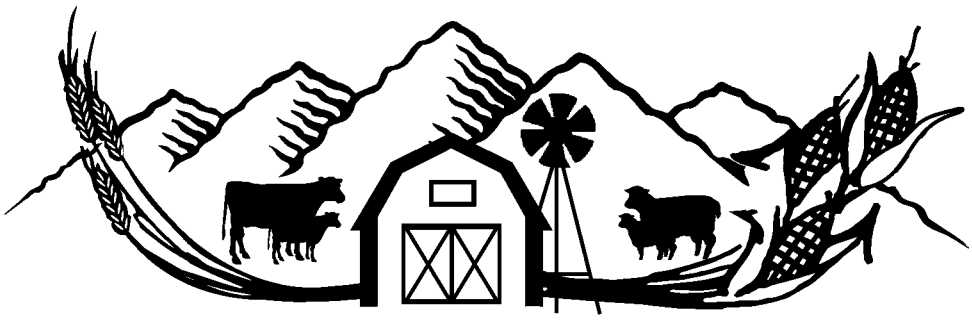

Risk and Resilience in Agriculture

Enterprise Diversification: Will It Reduce Your Risk?

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Weather, diseases, pests, and infertility are all factors which cause yield variability or production risk for agriculture. There are several reasons why producers might be interested in taking steps to reduce production risk. The reduction of income variability over time can allow more accurate planning for things such as debt repayment, living expenses and business growth (Kay, 1981). Another reason to reduce risk might be to assure some minimum income level to meet living or other expenses (Kay, 1981). Several years of low income can threaten business survival, and business survival is a goal that might motivate managers to reduce risk. Several studies show many managers rate business survival as their most important goal (Kay, 1981). Thus, many managers are willing to accept a lower expected income if it reduces income variability and hence the risk of business failure.

There are several approaches to address income variability associated with production risk. One approach is to have more than one enterprise or produce more than one product to avoid having your income totally dependent on the production and price of one product (Kay, 1981). If profit from one product is poor, profit from producing other products may prevent total profit from falling below acceptable levels. Product or enterprise diversification may reduce income variability if all product prices and yields are not low or high at the same time (Kay, 1981).

The extent to which diversification will reduce income variability for a farm or ranch is dependent on the price and yield correlations for the enterprises selected (Kay, 1981). If prices or yields for both of the enterprises tend to move up and down together, little is gained by diversifying. The more yields (and or prices) of different products move in opposite directions, the more income variability will be reduced by diversifying. Additionally, the extent of the income being smoothed out depends on the corresponding proportion of

income, which is derived from each enterprise (Kay, 1981). If only a small proportion of income comes from one product or the other during good years, then it has little effect on total income if a disaster happens to the product from which most of the income is normally derived.

Weather is the primary factor influencing crop yields. Crops with the same growing season experience the same weather, and their yields tend to have a strong positive correlation (i.e., yields move up and down together). The yield correlation for crops which have different growing seasons and are susceptible to different insects and diseases will be lower. Production rates among different types of livestock are less closely correlated, and there is little correlation between crop yields and livestock performance.

Most studies on the price correlations for major agricultural commodities show that pairs of commodities with a strong yield correlation often have a positive price correlation as well, since year-to-year production changes have a major impact on prices (Kay, 1981). Some specialty crops such as fruits and vegetables, however, may show a weak or even negative correlation with some of the major field crops.

This all sounds well and good, but how do you actually compare enterprises? Records and statistics are an important part of this process. A computer with a simple spreadsheet program also helps, but it isn't necessary if you are willing to take the time to make some calculations with a hand calculator and use some graph paper. The first way to look at whether an enterprise might increase or decrease your income variability is to graph out the gross revenue of the new enterprise you are considering and compare it to the enterprises you currently have. By graphing out gross revenue you have combined yield and price variability into one measure that gets you closer to measuring income variability. Moreover, most of the variability in income will come from variation in gross revenues associated with yield and price risk because costs tend to increase over time and are not usually highly variable.

The data you need to graph out these enterprises can be obtained from your state agricultural statistics publication. You can usually get this from your local extension office, or they will know who to call at your state statistical service to order the latest edition. Once you receive this publication you will want to locate the statistics for your county that best represent the enterprises you are interested in. You will want to gather information on production and acres harvested in your county. Once you have these data multiply the production times the price for that commodity and divide that by the total acres harvested in your county ((production * price)/acres harvested). This will give you an estimate of the gross revenue per acre. You can also do this same process but divide the gross revenue by 1,000 pounds to come up with some estimate of revenue for cattle. You want to get a good feel for the variability in that enterprise in good and bad years both for yield and price. Thus, more years of data is likely to capture historical highs and lows. It is good to do this for at least 10 years and 20 would be better. Once you have these data estimated, you will want to graph out gross revenue over time and compare the enterprises.

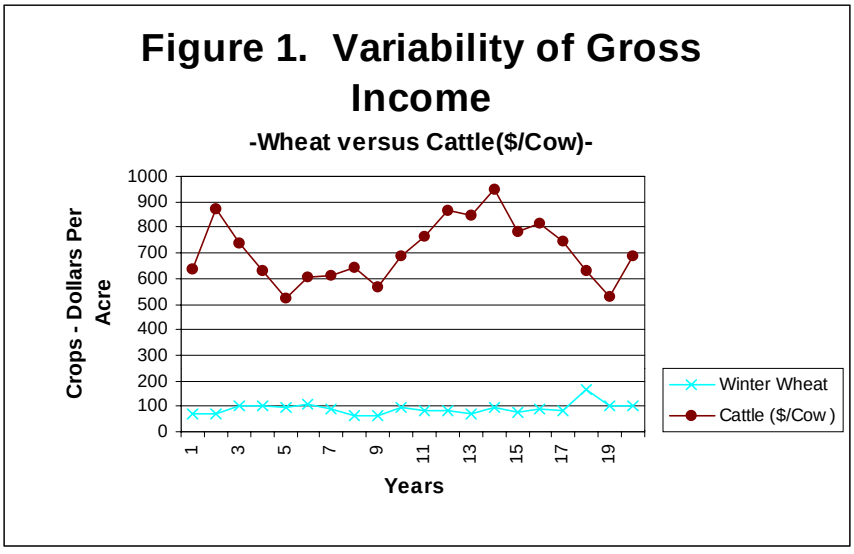
For purposes of example, let us choose two enterprises to compare. Suppose you have some ground in CRP, which is about to come out of the program and would make good pasture. You are trying to decide whether to raise some cattle or put the CRP back into winter wheat. You want to assess whether cattle production might reduce your income

variability compared to having all your income depend upon winter wheat. Figure 1 graphs out gross revenue per acre for winter wheat and per 1,000 pounds of cow for 20 years based on Wyoming Agricultural Statistics.

What kinds of things does Figure 1 tell us? First, one might conclude that cattle seem to have lows often times when winter wheat seems to have highs. If gross revenues from cattle are good when gross revenues are poor for wheat, this might suggest that cattle and wheat together might reduce income variability. However, gross revenues for cattle seem more variable than do gross revenues for wheat. Thus, it is unclear whether income variability would be reduced overall. Certainly, these two enterprises have some desirable features when considering enterprise diversification into cattle.

How might we measure how variable cattle is compared to wheat? If cattle is more variable than wheat, we may not achieve a goal of reducing income variability overall. There are three general measures one can use to compare variability of enterprises. They are range, standard deviation and coefficient of variation (Kay, 1981). Range is very easy to estimate. It is simply the difference between the highest and the lowest value. Generally, the wider the range the more variability in the data. In our example below (Table 1), cattle has a range from $949 to $531 or $418 per 1,000 lbs. over the years gathered. Wheat has a range in gross revenue of $166 to $63 or $103 per acre over the same time period. The problem with using range alone is that it doesn't give us a feel for how often income might experience the extreme highs or lows.

Standard deviation is a measure, which better takes into account how often highs and lows occur. If you have a spreadsheet program, it will estimate the standard deviation of the column of numbers you are interested in fairly easily. If you don't have a spreadsheet program, estimating the standard deviation can be done with a hand calculator. The first step in this process is to calculate the average or the mean as it is sometimes called. Take all the revenue numbers for wheat and add them up and divide by the number of years you have gross revenue numbers for, in this case we have 20 years worth. For wheat the average or mean is $90 per acre and for cattle the mean is $707 per 1,000 pounds (Table 1). Once you have this figure you need to take the gross revenue for each year and subtract the mean (Table 1). Take this number for each year and multiply it times itself or square it



(Table 1). Once you have this number for each year, you sum up the column and divide it by the number of years minus 1 (in our example it is 19). The next step is to take the square root of this number. This gives you the standard deviation. For our example, wheat has a standard deviation for gross revenue of $22.45 and cattle have a standard deviation of $120.86. This indicates that cattle has a wider standard deviation and may be more variable in income than wheat. It is important to remember that cattle has a higher mean gross revenue, so we might very well expect the standard deviation to be higher for cattle than for wheat. What we need now is a measure that puts the variability in perspective with the mean gross revenue.

Coefficient of variation is a measure that best puts the variability of gross revenue in perspective with the mean gross revenue of an enterprise. This is calculated by dividing the standard deviation by the mean. Notice that the coefficient of variation for wheat is 0.25, and it is 0.17 for cattle (Table 1). Thus, even though our first two measures of variability (range and standard deviation) suggested a cattle enterprise was more variable, the coefficient of variation number suggests that relative to the mean, gross revenue for cattle is less variable than wheat.

What have we learned so far? By looking at the graph (Figure 1) it appears that there often times are highs in gross revenue for cattle when there lows for wheat. This means adding cattle as an enterprise could potentially smooth out the highs and lows in income compared to if we just produced wheat as our only enterprise. The graph also suggests cattle tend to be very variable, and we are left with how to measure whether the variation in cattle is more or less than wheat. The coefficient of variation for cattle tends to suggest that revenue variability for cattle is less relative to its mean gross revenue than wheat. This supports the notion that adding cattle as an enterprise to our wheat operation could help reduce our income variability.

The previous discussion offers some simple tools that producers can use to evaluate whether adding a certain enterprise might help reduce income variability. This may only be part of the analysis, however, for many producers. What if you have to have a certain target level of income from your operation each year or risk not being able to meet your debt obligations. This notion of having to meet some minimum or target level of income has not been examined in the discussion thus far. This type of analysis is relatively easy to do if you already have the information gathered for analyzing the variability of an enterprise as discussed above. What needs to be done now is to combine the gross revenue information with cost information. If you do not have cost information for the enterprises you are interested in, you can use budgets developed by your Land Grant University and your Cooperative Extension Service. Once you have this, you can estimate your costs on a per acre or per 1,000 lbs. basis and subtract them from the years of gross revenue data you have. You must also decide what proportion of income is going to come from each enterprise. Once this is decided you can estimate several different scenarios of proportions of income coming from the enterprises in your farm or ranch plan. You can then identify how often you might fall below your desired target or minimum level of income, given the past gross revenue information. At this point you can decide whether this new enterprise you are considering might help you meet your goals and give you an acceptable level of production risk or income variability.

Diversification plans can include non farm or ranch activities as well. Investing in stocks or bonds, carrying out a part-time business not

related to agriculture, or holding an off farm or ranch job can all improve the stability of family income. Diversification may mean giving up the benefits of specializing in one enterprise in order to gain the benefits from less variability in income. Getting information from your state statistics service or your extension office and using it to do some simple planning can help you analyze your diversification plan. Using all or at least some of these tools presented here can help you better manage your income variability and decide on a diversification strategy that is right for you.

Table 1. Gross Revenue and Measures of Variability for Wheat and Cattle in Wyoming, 1978-1997.[a/]

Year	Winter Wheat – Gross Revenue ($/acre)	(Gross Revenue) – (Average) = Difference	Difference multiplied by itself (squared)	Cattle – Gross Revenue ($/1,000lb)	(Gross Revenue) – (Average) = Difference	Difference multiplied by itself (squared)
1978	67	-23	536.60	638	-69	4708.04
1979	71	-19	376.58	871	164	27029.13
1980	104	14	185.96	739	32	1005.86
1981	102	11	131.23	629	-78	6029.47
1982	97	7	43.76	523	-183	33654.16
1983	108	18	312.14	607	-100	10026.27
1984	88	-2	4.18	610	-96	9296.53
1985	66	-24	587.80	646	-61	3745.11
1986	63	-27	728.70	568	-139	19324.62
1987	95	5	26.42	688	-19	367.38
1988	82	-8	64.02	767	60	3596.01
1989	80	-10	98.88	863	156	24469.97
1990	70	-21	426.20	847	140	19641.56
1991	95	4	18.45	949	242	58573.47
1992	78	-13	162.42	782	76	5720.30
1993	90	-1	0.42	817	110	12075.03
1994	85	-5	25.45	742	35	1255.99
1995	166	75	5678.45	630	-77	5952.78
1996	100	10	95.17	531	-175	30770.50
1997	99	9	80.20	689	-17	303.84
Average	90			707		
		Sum	9583.01		**Sum**	277546.02
		Standard Deviation	22.46		**Standard Deviation**	120.86
		Coefficient of Variation	0.25		**Coefficient of Variation**	0.17

[a/] Data comes from Wyoming Agricultural Statistics. Various issues, 1978 to 1997.

References

Kay, R. D. 1981. Farm Management: Planning, Control, and Implementation. McGraw-Hill, Inc., New York.

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