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INCREASING INCOME STABILITY WITH ALTERNATIVE
ENTERPRISES: LESS RISK OR MORE RISK?
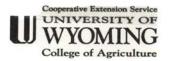by
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Farmers and ranchers in Wyoming and elsewhere have a wide range of crop and livestock enterprises from which to choose. For example, in Wyoming's grazing areas, the choice may be between cattle or sheep, or some of both; and in irrigated portions of the state it may be between sugar beets and dry beans, or an alfalfa-barley rotation. In considering these choices, most people focus on annual net returns. This criterion--while obviously important--is not the only one that should be used. Equally important is risk. The objectives of this article are to (1) examine and explain various issues associated with the concept of risk and, (2) illustrate some contrasting approaches for incorporating the risk-element into enterprise selection and decision-making. The second objective is accomplished by reporting results from a recent study of alternative crop combinations in Wyoming's Big Horn Basin.[2]

CONCEPTS OF RISK

Farmers and ranchers operate in a highly risky environment of imperfect knowledge. Sources of imperfect knowledge are many, including production (yield) risk and market (price) risk. Expected amounts of production can vary as a result of unfavorable weather, disease, insects and weeds, to name but a few. Similarly, expected prices for agricultural products are subject to frequent and abrupt changes dues to dynamic supply and demand conditions, occurring at both national and international levels.

While it is impossible to eliminate risk, certain strategies can be employed to reduce or counter the adverse effects of imperfect knowledge. For example, the consequences of production risk or yield variability may be reduced by diversifying among more enterprises, selecting more stable enterprises, or perhaps buying some insurance. Also, the ill effects of

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[2]   Held, Larry J. Crop Enterprise Risk: Chance and Amount of Loss Versus Income Variability. RJ 177, July 1986. University of Wyoming Agricultural Experiment Station.

market risk or price variability may be tempered by hedging, forward contracting or perhaps spreading sales over time.

Although most will agree that managing risk with one or a combination of selected strategies is important, there is not total agreement on how risk, or the consequences of imperfect knowledge, should be measured. Some analysts prefer to measure risk in terms of annual income variability. Therefore, if income variability can be decreased by diversifying among more enterprises, or perhaps selecting more stable enterprises, less risk is said to exist.

Alternatively, others argue that risk is better measured in terms of the potential chance and amount of loss associated with some course of action. For example, even though diversification may reduce income variability, it may also reduce the amount of realized income. In fact, income may be reduced to such an extent that chances of falling below a critical threshold (necessary for meeting fixed financial obligations) may become quite large indeed. Thought of in this sense, associating lower income variability with less risk could at times be misleading.

CASE ILLUSTRATION OF DIFFERENT RISK MEASURES

The results of expressing risk in two different ways--income variability versus "chance and amount of" loss--can be illustrated with a case analysis of different crop combinations for an irrigated farming operation. However, before examining the different combinations of enterprises, income and income variability for the individual crops, and the income relationship among crops will be analyzed. Crop alternatives in this case include sugar beets, dry beans, malt barley, corn and an alfalfa-barley rotation.

Income and Its Variability For Individual Crops

Table 1 shows a 10-year series (1975-1984) of per-acre net returns for each of the crops. Net returns are calculated as gross returns minus variable cash costs. As a result, net returns represent a return to unpaid fixed resources, including machinery and equipment, labor and real estate.

During this selected 10-year period, crops differed considerably in terms of income potential and variability. Income-wise, sugar beets dominated other crops by a large margin ($531/acre versus $296 and less). The alfalfa-feed barley rotation (3 acres of alfalfa with 1 acre of feed barley) showed lowest average returns ($181/acre). It is also noted that higher income crops such as sugar beets and dry beans show greater year-to-year income variability than others. This is shown in terms of both higher "standard deviation" and "10-year range" of high-to-low income. Data in Table 1 suggest that farm plans including large acreages of these crops would show higher income, but more income instability as well.

Income Relationships Among Crops

Besides income variability of individual crops, the relationship of crop returns with each other is yet another factor which may influence annual stability of whole-farm income. In other words, more stable income may be achieved by growing a combination of crops whose returns do not always move together in a consistent manner. An ideal situation is diversifying between crops whose returns generally move in opposite directions from each other. Then, a year of low income from one crop is accompanied by high income from

the other and vice versa. Unfortunately, economic and/or biological forces affecting one crop (e.g., prices or weather) often affects other crops in a similar, although not perfect manner. As a result it is usually difficult to find crops whose returns consistently move in opposite directions over extended periods of time.

Table 1. Per Acre Net Returns for Selected Crops, 1975-1984[a].

Year	Sugar[b] Beets	Dry Beans	Malt Barley	Corn	Alfalfa[c] Barley Rot.
	- - - - - - - - - -$/acre- - - - - - - - - -				
1975	478	456	442	297	249
1976	382	218	258	260	256
1977	525	582	276	225	129
1978	379	241	302	138	150
1979	548	507	242	239	185
1980	978	542	317	307	221
1981	702	205	274	246	163
1982	576	-26	236	198	130
1983	367	142	198	222	164
1984	375	93	194	185	163
10-year Average($)	531	296	274	232	181
Standard Deviation($)[d]	192	210	71	51	46
10-year Range of High to Low income($)	611	608	248	169	127

a/   Net returns computed as gross returns minus variable cash costs. Annual variation in net returns reflects both yield and price variability.
b/   Since net returns do not include a charge for machinery ownership costs, net returns for sugar beets may be overstated to some extent relative to other crops. This is because machinery ownership costs for sugar beets comprise a larger percentage of total operating costs than is true for other crops.
c/   Alfalfa-barley rotation is the weighted average return from 3 acres of alfalfa and 1 acre of feed barley. Alfalfa is established by seeding in barley stubble after harvest.
d/   The standard deviation is a statistical measure of dispersion, where larger values reflect more variability around the 10-year average.

Table 2 shows correlation coefficients of returns between individual crops. Larger coefficients indicate a greater tendency for crop returns to move in the same direction. In all cases, crop returns generally moved together to varying degrees. For example, data in Table 2 indicate more income stability could likely be achieved by diversifying with sugar beets and malt barley rather than sugar beets and dry beans, since sugar beet/malt barley correlation (.2530) is less than sugar beet/dry bean correlation (.4138). The advantage of combining sugar beets and malt barley (versus sugar beets and dry beans) for better income stability is further supported by noting malt barley showed less income variability than dry beans over the 1975-1984 period (Table 1).

Table 2. Correlation of Net Returns Between Crops.

		(1) Sugar Beets	(2) Dry Beans	(3) Malt Barley	(4) Corn	(5) Alfalfa-Barley Rotation
(1)	Sugar Beets	1.0000	.4138	.2530	.5726	.1060
(2)	Dry Beans		1.0000	.5397	.5412	.3084
(3)	Malt Barley			1.0000	.5048	.5252
(4)	Corn				1.0000	.7281
(5)	Alfalfa-Barley Rot.					1.0000

Two Measure of Risk for the Entire Farm: Income Variability and "Chance and Amount" of Loss

Table 3 shows three example farm plans (or crop mixes) for a representative 480-acre farm. Farm Plan #1, yielding highest net income of $172,188, concentrates its acreage between sugar beets (33%) and dry beans (49%), with remaining acreage spread between malt barley (5%) and alfalfa-barley (13%). Compared to Plan #1, Farm Plan #2 is more diversified, and shows a large reduction in dry beans, compensated by more malt barley and the addition of some corn. Finally, Farm Plan #3, yielding lowest income of $150,000 shows a cutback in sugar beets compensated by more malt barley and alfalfa-barley.

Table 3. Three Selected 480-Acre Farm Plans.

Crop	#1 Highest Return	#2 Medium Return	#3 Lowest Return
	- - - - - - -acres- - - - - - - -		
Sugar Beets	160	160	117
Dry Beans	234	40	--
Malt Barley	26	160	240
Corn	--	60	--
Alfalfa-Barley Rotation	60	60	123
Total Acres	480	480	480

Table 4 shows annual returns (1975-1984), 10-year average income, and selected measures of variability and risk for each of the three farm plans described above. Not surprisingly, the highest return crop mix (#1) comprised mostly of sugar beets and dry beans, shows the greatest amount of income instability, having the highest standard deviation ($69,633) and 10-year range of income ($208,108). Conversely, the lowest return crop mix (#3) results in least income variation in terms of standard deviation ($33,894) and range of income ($107,095). To the extent that risk is associated with instability of annual income, Farm Plan #1 is considered most risky, and Plan #3 least risky. However, for some purposes, income variability may not always be a complete or sensible measure of risk.

Table 4. Annual Returns, 10-Year Average Income, and Measures of Variability and Risk for Three Selected Farm Plans.[a]

| | Selected Farm Plans | | |
| | #1 Highest Return | #2 Medium Return | #3 Lowest Return |
Year			
	- - - - - - Annual Income ($) - - - - - -		
1975	209,610	198,200	192,561
1976	* 134,218	142,080	* 138,062
1977	234,937	172,650	143,345
1978	* 133,883	* 135,850	* 135,139
1979	223,591	172,120	144,836
1980	304,724	260,575	217,481
1981	177,210	188,885	167,742
1982	* 100,114	148,545	* 139,850
1983	* 106,976	* 119,255	* 110,598
1984	* 96,616	* 115,625	* 110,386
10-Year Average($)	172,188	165,379	150,000
Standard Deviation($)	69,633	43,578	33,894
10-Year Range of High-to-Low Income($)	208,108	144,950	107,095
*Frequency (years in ten) Annual Income is Below $140,000 Target	5/10	3/10	5/10
Total Amount Annual Income is Below $140,000 Target($)	128,193	49,270	65,965

[a] Annual returns for each of the three farm plans are found by multiplying per acre returns of individual crops (Table 1) by respective acreages (Table 3).

As an alternative to associating risk with income variability, it may be more desirable to consider risk in the context of "chance and amount" of loss. With this approach, variation of income from extremely high to low amounts is not the major concern. Specifically, high income years are not considered as a threat or source of risk. On the other hand, low income years are considered a threat. Therefore, concern is now focused on whether a given crop mix might frequently generate unacceptably low income over a series of successive years.

To illustrate this approach, it is necessary to establish a threshold of target income to represent some disaster level, below which adverse financial consequences would occur. Selection of a specific target is somewhat arbitrary and certainly would be unique for each individual farm and its financial situation. For example, the $140,000 target used in this analysis could represent the minimum amount of annual income required to meet annual fixed cash obligations such as fixed production expenses, debt retirement and family living needs.

The last two rows of Table 4 show risk measured from the standpoint of "frequency" and "total amount" that annual income falls below the designated $140,000 target over the 1975-1984 time period. It is seen that Farm Plan #1, having highest income and variability (as a result of concentrated acreage of sugar beets and dry beans) is also the most risky in a chance and amount of loss context. It misses the $140,000 target in 5 of 10 years by a total of $128,193. The more diversified crop mix (Farm Plan #2) is less risky, since it misses the $140,000 target by a total of only $49,270 and in only 3 years of 10.

Farm Plan #3 shows lowest income and is least variable, but also misses the $140,000 target by a greater frequency (5 versus 3 years in ten) and amount ($65,965 versus $49,220) than does Farm Plan #2. Therefore, while Plan #3 is considered least risky in terms of lowest income variability, Plan #2 is actually least risky in the context of frequency and amount of loss.

CONCLUSIONS

Choosing alternatives having lower but more stable income over time may not always be the best answer. Higher income options, in spite of being more variable, can sometimes, although not always, reduce the risk of falling below an income target which is critical for financial well-being.

If decision-makers are considering the addition of new enterprises, or expansion of existing enterprises that have high expected income potential, increased income instability will often be the result. However, any adverse effects of greater income variability should be weighed against potential benefits of reducing the risk of frequent annual losses below some critical target, which is unique to that operation's financial situation.

For example, dry beans were shown to be highly variable; and when a high proportion is included in the farm plan, the risk of falling below a critical income target appeared quite high. Unless a producer is financially able to incur frequent shocks of low annual income, it might be wise to limit dry bean acreage to a very modest amount.

On the other hand, sugar beets, in spite of showing high income variability over the 1975-1984 period, generated very high returns relative to other selected crops. Therefore, although seemingly risky from a variability standpoint, they did not appear as risky from a loss standpoint, since lower income years from sugar beets often compared favorably with average or good income years of other crops. As a result, reductions in sugar beet acreage stabilized income, but also resulted in a greater risk of loss below the designated financial target.