



Financial aspects of investment in livestock and pastures on irrigated farms
by John Reichel

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree
of Master of Science in Agricultural Economics
Montana State University
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Abstract:

The purpose of this study is to develop a method which may be used to determine the effect that alternative degrees of livestock-grassland type of farming would have upon the financial position of an irrigated farm unit.

Part I develops the various aspects of the problem and thus provides a basis for the study. The basic concepts and principles of the theory of the firm are discussed. The relationship that exists between the firm theory and the budget method as a means of making empirical investigations is presented. • The budget method is described in the following pages.

In Part II the results of a previous study are summarized and used as the basis for the analysis upon which the present study is centered. Three selected types of price movement are applied to the "typical" farm organization. Costs and receipts are adjusted by the use of appropriate indexes. The analysis of each alternative for each year are presented in a series of annual budgets. The results of these budgets are used to make comparisons in changes in borrower-creditor equity.

Part III draws the conclusion that any expansion of the livestock organization by the use of borrowed funds would jeopardize the financial position of a farm operator. This part is also concerned with the general implications of the study for individual farmers and agricultural credit agencies. Last, it considers the limitations that can be associated with this type of study.

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AND PASTURES ON IRRIGATED FARMS

by

JOHN REICHEL

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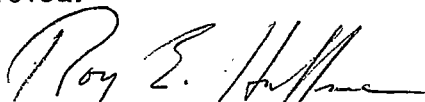
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Dean, Graduate Division

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ABSTRACT

The purpose of this study is to develop a method which may be used to determine the effect that alternative degrees of livestock-grassland type of farming would have upon the financial position of an irrigated farm unit.

Part I develops the various aspects of the problem and thus provides a basis for the study. The basic concepts and principles of the theory of the firm are discussed. The relationship that exists between the firm theory and the budget method as a means of making empirical investigations is presented. The budget method is described in the following pages.

In Part II the results of a previous study are summarized and used as the basis for the analysis upon which the present study is centered. Three selected types of price movement are applied to the "typical" farm organization. Costs and receipts are adjusted by the use of appropriate indexes. The analysis of each alternative for each year are presented in a series of annual budgets. The results of these budgets are used to make comparisons in changes in borrower-creditor equity.

Part III draws the conclusion that any expansion of the livestock organization by the use of borrowed funds would jeopardize the financial position of a farm operator. This part is also concerned with the general implications of the study for individual farmers and agricultural credit agencies. Last, it considers the limitations that can be associated with this type of study.

PART I. INTRODUCTION

The Problem

When a farmer shifts from one enterprise, or system of farming, to another, he runs into a capital problem. He may need additional operating capital, or the adjustment may require new fixed capital outlay. Adding a dairy-hog enterprise often presents the latter capital problem. The purpose of this study is to determine the financial position (level and structure of equity) required, under different kinds of anticipated price and cost relationships, to justify shifts from a cash crop system of farming to alternative degrees of livestock (dairy-hog)-grassland type of farming on irrigated farms.

Variations in yields and/or prices result in low net incomes (or perhaps even a negative income) in some years, and in very high incomes in other years. The wide variations of income relative to the higher fixed costs, plus the indebtedness which may be necessary in shifting to a dairy-hog operation may force the farmer into insolvency during the low income years. The farmer must evaluate his resources accurately in terms of loan value to determine the extent of indebtedness which he may safely incur.

Given an uncertainty setting, the optimum plan for any individual depends, among other things, on his psychological makeup, his capital position and the ends he wishes to maximize. Will "survival of the firm"

or maximization of profits be the ends of production? 1/ Profits constitute a goal intermediate to the attainment of utility on many farms. Among other goals is the desire for security which gives rise to an attempt for continuous or regular income rather than the possibilities of short-run, maximum profits. On the other hand, survival may be regarded as an intermediate end. Survival of the firm in the short-run is a means of maximizing returns over a period of several years. While survival as an end may be competitive with profit maximization in the short-run, short-run survival is complementary with profit maximization in the long-run. Precautionary measures employed by farmers in attempting to guarantee survival may outweigh any small changes in price relationships in the use of resources.

When production and income are variable, two alternatives for planning farm production and family expenditures are open. A plan can be adopted which (1) involves large variations from year to year but allows a greater average net income over time, or (2) results in (a) smaller variations between years, and (b) a lower average income over all years.

The Method

Comparisons are made between the effect that three selected type of price movements would have upon the income and solvency of the farmer of

1/ Schickele defines "farm survival end" in operational terms in this way: "To manage production, inventories, cash reserves and access to outside funds so as to minimize the probability of a risk loss large enough to render the farmer insolvent". See Rainer Schickele, "Farmers' Adaptations to Income Uncertainty", Journal of Farm Economics, XXXII, August, 1950, p. 363.

three different alternative farm organizations. The "original" organization was the one found to be the most prevalent in the area of study. The alternative organizations selected are concerned with varying degrees of increase in livestock organization, which required additional operating costs and new fixed capital outlays.

From alternative farm budgets previously organized 1/ an attempt will be made to determine the effect different types of price movements would have had upon the net farm income for the particular type and size of farms considered. Any additional investment in pastures, livestock and equipment had been made in 1948-'49. It will be assumed that any additional investment would be made through the use of borrowed capital. The effect of varying net farm incomes upon the equity position will be noted to determine whether the entity of the firm 2/ can be maintained with the type of price movements applied.

The Theory of the Firm 3/

The basic concepts and principles of the theory of the firm provide

1/ See Clarence W. Jensen, The Economics of Pasture Integration on Irrigated Farms, Montana State College Experiment Station, Mimeograph Cir. 67, Bozeman, Montana, July, 1952.

2/ The entity of the firm may be defined in terms of maintaining the value of the firm as expressed by the difference between total assets value and outstanding liabilities. For an elaboration on this point, see C. B. Baker, Government Participation in the Supply of Short Term Credit for Agriculture, Unpublished Ph.D. thesis, University of California, pp. 192-3.

3/ For a more detailed discussion of the theory, see Appendix A.

tools for determining the optimum allocation of resources. Since an irrigated farm, characteristically, is in a purely competitive position with regard to other agricultural firms for the purchase of inputs and sale of outputs, the discussion may be limited to a firm in pure competition. A set of functional relationships may be derived from various combinations of factors for the production of a product or products. The functional relationship of a variable factor in combination with certain fixed factors in the production of a product is eventually subject to the law of diminishing returns. The application of prices to the marginal analysis derived from the theory provides a basis for making a choice between alternatives which is based on certain maximizing and minimizing conditions. The maximizing condition is that marginal cost must be equated to price of output. The minimizing condition is that the proportionate combination of factors must be the cheapest combination of factors that yield a given quantity of product. ^{1/}

Where the choice involves the allocation of given resources between competing products, maximum value product (net of the variable resource cost) is attained when the marginal rate of product substitution is inversely equal to the product price ratio.

The brief discussion above presents the case for the allocation of given resources and maximization of profits where perfect knowledge exists. The assumption of a fixed quantity of resources and perfect knowledge must be lifted to analyze the problem. Yields and prices in

^{1/} See Appendix A for an elaboration of these conditions.

agriculture are uncertain and vary from year to year. The effect of adding another variable factor (borrowed funds) upon (1) the costs, (2) the revenue, (3) the output of products, and (4) the new equilibrium position with respect to the proportioning of variable factors between products must be analyzed with some degree of subjective probability.

The effect of subsequent price variations, especially where capital is borrowed, becomes important in maintaining entity of the firm, as well as maximization of profits. The extension of capital by lenders is dependent upon certain attributes of the borrower as well as the economic position of the lenders. "The principle of increasing risk" ^{1/} places a limitation upon the use of borrowed capital. This "principle" is reflected in two phenomena associated with uncertainty. One, risk aversion, is the situation in which limitations are imposed internally to the acquisition and use of resources. The other, capital rationing, is the situation in which limitations are imposed externally to the acquisition and use of resources.

Relation Between the Budget and the Theory of the Firm

The theory of the firm is difficult to use empirically. However, the marginal analysis as developed in the theory of the firm provides a basis for making a comparison of costs and returns in any enterprise through the budget method. The theory does not provide a simple accounting technique, but it does provide a method of reasoning that can be

^{1/} M. Kalecki, "Essays in the Theory of Economic Fluctuations", Allen & Urwin, London, 1939, pp. 95-106.

incorporated into the budget analysis. The discussion of the budget method and the method of substitution in the budgeting process is contained in the section following.

The budget method is a means for testing combinations of available resources in terms of the prospective income flows that can be derived from alternative organizations. This is consistent with the basic assumption of the theory of the firm in the sense that profits constitute one of the entrepreneurial goals.

The testing of different combinations of resources is analogous to determining the marginal rate of substitution of factors and minimization of cost for any level of output as set up by the theory of the firm. Use of the marginal analysis presents some difficulties as applied in the method of substitution. The theory assumes that inputs can be applied in infinitesimal amounts. This assumption is not completely applicable to some factors of production in agriculture, such as buildings and equipment. This situation can be somewhat alleviated by the addition of smaller size units.

The substitution of alternative organizations and comparing the net farm incomes of different combinations of enterprises can be compared to the principle in the theory that sets forth the conditions for maximizing profits from competing products that are produced by a given set of resources. The budget method does not present simple unquestioned solution, but it does imply rough estimates of product substitution.

In spite of the empirical shortcomings that may exist between the theory and the budget method, the concept of the theory of the firm is

invaluable as a guide to organizing a budget. With this relation in mind the next step shall be to develop a methodology for determining the effect that indebtedness and varying amounts of net farm income with alternative degrees of livestock organization will have upon the equity position, net worth, and solvency of the firm. This will be accomplished by the use of the budget method.

The Production Method or Production Plan

A budget plan is a definite plan for the use of resources during some future period of time. The specific purpose of the budget is to estimate returns most likely under a given system of organizing or managing a farm. The plan should be organized to achieve any goals "appropriate" to a given situation, and thus maximize the "surpluses", in terms of these goals, produced by the resources over a period of several years. 1/

The budget is the planning phase of farming carried out beforehand on paper or in the mind. Results of the plan are measured in terms of some net income. The farmer does not plan to produce a certain dollar's worth of a crop, but estimates that a certain number of acres will yield a certain physical quantity of product. The criteria of choice between competing enterprises are the level, and with proper application, variation of net income from the available resources.

The Use of the Budget Method

The budget method is a tool used in farm management for testing

1/ Time period varies with the problem.

combinations of resources in terms of the prospective income flows that can be derived from alternative organizations. The budget method may be used to compare (1) alternative plans of a new farm business, or (2) alternative organizations for a "going" farm business. 1/ An organizational change may be constituted by a different proportion of enterprises, different practices and methods of production, different schemes for soil conservation, or net additions to the total quantity of resources employed, together with the various means by which they may be acquired. Enterprises may produce competitive independent products with constant or increasing rates of substitution; they may also produce complementary or supplementary products. The method of substitution is generally the method used to select between competing enterprises. 2/

The substitution method consists of completely or partially substituting for an existing enterprise organization a different combination of enterprises and checking the value of the results upon the total net income flows of the farm. Since only variable costs are relevant to current management decisions, it is only necessary to consider the variable costs in the method of substitution. The farmer must sometimes make a choice or compromise between the level of income and the stability

1/ Andrew Boss and George A. Pond, Modern Farm Management Principles and Practice, The Webb Publishing Co., St. Paul, Minn., 1947, pp. 198-222.

2/ Other methods of farm planning are the (1) method of direct comparison, and (2) standard comparison of farm enterprises. For a discussion of these methods, see G. W. Forester, Farm Organization and Management, Prentice-Hall, Inc., New York, 1949, pp. 97-150.

which he desires when he makes decisions regarding the absolute and relative size of enterprises.

Divisions of the Farm Budget

Generally the farm budget is broken down in the three following divisions, viz., the crop plan, the livestock plan, and the indirect and fixed expenses. 1/ These parts are then summarized into an aggregate in the budget summary. The organization of competing enterprises within the crops and livestock enterprises and between these enterprises should be so arranged that the "net marginal return" from each is equal for all of the resources employed.

Information Needed for the Budget

The information needed for budget analysis can be classified into the two broad categories of production data and price data. On the production side, the farmer must consider the technical possibilities of production between competing, complementary, or supplementary enterprises from the extent and condition of available farm resources--land, labor, capital, equipment, and entrepreneurial ability. The input-output relationship of crops and livestock represent expectations for a time span relevant to the problem at hand. The production functions are uncertain, but they may be based upon average yields for the past 5 or 10 years, or they may be based on some "normal" year. Whatever method is adopted, the information should be reliable and adaptable to the quality and quantity of resources

1/ John A. Hopkins, Elements of Farm Management, Prentice-Hall, Inc., New York, 1947, pp. 113-4.

(expected to be) available through time.

The category of price data is concerned with putting prices on the inputs and the outputs. Since future prices are uncertain, the expected price becomes a "subjective prediction" on the part of the farmer with a probability distribution that is conditioned by the general economic conditions and government price support programs ^{1/}, and enters the decision function subject to the individual's psychological makeup, his financial position, and the ends to be maximized. Although prices applied to inputs and outputs in budgeting are always "expectations" rather than "actual", they may be based on historical price behavior. It is important that the price relationship between, as well as within, the input-output relationships is consistent. It will be the relative yields, prices, and costs taken together which determine the most profitable crop and livestock enterprises. ^{2/} The movement of prices is a subject which must be given particular attention by the farmer if a wise choice of enterprise is to be made.

Flexibility of Production

The emphasis in the budget method has been upon the balance needed to maximize the net farm income. But when production and income are variable, due to the uncertainty of prices and yields, the farmer may follow a more conservative plan in order to guarantee survival. A plan may be

^{1/} D. B. Williams, "Price Expectations and Reactions to Uncertainty by Farmers in Illinois", Journal of Farm Economics, Vol. XXXIII, Feb. 1951, p. 237.

^{2/} John A. Hopkins and Earl O. Heady, Farm Records, Third Edition, Iowa State College Press, Ames, Iowa, 1949, pp. 14-15.

adopted which results in smaller variations between years even if it provides a lower income over all years. The farmer may sacrifice level of income for stability of income. Different combinations of capital, with regard to liquidity, will result in firms with different degrees of flexibility. Liquidity in asset structure may also be considered a form of financial flexibility. Liquidity can be used to counteract economic shocks. Cash or credit is also needed in order to carry on current production and otherwise facilitate current operation.

Flexibility can be provided by establishing a type of plant that allows for greater substitution of enterprises. Production possibilities open after selection of a specialized plan are limited in the short-run, due to the technical limitations of specialized resources. The adoption of a flexible plan allows the firm to adjust production to changing price ratios. A short-lived resource provides a greater time flexibility than a durable resource. If a change in plans is brought about by a change in the prices of competing products, the operator does not sacrifice as great an investment in the short-lived resource as he may in the durable resource. It is assumed that the durable resource has a higher initial total cost. A good example of product flexibility is the selection of dual purpose cows instead of dairy cows to allow a switch between beef and butterfat as price ratios vary. Some types of livestock production have less flexibility than do some of the annual crops.

In addition to a flexible multiple-product plant, diversification can be accomplished by selecting enterprises in fixed proportions over time. The premise of this idea is that if the returns are low in one

20.

crop, the returns in another may be high, due to the relative price changes of products over time and changes of yields of products.

PART II. EMPIRICAL INVESTIGATION

Summary of Results of Previous Study

The present study is based on a previous study made to determine the most profitable proportion of pastures and cash crops in an irrigated farm organization. ^{1/} Thirty sample farms were drawn from those having seeded irrigated pastures along the Yellowstone River in Stillwater and Yellowstone counties of Montana. On the average, as of 1948, these farms contained about 120 acres of irrigated land. This was the size that was used as the "typical" farm. The irrigated land was used for crop and pasture in the following proportions:

Sugar beets -----	32 per cent
Hay and pasture-----	31 per cent
Grain-----	28 per cent
Fence lines, roads, irrigation ditches, farmstead, etc.-----	9 per cent

Farm returns and costs were calculated on the basis of average prices for 1948-'49. These averages were applied to a farm "typical" of the area. This organization was then used as a basis for comparing alternative organizations which might be set up in the area. Increased yields derived from having forages in the rotation were not calculated for the alternative organizations. Since dairying was found to be the major livestock enterprise, it was used in the budgets for the alternative farm organizations. Comparison of incomes from alternative organizations based on

^{1/} Jensen, op. cit., p. 17.

prices and costs was then made. The budget summaries for the original and three alternative organizations are given in Table I. ^{1/}

Table I. Budget Summaries of Receipts and Expenses for Original and Three Alternative Farm Organizations.

Organization	Receipts	Expenses
Original Farm Organization	Crops \$ 6,773 Dairy-Hog 4,025 Home Consumed 502 TOTAL \$11,300	Crops \$ 4,067 Dairy-Hog 549 Indirect and Fixed 2,613 TOTAL \$ 7,229 NET FARM INCOME \$ 4,071
Alternative No. I	Crops \$ 215 Dairy-Hog 13,461 Home Consumed 502 TOTAL \$14,133	Crops \$ 487 Dairy-Hog 3,859 Indirect and Fixed 4,824 TOTAL \$ 8,400 NET FARM INCOME \$ 5,733
Alternative No. II	Crops \$13,704 Dairy-Hog ---- Home Consumed 280 TOTAL \$13,984	Crops \$ 7,502 Dairy-Hog 143 Indirect and Fixed 2,983 TOTAL \$10,628 NET FARM INCOME \$ 3,356
Alternative No. III	Crops \$ 2,974 Dairy-Hog 14,304 Home Consumed 502 TOTAL \$17,780	Crops \$ 2,101 Dairy-Hog 3,286 Indirect and Fixed 6,158 TOTAL \$11,545 NET FARM INCOME \$ 6,235

The original crop and pasture organization was made up of the proportion of crop acres as given above. The livestock enterprise was composed

^{1/} Ibid., Table XIV, p. 71.

of 10 dairy cows, from which butterfat and yearlings were marketed, and a hog enterprise of 3 sows which produced 18 pigs for market.

In Alternative No. I, nearly all land was shifted to the production of forage. The size of the dairy enterprise was increased from 10 to 30 cows, and the hog enterprise from 3 sows to 9 sows. This required an additional outlay of \$4,600 for livestock and \$1,725 for sufficient buildings and equipment to handle them.

In Alternative No. II, all land was shifted to cash crops -- 75.5 acres of sugar beets and 33.5 acres of wheat. This alternative has no livestock in the farm organization. Since this study is concerned with shifting to varying degrees of increases in livestock organization in comparison to the "original" organization, this alternative provides no basis of concern here; therefore, it will not be considered further.

Alternative organization No. III was made up of about 1/3 cash crops (sugar beets) and 2/3 forage and pasture. The dairy enterprise was increased to 28 cows, and the hog enterprise was increased to 18 sows. This organization would have required an additional outlay of \$2,100 for buildings and equipment and \$4,500 more for livestock investments.

The conclusion that can be drawn from these budgets is that with prices for livestock and livestock products at 1948-49 levels, the average farmer in the Billings area could have improved his income by shifting to the production of more forage and livestock.

But variation as well as level of net farm income is critical to most farmers. The variation in net farm income was greater for the two livestock alternatives than it was for the original or the all cash crop

alternative. Certain statistical measures were used to determine the relative net income vulnerability of an average farmer under the organizations planned. The basis for comparing the variations in income among the alternatives was the price coefficient of net income variation. The coefficient of variation may be defined as the standard deviation of a sample divided by the mean value of the items in the sample. That is, variability is expressed as a certain per cent of the mean. Since the coefficient of variability measures relative dispersion, it is useful in comparing alternative organizations.

The first step in the calculation of the gross income variation was to calculate the coefficient of price variation for the five major marketable commodities--sugar beets, wheat, butterfat, beef and hogs for the years 1920-1948. The coefficient of price variation arrived at here gave the percentage which the price could be expected to vary from the mean in two years out of three. The coefficient of price variation figures are as follows: sugar beets, .273; wheat, .451; butterfat, .402; beef, .512; and pork, .495. ^{1/}

The next step consisted of weighting the coefficients of price variation by the proportion that each commodity contributed to the gross farm income. The summation of each weighted coefficient of price variation for each enterprise divided by 100 in each organization gives a comparison of gross farm income variation among the alternatives. The gross income

^{1/} Ibid., p. 75.

coefficient of variation for each alternative is as follows: 1/

Original-----	.3516
Alternative No. I-----	.4700
Alternative No. II-----	.2956
Alternative No. III-----	.4415

Since variation in net farm income is the critical income figure, it was necessary to combine the gross income coefficient of variation with farm expenses to secure a comparison of the price vulnerability of net farm income among the different organizations. In combining the gross income coefficient of variation with expenses, the assumption was made that there will be no significant difference in expense variation over time among alternative organizations. With this assumption, the ratio of the gross income coefficient of variation to the difference between average gross income and total expenses ($\frac{V}{1 - E/I}$) permits a comparison of the price vulnerability of net farm income among the different organizations. The net income vulnerability for the different organizations budget are as follows: 2/

Original-----	.9759
Alternative No. I-----	1.1588
Alternative No. II-----	1.2317
Alternative No. III-----	1.2589

1/ Ibid., p. 76.

2/ See Jensen, Ibid., for determination of net income vulnerability and figures.

Budget Synthesis

The "original" organization based on 1948-'49 averages as shown in the previous study is presented in detail in order to reflect the yields and specific costs associated with each enterprise. Since it is not possible to determine the specific land use of Alternatives I and III, the "original" organization will be used as a basis for estimating the results of the alternative organizations. The budgets for crop and livestock production are presented in Tables II and III. Yields are averages for Yellowstone and Stillwater counties in 1948-'49. 1/ The prices applied to these production averages were the average prices received by Montana farmers in 1948-'49. 2/

1/ Montana Agricultural Statistics, Montana Department of Agriculture and Labor Industry cooperating with United States Department of Agriculture, Bureau of Agricultural Economics, Helena, Montana, Vol. III, December, 1950, pp. 95 and 103.

2/ Ibid., pp. 95 and 103.

Table II. Budget for Crop Production.

Crop		Acres	Yield per Acre(a)	Total	Crop Disposition			
					Feed	Sale	Unit Price(a)	Gross Sales
Sugar Beets (tons)		38.0	12	456	--	456	\$13.09(b)	\$5969
Grains (bu.)	Wheat	16.0	30	480	75	405	1.84	745
	Oats	6.5	45	293	293	--	--	--
	Barley	8.5	40	340	340	--	--	--
Hay (T.)		24.0	1.94	46.5	43	3.5	19.53	68
Pasture (lbs. TDN)		13.0	2036	26470	26470	--	--	--
Corn (bu.)		1.5	33	49.5	49.5	--	--	--
Fallow		1.5	--	--	--	--	--	--
Waste		11.0	--	--	--	--	--	--
TOTAL		120.0						\$6773

(a) Source for yield and price data: Montana Agricultural Statistics, op. cit., pp. 95, 103.

(b) Including \$2.44 per ton government payment. Source: Ibid., p. 13.

Table III. Budget for Livestock Production.

Enterprise	No.	Production		Disposition			
		Kind	Amount	Home Consumed	Marketed		
					Amount	Unit Price	Value
Dairy Cows	10	B.F.	2245 lbs.	215 lbs.	2030 lbs.	\$0.705	\$1413
		Meat	1500 lbs.	--	1500 lbs.	0.20	300
Yearlings	8.5	Meat	5400 lbs.	750 lbs.	4650 lbs.	0.24	1116
Calves	9	--	--	--	--	--	--
Sows	3	Pork	900 lbs.	--	900 lbs.	0.18	162
Pigs	18	Pork	3564 lbs.(a)	440 lbs.	2420 lbs.	0.22	532
Poultry	100	Eggs	850 doz.(a)	125 doz.	700 doz.	0.405	284
		Meat	775 lbs.	90 lbs.	665 lbs.	0.30	200
TOTAL							\$4025

(a) An average of 3.2 pigs per year held as replacement stock.

(b) Twenty-five dozen eggs used for hatching chicks.

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Crop Production Expenses

Estimates of direct crop production costs are given in Table IV.

These are only the direct expenses that can be applied to specific enterprises.

Table IV. Budget for Crop Production Expenses. (a)

<u>Sugar Beets:</u>			
<u>Direct Expense</u>	<u>Per Acre</u>	<u>Total</u>	
Seed (4.5 lbs./A.)*	\$ 1.80	\$ 68	
Fertilizer (5T. manure and 100 lbs. phosphate/A.)	10.90	414	
Contract labor (25.5 manhours/A.)**	35.40	1345	
Fuel, Grease, Oil, and Repairs	3.60	138	
Harvesting and Hauling	40.80	1550	
Machinery Depreciation***	1.44	55	
TOTAL	\$93.94	\$3570	

* Seed price of 45 cents per pound and seeding rate from D. C. Myrick, U.S. Department of Agriculture, Bureau of Agricultural Economics, Bozeman, Montana, unpublished data.

** Contract labor rates adjusted by index of farm wage rates to reflect 1948-49 prices. Source: The Farm Cost Situation, Bureau of Agricultural Economics, U.S. Dept. of Agriculture, Washington 25, D.C., March 1952, p. 2.

*** Specialized equipment used only for beets.

<u>Wheat:</u>			
<u>Direct Expense</u>	<u>Per Acre</u>	<u>Total</u>	
Seed (1 bu./A.)*	\$ 4.00	\$ 64	
Fuel, Grease, Oil, and Repairs	1.44	23	
Harvesting	5.50	88	
TOTAL	\$10.94	\$ 175	

* Price of seed wheat estimated at twice the market grain price.

Table IV (continued)

Oats:		
<u>Direct Expense</u>	<u>Per Acre</u>	<u>Total</u>
Seed (2 bu./A.)*	\$ 4.00	\$ 26
Fuel, Grease, Oil, and Repairs	1.44	9
Harvesting	5.50	36
TOTAL	\$10.94	\$ 71

* Price of seed oats estimated at twice the market grain price.

Barley:		
<u>Direct Expense</u>	<u>Per Acre</u>	<u>Total</u>
Seed (1.5 bu./A.)*	\$ 3.30	\$ 28
Fuel, Grease, Oil, and Repairs	1.44	12
Harvesting	5.50	47
TOTAL	\$10.24	\$ 87

* Price of seed barley estimated at twice the market price.

Hay:		
<u>Direct Expense</u>	<u>Per Acre</u>	<u>Total</u>
Seed (8 lbs./A.)*	\$1.12	\$ 27
Fuel, Grease, Oil, and Repairs	1.66	40
TOTAL	\$2.78	\$ 67

* Seed price of 56 cents per pound (1948-'49 average price, Elliott Seed Co., Billings, Mont.). Seeding rate from R. D. Mercer, Department of Agronomy and Soils, Montana State College, Bozeman, Montana. Cost of seed allocated over a four-year period.

Table IV (continued)

Pasture:		
<u>Direct Expense</u>	<u>Per Acre</u>	<u>Total</u>
Seed (16 lbs./A.)*	\$ 1.22	\$ 16
Fertilizer**	5.10	66
Fuel, Grease, Oil, and Repairs	<u>1.19</u>	<u>15</u>
	TOTAL	\$ 97

* From primary data. Seed cost allocated over five-year period.

**Seventeen tons of manure applied over the five-year period.

TOTAL DIRECT EXPENSES	\$4067
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(a) Source for expense items: Farm Budget Standards for Irrigation Farming, Branch of Operation and Maintenance, U.S. Dept. of Interior, Bureau of Reclamation, Region 6, Billings, Montana, October, 1948, pp. 2-14.

Source for index of expense items: The Farm Cost Situation, op. cit., p. 2.

Direct Livestock Expenses

The budget for livestock expenses is presented in Table V. Home grown feeds are included in the table only to show the feed requirements for each class of livestock. The prices farmers would have received for grains is used as a basis for estimating cost of purchased grain.

Table V. Budget for Livestock Expenses. (a)

Enterprise	Direct Expenses				
	Kind	Amount Home Grown	Amount Purchased	Unit Price	Value
Cattle	Oats	221 bu.	161 bu.	\$0.67	\$108
	Barley	245 bu.	xx	xx	xx
	Hay	41.5 T.	xx	xx	xx
	Pasture	26500 TDN	xx	xx	xx
	Vet.	xx	xx	xx	75
	Equip.				
	Depr. (b)	xx	xx	xx	38
Hogs	Corn	49.5 bu.	51 bu.	1.60	82
	Oats	72 bu.	53 bu.	0.67	36
	Barley	95 bu.	xx	xx	xx
	Skim Milk	14700 lbs.	xx	xx	xx
	Vet.	xx	xx	xx	10
	Building				
	Depr. (b)	xx	xx	xx	12
Poultry	Wheat	75 bu.	xx	xx	
	Mash	6000 lbs.	6000 lbs.	2.75/cwt	.165
	Building				
	Depr. (b)	xx	xx	xx	23
TOTAL					\$549

(a) Feeds fed to livestock based on Recommended Nutritive Allowances for Domestic Animals, Committee on Animal Nutrition, Washington 25, D.C., No. I to VI, Revised, 1950.

(b) Value of equipment and buildings based upon prices as given in Farm Budget Standards for Irrigation Farming, op. cit., p. 57. Adjusted by index of building materials prices to 1948-'49 price level.

The inventory of machinery, buildings, and equipment as taken from Table XI of Jensen's work is presented in Table VI. Items that are required for the farm household are omitted, as these items are dependent upon the size of net farm income and individual family desires.

Table VI. Inventory of Machinery, Buildings, and Equipment.(a)

Item	Cost	Life (Years)	Annual Depr. (b)	Annual Repairs (c)	Total
Tractor	\$2117	10	\$250	\$ -- (d)	\$ 250
Plow	437	18	24	11	35
Duckfoot	230	15	15	6	21
Spiketooth Harrow	64	20	3	2	5
Springtooth Harrow	190	18	11	5	16
Disc	205	16	13	5	18
Wagon	221	10	22	6	28
Float	63	10	6	2	8
Spreader	332	15	22	8	30
Ditcher	193	20	10	5	15
Beet Cultivator	284	15	-- (d)	-- (d)	--(d)
Roller	174	20	9	4	13
Beet Drill	594	15	-- (d)	-- (d)	--(d)
Lifter	110	18	-- (d)	-- (d)	--(d)
Mower	209	12	17	5	22
Side Del. Rake	265	15	18	7	25
Dump Rake	120	18	7	3	10
Stacker	158	15	11	4	15
Grain Drill	485	15	32	12	44
Milker	152	10	-- (d)	-- (d)	--(d)
Cream Separator	210	15	-- (d)	-- (d)	--(d)
Feed Grinder	95	17	6	2	8
Post Hole Digger	300	15	20	8	28
Misc. Tools	158	5	32	4	36
Truck	1980	12	165	151 (e)	316(e)
Auto (farm share)	1052	10	105	243 (e)	348(e)
Barn	1300	33	39	26	65
Granary	375	33	11	8	19
Garage and Shop	750	33	23	15	38
Hog Houses and Equipment	230	33	-- (d)	-- (d)	--(d)
Poultry Houses and Equipment	450	33	-- (d)	-- (d)	--(d)
Barbed Wire Fencing	315	33	10	6-	16

Table VI. (continued)

Woven Wire Fencing	50	33	2	1	3
Electric Fencing	70	33	2	1	3
Irrigation Structures	195	33	5	4	10
	<u>\$11128</u>		<u>\$891</u>	<u>\$554</u>	<u>\$11445</u>

- (a) Source: Farm Budget Standards for Irrigation Farming, op. cit., pp. 56-60.
- (b) Annual depreciation of tractor is based upon hours of operation as calculated in method presented by Orlin J. Scoville, "Fixed and Variable Elements in the Calculation of Machine Depreciation", Agricultural Economics Research, U.S. Dept. of Agric., B.A.E., Washington, D.C., July, 1949, pp. 66-67. Depreciation of other machinery and equipment based upon normal life expectancy, Farm Budget Standards for Irrigation Farming, op. cit., pp. 66-67.
- (c) Annual repairs estimated at 2.5 per cent of new cost for machinery and 2 per cent for buildings and improvements. Ibid.
- (d) These expense items have been entered as direct expenses to the enterprises for which they are specialized. Tables IV and V.
- (e) Also includes gas, oil, grease, and tires.

Indirect expense items are shown in Table VII. These include the total of machine depreciation and repairs (from Table VI) and the amount of hired help. 1/

Fixed expense items, shown in Table VII, include taxes, insurance, and building and improvements depreciation and repairs. The amount of the tax estimate is based upon taxes as reported by sample farmers interviewed. This amounted to an average of \$3.03 per acre, not including water charges.

1/ Excluding contract hand labor and custom hired harvesting. These items were charged to the enterprises as direct expenses.

Table VII. Indirect and Fixed Farm Expenses

<u>Indirect Expenses</u>		<u>Amount</u>
Machine Depreciation and Repairs (From Table VI)		\$1291
Hired Labor		<u>417</u>
	TOTAL INDIRECT	\$1708
<u>Fixed Expenses</u>		
Taxes (a)		\$ 364
Insurance (b)		55
Building and Improvements		
Depreciation and Repairs (From Table VI)		154
Water Charge		<u>305</u>
	TOTAL FIXED	\$ 878

- (a) Real estate tax rate is an average of the rates reported by 17 of the 30 farmers interviewed.
- (b) Amount of insurance based upon the amount invested in machinery, livestock, buildings, and improvements, as compared with like investments and insurance premium in Plan No. 1, p. 53, Some Economic Aspects of the Proposed Lower Marias Irrigation Project, Department of Agricultural Economics and Rural Sociology, Montana Agricultural Experiment Station, Montana State College, Bozeman, Montana, in cooperation with the Bureau of Reclamation, Department of the Interior, June, 1946.

The Budget Analyses

It will be remembered that the purpose of this study is to develop a method for determining the financial position a farmer should have, under anticipated price and cost relationships, in order to justify shifts to varying degrees of livestock in an irrigated farm unit. One method of determining the annual and cumulative effect of different price movements on farm organization and income for different farming systems is to develop a series of annual budgets in which receipts and costs are varied in accordance with price and cost movements as they existed in the past

or according to anticipated future movements. The method used here to show the relative effects of past movements upon the financial position of a farmer after the investment has been made in pasture, livestock, and allied assets. Three periods have been selected. They are: 1929-1932, 1939-1942, and 1949-1952. The overall index of prices received, prices paid, and ratio of prices received to prices paid by farmers for each of the three periods are shown in Table VIII. The ratio moved continuously downward in the first period; continuously upward in the second; and was relatively stable in the last period.

Table VIII. Index Numbers of Prices Received, Prices Paid,
and Ratio of Prices Received to Prices Paid.*
1910-14 = 100

Year	Prices Received	Prices Paid	<u>Prices Received</u> <u>Prices Paid</u>
1929	148	160	92
1930	125	151	83
1931	87	130	67
1932	65	112	58
1939	95	122	78
1940	100	124	81
1941	123	132	93
1942	158	151	105
1948-'49	267	254	105
1950	256	255	100
1951	302	281	107
1952	288	277	104

* Source: Outlook Charts, United States Department of Agriculture, United States Government Printing Office, Washington, D.C., 1952, p. 9.

Method of Adjusting Receipts and Costs

The method used to adjust the receipts and costs for each alternative to the three-year periods was to apply the movement of prices received and prices paid by appropriate indexes as they occurred in these periods. The year ending in nine was taken as the base 100 for each year except 1949-1952. The base period, 1948-'49, was used for the later period because receipts and costs of the previously organized budgets were based on the average of these two years.

Adjustment of Receipts

To adjust the gross receipts from each alternative for each price period, the 1948-'49 gross receipts from each product were multiplied by the calculated index of prices received in each year for that product. The gross receipts from each product for the original organization are given in Tables II and III. The gross receipts from each product in alternatives I and III are given in Appendix B and C, respectively. The prices given in the Montana Farm and Ranch Prices 1/ were the basis for determining the index of prices received in the 1929-'32 and 1939-'42 period. The prices given in the Montana Agricultural Statistics 2/ was the basis for determining the index of prices received in the 1950-'52 period. The gross receipts from each enterprise for each year are given in Appendix, Tables I - III.

1/ Montana Farm and Ranch Prices, Mimeograph Cir. 51, Montana State College, Bozeman, Montana, April, 1949.

2/ Montana Agricultural Statistics, Montana Department of Agriculture and Labor Industry cooperating with U.S. Department of Agriculture, Bureau of Agricultural Economics, Helena, Montana, Vol. IV, Dec., 1952.

Adjustment of Costs

Since it was not possible to determine the land use of alternatives I and III, the change in costs that occurred in the "original" organization is used to adjust costs in alternatives I and III. To adjust the direct crop production costs in the original organization, appropriate indexes for each year are applied to the specific costs associated with each enterprise in 1948-'49. The indexes used are given in Appendix D. The indexes used to adjust the direct costs in the years 1930-'32 and 1940-'42 were based on indexes of prices paid by United States farmers. 1/ The indexes used to adjust the direct costs in 1950-'52 were based on indexes of prices paid by Montana Farmers. 2/ There should be no significant difference here because the method is used merely to reflect movement of prices.

The adjustment of direct livestock expenses was made by applying the calculated index of prices received 3/ for the grains fed to the total cost of each type of feed purchased in 1948-'49. The veterinary costs for cattle and hogs and the mash fed to poultry were adjusted by the indexes given in Appendix D. The depreciation cost on buildings and equipment was not adjusted by any index, as these items were a constant for

1/ The Farm Cost Situation, op. cit., p. 2.

2/ Indexes of Prices Paid by Montana Farmers and Ranchers, 1935 to 1951, Montana State College Agricultural Experiment Station, Bozeman, Montana, in cooperation with the Bureau of Agricultural Economics, USDA, Office of the Agricultural Statistician, Helena, Montana, 1952.

3/ Montana Farm and Ranch Prices, op. cit., and Montana Agricultural Statistics, Vol. IV, op. cit.

each year. The items adjusted in the indirect and fixed costs (Table VII) were the machinery repairs, hired labor, taxes and insurance, and the building repairs cost. See Appendix D for the indexes used to adjust these items.

Adjustment of Costs in Alternatives I and III

To adjust the expenses in alternatives I and III, it was assumed that the direct (crop and livestock) expenses, and indirect and fixed expenses for these alternatives (from Table I) would vary in the same proportion from year to year from the 1948-'49 level, as the costs varied from year to year in the original organization. The budget summary of expenses for each alternative in each year is given in Appendix Tables IV and V.

Year by Year Effects Upon Income

The annual effects on income of the three different types of price movements are shown in Table IX through XII. The residual indentified here as "income for savings and debt payment" reflects that portion of the annual income a farm family would have left for payment on debts and income tax, additional farm investments, and building up operation and cash reserves, after paying for a stable, reasonably adequate level of family living.

Table IX. -- Annual Effects on Income with 1950-'52 Price Movement.

Year	Gross Farm Income			Cash Expenses			Net Cash Income			Income for Savings or Debt Payment*		
	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III
1	\$11247	\$13008	\$16646	\$7363	\$9351	\$11772	\$3884	\$3657	\$4874	\$2084	\$1857	\$3074
2	12184	14993	18545	7887	9617	12507	4297	5376	6038	2497	3576	4238
3	12292	14734	18283	8043	10421	13071	4239	4313	5212	2439	2513	3412
Ave.	11908	14245	17825	7764	9796	12450	4140	4449	5375	2340	2645	3575

*Net cash income adjusted by subtracting estimated costs for family living. Annual family living costs estimated at \$1800 annually.

Table X. -- Annual Effects on Income with 1930-'32 Price Movement.

.07

Year	Gross Farm Income			Cash Expenses			Net Cash Income			Income for Savings or Debt Payment*		
	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III
1	\$10337	\$11480	\$15341	\$6890	\$8755	\$11130	\$3357	\$2725	\$4211	\$1557	\$ 925	\$2411
2	7978	8050	11031	6293	7636	9847	1685	414	1184	- 315	-1386	- 616
3	6692	5679	8046	5693	7024	9040	999	-1345	- 994	- 809	-3145	-2794
Ave.	8336	8403	11473	6322	7805	10006	2014	598	1467	144	-1202	- 333

*Net cash income adjusted by subtracting estimated costs for family living. Annual family living costs estimated at \$1800 annually.

Table XI. — Annual Effects on Income with 1940-'42 Price Movement

Year	Gross Farm Income			Cash Expenses			Net Cash Income			Income for Savings or Debt Payment*		
	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III	Orig.	Alt.I	Alt.III
1	\$11937	\$15020	\$18144	\$7250	\$9371	\$11728	\$4687	\$5649	\$6416	\$2887	\$3849	\$4616
2	15498	19178	24182	7671	9976	12435	7827	9202	11747	6027	7402	9947
3	17884	23723	29804	8764	11241	13990	9120	12482	15814	7320	10682	14014
Av.	15106	19307	24043	7895	10196	12718	7211	9111	11325	5411	7311	9525

* Net cash income adjusted by subtracting estimated costs for family living. Annual family living costs estimated at \$1800 annually.

The Operator's Cash Position

The operator's cash position, from the beginning through each three-year period for alternatives I and III is shown in Tables XII through XVII. Since the original alternative required no additional investment, all of the income outside of family living in each period would be an addition to cash reserves. It will be assumed that the operator was debt free to begin with, but that a loan had to be made to finance the additional investment in livestock and buildings. The first alternative had an additional investment of \$6,325 in buildings and livestock. To determine the net additional outlay that is needed, it would be necessary to subtract the income that would be received from the disposal of surplus equipment. According to assumptions concerning ownership and use of farm machinery, the equipment that would have to be disposed of would be spring tooth harrow, beet cultivator, roller, beet drill, lifter, grain drill, and duckfoot. ^{1/} The initial cost of these items totals \$2067. Assume that they are 1/2 depreciated, and the farmer receives the remaining value upon the sale of the equipment. This would amount to \$1034. The subtraction of this amount from \$6235 would leave a net investment of \$4,291.

The third alternative had an additional investment of \$6600 for buildings, equipment and livestock. The surplus equipment that could be disposed of includes the roller, beet drill, and grain drill. The initial cost of this equipment totals \$1253. Again assuming that these

^{1/} Farm Budget Standards for Irrigation Farming, op. cit., pp. 61-62.

43.

items are $1/2$ depreciated and the operator receives the remaining value upon the sale of the equipment, the amount received would be \$627. The subtraction of this amount from \$6600 would leave a net investment in buildings, equipment, and livestock of \$5973. The repayment plans for these alternatives are based on semi-annual payments with interest at 6 per cent on the unpaid principal.

Table XII. -- Loan Advances and Repayments As Related to Net Cash Income
During 1950-'52 Price Movement. Alternative No. I.

Year	Net Loan	Net Cash Income Available(a)	Principal Payments	Unpaid Balance(b)	Interest Paid	Total Principal and Interest Payments	Available for Other Purposes
1	\$4291	\$929	\$800	\$4291	\$129	\$929	0
1-1/2	0	929	824	3491	105	929	0
2	0	1788	1708	2667	80	1788	0
2-1/2	0	1788	959	959	29	990	\$800
3	0	1257	0	0	0	0	1257
3-1/2	0	1257	0	0	0	0	1257

(a) After deducting \$900 each six months for family living.

(b) Beginning of each half-year, except for first year when loan is advanced early in the year.

Table XIII. -- Loan Advances and Repayments As Related to Net Cash Income
During 1950-'52 Price Movement. Alternative No. III.

Year	Net Loan	Net Cash Income Available(a)	Principal Payments	Unpaid Balance(b)	Interest Paid	Total Principal and Interest Payments	Available for Other Purposes
1	\$5973	\$1537	\$1358	\$5973	\$179	\$1537	0
1-1/2	0	1537	1399	4615	138	1537	0
2	0	2119	2023	3216	96	2119	0
2-1/2	0	2119	1193	1193	36	1229	\$890
3	0	1706	0	0	0	0	1706
3-1/2	0	1706	0	0	0	0	1706

(a) After deducting \$900 each six months for family living.

(b) Beginning of each half-year, except for first year when loan is advanced early in the year.

Table XIV. -- Loan Advances and Repayments as Related to Net Cash Income
During 1930-'32 Price Movement. Alternative No. I.

Year	Net Loan	Net Cash Income Available(a)	Principal Payments	Unpaid Balance(b)	Interest Paid	Total Principal and Interest Payments	Available for Other Purposes
1	\$4291	\$463	\$334	\$4291	\$129	\$463	0
1-1/2	0	463	344	3957	119	463	0
2	693	-693	0	4306	0	0	0
2-1/2	693	-693	0	5128*	0	0	0
3	1573	-1573	0	6851**	0	0	0
3-1/2	1573	-1573	0	8621***	0	0	0

•96

(a) After deducting \$900 each six months for family living. Minus sign indicates loan for this purpose.

(b) Beginning of each half-year, except for first year when loan is advanced early in the year.

* Includes \$129 unpaid interest from first half of year.

** Includes \$279 unpaid interest from first year.

*** Includes \$476 unpaid interest from the first year and a half.

Table XV. — Loan Advances and Repayments As Related to Net Cash Income
During 1930-'32 Price Movement. Alternative No. III.

Year	Net Loan	Net Cash Income Available(a)	Principal Payments	Unpaid Balance(b)	Interest Paid	Total Principal and Interest Payments	Available for Other Purposes
1	\$5973	\$1205	\$1026	\$5973	\$179	\$1205	0
1-1/2	0	1205	1057	4947	148	1205	0
2	313	-313	0	4203	0	0	0
2-1/2	313	-313	0	4642*	0	0	0
3	1397	-1397	0	6174**	0	0	0
3-1/2	1397	-1397	0	7748***	0	0	0

47.

(a) After deducting \$900 each six months for family living. Minus sign indicates loan for this purpose.

(b) Beginning of each half-year, except for first year when loan is advanced early in the year.

* Includes \$126 unpaid interest from first half of year.

** Includes \$261 unpaid interest from first year.

*** Includes \$438 unpaid interest from first year and a half.

Table XVI. -- Loan Advances and Repayments As Related to Net Cash Income
During 1940-'42 Price Movement. Alternative No. I.

Year	Net Loan	Net Cash Income Available(a)	Principal Payments	Unpaid Balance(b)	Interest Paid	Total Principal and Interest Payments	Available for Other Purposes
1	\$4291	\$1925	\$1796	\$4291	\$129	\$1925	0
1-1/2	0	1925	1850	2495	75	1925	0
2	0	2701	645	645	19	664	\$2037
2-1/2	0	2701	0	0	0	0	2701
3	0	5341	0	0	0	0	5341
3-1/2	0	5341	0	0	0	0	5341

18.

(a) After deducting \$900 each six months for family living.

(b) Beginning of each half-year, except for first year when loan is advanced early in the year.

Table XVII. -- Loan Advances and Repayments As Related to Net Cash Income
During 1940-'42 Price Movement. Alternative No. III.

Year	Net Loan	Net Cash Income Available(a)	Principal Payments	Unpaid Balance(b)	Interest Paid	Total Principal and Interest Payments	Available for Other Purposes
1	\$5973	\$2308	\$2129	\$5973	\$179	\$2308	0
1-1/2	0	2308	2193	3844	115	2308	0
2	0	4973	1651	1651	50	1701	\$3272
2-1/2	0	4973	0	0	0	0	4973
3	0	7007	0	0	0	0	7007
3-1/2	0	7007	0	0	0	0	7007

49.

(a) After deducting \$900 each six months for family living.

(b) Beginning of each half-year, except for first year when loan is advanced early in the year.

Changes in Borrower-Creditor Equity

The investment position of the operator may be summarized by setting up a balance sheet on April 1 of each year for all three types of price movements for each alternative. Usually at this time annual farming operations begin, and loans are usually needed. Gross investment by alternatives, the indebtedness for alternatives I and III, and the capital ratios for each year are shown in Tables XVIII through XX. The balance sheet presented for October 1 shows the capital position of each alternative upon the close of the harvest season after the third year. The current assets should be larger for the October 1 balance sheet by the amount of the value of feed. Since it was not possible to determine the land use of some of the alternatives, the value of feed has been omitted.

The items included in the fixed asset class are land and buildings. The land value has been assumed to be \$150 an acre. This would make the total value for the "typical" farm in this area \$18,000. The value of buildings was that determined in 1948-'49, with only the depreciation deducted for each year. For alternatives I and III the additional investment in buildings was added to the original investment.

The items included in the working asset class are dairy breeding stock, sows, and equipment (including car and truck). The value of dairy cows was estimated at \$200 per head for each alternative, and held at a constant value for each year. The sows were valued at \$60 a head. The equipment (from Table VI) reflects depreciation from year to year, and is adjusted in alternatives I and III to reflect the value of this equipment upon the disposal of surplus machinery.

The current assets are made up of yearlings or calves, poultry, and cash. For the valuation of the yearlings, calves, and poultry the calculated 1948-49 value of these were adjusted by the appropriate indexes in the same way that the gross receipts for each type of price movement were determined from each enterprise earlier in the thesis. It was assumed that the yearlings would weigh 500 pounds by April 1, and that the calf crop in the third year would weigh 400 pounds by October 1. No pigs are included in this inventory for if only spring pigs are raised, the value of these would be small on April 1, and it is presumed that pigs would have been sold by October 1. No value is given either to crops or feed on the April 1 inventory because the farming operations would be just starting about this time and most of the feed would have been fed to the livestock during the winter months.

It is assumed that there is no initial indebtedness. The only liabilities that the operator would have would be the loans that are extended for family living or investment in livestock, equipment, and buildings. The ratios presented show the various conditions of the farm business. The net ratio is obtained by dividing the total assets by the total liabilities. The working ratio is obtained by dividing the sum of the working and current assets by the sum of the intermediate liabilities, such as promissory notes, plus current liabilities. The current ratio is obtained by dividing the current assets by the current liabilities.

Table XVIII. -- Investment and Net Worth of the Farm Business During the Three-Year Periods. Original Organization.

Asset		1950-'52 Type Price Movement				1930-'32 Type Price Movement				1940-'42 Type Price Movement			
	Unit	Apr.1	Apr.1	Apr.1	Oct.1	Apr.1	Apr.1	Apr.1	Oct.1	Apr.1	Apr.1	Apr.1	Oct.1
Fixed Assets	\$	20997	20889	20781	20727	20997	20889	20781	20727	20997	20889	20781	20727
Working Assets	\$	12299	11390	10481	10026	12299	11390	10481	10026	12299	11390	10481	10026
Current Assets	\$	3218	5931	8150	8140	2514	1916	921	856	4124	10417	18163	23360
Total Assets & Net Worth	\$	36514	38210	39412	38893	35810	34195	32183	31609	37420	42696	49425	54113

Table XIX. -- Investment, Indebtedness and Net Worth of the Farm Business During the Three-Year Periods. Alternative No. I.

		1950-'52 Type Price Movement				1930-'32 Type Price Movement				1940-'42 Type Price Movement			
	Unit	Apr.1	Apr.1	Apr.1	Oct.1	Apr.1	Apr.1	Apr.1	Oct.1	Apr.1	Apr.1	Apr.1	Oct.1
Fixed Assets	\$	22517	22363	22209	22055	22517	22363	22209	22055	22517	22363	22209	22055
Working Assets	\$	15932	15066	14200	13569	15932	15066	14200	13569	15932	16066	14200	13569
Current Assets	\$	3124	3750	5125	6352	2541	1783	1320	1148	3356	4721	13651	18951
Total Assets	\$	41573	41179	41534	41976	41990	39212	37729	36772	41805	42150	50061	54575
Total Debts	\$	4291	2667	0	0	4291	4306	6581	8621	4191	645	0	0
Net Worth	\$	37282	38512	41534	41976	36699	34906	31148	28151	37514	41505	50061	54575
Net Ratio		9.7	15.4	-	-	9.5	9.1	5.7	4.3	9.7	65.3	-	-
Working Ratio		4.4	7.1	-	-	4.3	3.9	2.4	1.7	4.5	3.06	-	-
Current Ratio		.7	1.4	-	-	.59	.4	.2	.13	.7	7.3	-	-

Table XX. -- Investment, Indebtedness and Net Worth of the Farm Business During the Three-Year Periods. Alternative No. III.

		1950-'52 Type Price Movement				1930-'32 Type Price Movement				1940-'42 Type Price Movement			
	Unit	Apr.1	Apr.1	Apr.1	Oct.1	Apr.1	Apr.1	Apr.1	Oct.1	Apr.1	Apr.1	Apr.1	Oct.1
Fixed Assets	\$	23097	22925	22753	22567	23097	22925	22753	22567	23097	22925	22753	22567
Working Assets	\$	15633	14811	13989	13578	15633	14811	13989	13578	15633	14811	13989	13578
Current Assets	\$	2925	3510	5472	7150	2426	1702	1260	1068	3202	7143	20081	26392
Total Assets	\$	41655	41246	41214	43295	41156	39438	38002	37213	41932	44879	56823	62537
Total Debts	\$	5973	3216	0	0	5973	4203	6174	7748	5973	1651	0	0
Net Worth	\$	35682	38030	41214	43295	35183	35225	31828	29465	35959	43218	56823	62537
Net Ratio		6.9	12.8	-	-	6.9	9.4	6.2	4.8	7.02	27.2	-	-
Working Ratio		3.1	5.7	-	-	3.02	3.9	2.5	1.8	3.2	13.3	-	-
Current Ratio		.5	1.09	-	-	.4	.4	.2	.14	.5	4.3	-	-

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Summary of Tables

The average income for savings or debt payment in each period for each alternative as taken from Tables IX through XI is summarized in Table XXI.

Table XXI. Effects of Three Different Selected Price Movements Upon the Average Income.

Period	Average Annual Income for Savings or Debt Payments (a)		
	Original	Alternative No. I	Alternative No. III
1950-'52	\$2340	\$2645	\$3575
1930-'32	144	-1202	-333
1940-'42	5411	7311	9525

(a) Average annual income after deducting estimated living costs.

During the 1950-'52 period, the average annual income would have been only 1.13 times as great in alternative No. I as in the "original" organization. Alternative No. III would have had an average income 1.53 times as great as the "original". During the 1930-'32 type period, the average annual income would have averaged nine times greater in the "original" organization as in alternative No. I, and three times as great as alternative No. III. During the 1940-'42 type period, alternatives I and III would have averaged incomes 1.3 and 1.7 times, respectively, as great as the "original" plan.

Table XXII illustrates the annual accumulations of income that are available for savings or debt payment. The accumulations would have been

greater under alternatives I and III during the 1950-'52 and 1940-'42 type periods than in the original. During the 1930-'32 type period the accumulations would have been a deficit in alternatives I and III.

Table XXII. Accumulations of Annual Income Available for Savings or Debt Payment During the Three Selected Periods Under the Three Farm Organizations. (a)

Period	Original	Alternative No. I	Alternative No. III
1950	\$ 2,084	\$ 1,857	\$ 3,074
1951	4,581	5,433	7,312
1952	7,040	7,946	10,724
1930	\$ 1,557	\$ 925	\$ 2,411
1931	1,242	-461	1,795
1932	433	-3,606	-999
1940	\$ 2,887	\$ 3,849	\$ 4,616
1941	8,914	11,251	14,563
1942	16,234	25,265	28,577

(a) After deducting estimated family living costs from net cash income. Annual living costs estimated at \$1800.

Table XXIII illustrates the accumulations of annual income after payments have been made on the principal and interest of the debt for the years 1950-'52 and 1940-'42. The 1930-'32 period illustrates the indebtedness of the operator that would result if loans are given to meet operating expenses and to maintain family living at the estimated level. In this type of period, a terrific strain is placed on the solvency of the firm. During such periods, the family could reduce its family living below the estimated level in order to maintain control of resources.

Table XXIII. Accumulations of Annual Income Available After Payments on Debt During the Three Selected Periods Under the Three Farm Organizations.

Period	Original	Alternative No. I	Alternative No. III
1950	\$ 2,084	\$ 0	\$ 0
1951	4,581	800	890
1952	7,040	3,314	4,302
1930	\$ 1,557	\$-3,597	\$-4,947
1931	1,242	-5,128	-4,642
1932	433	-8,621	-7,748
1940	\$ 2,887	\$ 0	\$ 0
1941	8,914	3,365	8,245
1942	16,234	14,047	22,259

Interpretation of the Balance Sheets

General conclusions can be drawn from these balance sheets based on the percentage change in net worth. The per cent changes in net worth imply that by adopting a dairy-hog enterprise, such as alternatives I and III, in the farm organization with the use of borrowed funds, the net worth would decrease more than the original organization in a downward price movement, such as the 1930-'32 period. The net worth changes would be approximately two times as great with alternative No. I, and approximately three times as great with alternative No. III, with a movement similar to the 1950-'52 period. With a price movement such as 1940-'42, the change in net worth of alternative No. I over the original organization would be slight. But alternative No. III would have been about a 1.5 times as great a change in net worth as either the original or alternative No. I.

The original organization had no indebtedness, and hence should not present a problem of determining the solvency of the firm. The per cent changes in net worth and changes in working ratios are given in Table XXIV.

Interpretation of Alternative No. I

The effect of the different types of price movements upon the capital position shall be noted for alternative No. I. The type of indebtedness will be a short-term loan based on the working and current assets. Assume that the lending firm evaluates the working and current assets at only half of the estimated value given in Table XIX, and will lend to this amount. The farmer's working ratio, as determined by the values given in Table XX would have to be at least 2 to 1 to retain access to short-term credit. The working ratios for the two periods 1950-'52 and 1940-'42 would always be greater than 2 to 1; hence, the farm firm would not face a critical financial problem. On the other hand, with a downward price movement such as the 1930-'32 type, the working ratio of the farmer would fall below 2 to 1. If the income is not large enough to cover operating costs plus the estimated level of family living, the farmer would place a strain on the line of credit for the firm during this period. The farm household may lower its level of living and not set aside any reserves for depreciation of assets for maintaining entity of the firm. Generally speaking, the hardships that the farm household would bear in order to continue this type of operation would be dependent upon the expectations for the future.

Interpretation of Alternative No. III

The effect of different types of price movements on this alternative organization is similar to alternative No. I. If the 2 to 1 working ratio

Table XXIV. -- Percent Change in Net Worth and Changes in Working Ratios of the Three Farm Organizations During the Three Selected Periods.

Period	Organization	Percent Change in Net Worth	Changes in Working Ratio			
			Apr. 1, Year 1	Apr. 1, Year 2	Apr. 1, Year 3	Oct. 1, Year 3
1950-'52 type price movement	Original	6.5	-	-	-	-
	Alternative No. I	12.6	4.4	7.1	-	-
	Alternative No. III	21.3	3.1	5.7	-	-
1930-'32 type price movement	Original	-11.7	-	-	-	-
	Alternative No. I	-23.3	4.3	3.9	2.4	1.7
	Alternative No. III	-16.3	3.02	3.9	2.5	1.8
1940-'42 type price movement	Original	44.6	-	-	-	-
	Alternative No. I	45.8	4.5	3.06	-	-
	Alternative No. III	74.3	3.2	13.3	-	-

is to be maintained, farmers could adopt a dairy-hog enterprise with the use of credit provided the price movement were not similar to the 1930-'32 period. The firm's working and current assets could be as low as \$12,000 provided the prices were to move in a manner similar to the 1950-'52 or 1940-'42 period.

The assumption that the lending firm would lend to the full amount of its appraised value has been selected arbitrarily. If the lending firm were to limit the amount of funds, the working ratio of the farmer would change. If it were necessary to operate with at least a 3 to 1 working ratio, the assets of the borrower would have to be greater in order to borrow the necessary funds. A 3 to 1 working ratio would make the borrower more vulnerable to financial strain with a price movement similar to 1930-'32.

PART III. CONCLUSIONS

The conclusions from this study can be drawn from the tables given in Part II. These conclusions are related to effect upon income if prices moved in a manner similar to the three selected periods. The income figures given are the incomes available after deducting estimated family living costs of \$1800 annually from net cash farm income. With a 1950-'52 type price movement, the average annual income (from Table XXI) in alternative No. I would have been \$305 greater than the original plan. Alternative No. III would have produced an average income \$1235 greater than the original plan.

With a downward price movement, such as the 1930-'32 period, the original plan would have produced an annual income of \$144, while the average income would have been a deficit in alternatives I and III. Alternative No. I would have an annual income of -\$1202, while alternative No. III would have an annual income of -\$333. With a deficit average income, it would not be possible to repay any debts that may have been incurred. The solvency position of the firm might be endangered with a large outstanding debt, such as it is assumed the farmer would have in this analysis.

With a movement of prices similar to the 1940-'42 period, the average incomes would have been higher in the two alternatives than in the original. Alternative No. I produced an average income of \$1900 more than the original, while the average income of alternative No. III was \$4114 greater. Alternative No. III also had a greater average income: \$2214 more than alternative No. I.

The annual accumulations of income or the debt position of the operator given in Table XXIII indicates that with price movements similar to the 1950-'52 and 1940-'42 periods, the operator would have been able to pay off the debt incurred. With a rising price level, such as the 1940-'42 period, the accumulation of incomes after repaying the debt would have been only \$2187 less in alternative No. I than in the original, which had no debt to repay. Alternative No. III had an accumulation of income that was \$6025 greater than the original plan, even after repayment of the debt.

But with a downward movement of prices, such as the 1930-'32 period, there would have been no accumulations of income in alternatives I and III. In fact, loans for operating costs and maintenance of family living would have increased the size of debt until the entity of the firm would be in a critical position.

The working ratio (Table XXV) in alternative No. I would steadily decrease from 4.3 on April 1 of the first year, to 1.7 on October 1 of the third year. The 1.7 working ratio indicates a very weak intermediate capital position. In alternative No. III, the working ratio would change from a relatively strong position of 3.02 on April 1 of the first year, to a weak position of 1.8 on October 1 of the third year. The working ratios on April 1 of the third year indicate that the working ratios of these two alternatives are above the 2 to 1 minimum. The income in the third year was a negative amount. Due to the increase in indebtedness, the working ratio declined below the 2 to 1 minimum. If a 2 to 1 working ratio is necessary to maintain entity of the firm, these two alternatives would lead the firm into insolvency with a 1930-'32 type price movement. The

working ratios with the other two periods would have increased from the first year, indicating an improvement in the capital position of the firm. The changes in working ratios that occurred are also reflected in the changes in net worth.

The changes that are reflected in the net worth position have a relationship similar to that of the accumulations in income and changes in working ratio. The changes in net worth (from Table XXIV) show that the original organization would not have as great a positive a change in net worth as alternatives I and III with a type of price movement similar to 1950-'52 or 1940-'42. But with a downward price movement, such as the 1930-'32 period, the two alternative organizations would have a greater negative change in net worth than the original farm organization. The greater negative change in net worth in these two alternatives can be attributed to the negative incomes received plus the increases in debt needed to maintain family living and operating costs.

The general conclusions from these tables would seem to indicate that the adoption of a dairy-hog enterprise with borrowed capital would be economically feasible with an upward price movement, such as the 1940-'42 period, or a generally stable movement that occurred in the 1950-'52 period. But with a downward price movement, the borrowing of funds to establish a dairy-hog enterprise may jeopardize the entity of the firm.

General Implications of the Study

The direction in which prices for livestock and livestock products will move rests with future supply made available and the demand that

will be exerted by changes in population growth and with the general level domestic production and income. The effect that domestic production and income will have is uncertain. But it appears that the eleven Western States are likely to be a relatively dwindling source of supply of livestock for the rest of the country, even with a maximum rate of irrigation development. 1/ The assumption will be more valid if western population increases relative to national population as it has in the past, and if there is no material decrease in consumption of meat per capita.

For Individual Farmers

Farmers contemplating a grassland type of farming should be conscious of the possible effects that the movement of prices may have upon his financial position. If capital is borrowed for investment in livestock and buildings, and the prices received for products should go down, then the income may not be large enough to meet operating costs, family living, and repayment of the borrowed funds. The firm may become insolvent before conditions improve. If it is expected that prices for dairy-hog products will improve or be generally stable, then it would seem that the adoption of these enterprises would be highly profitable in relation to the cash crop organization.

Although the type of analysis presented above may not be very valuable to a farmer under the peculiar conditions he faces, it does illustrate one method of approaching the problem. The farmer's own subjective

1/ See H. E. Selby and D. T. Griffith, Livestock Production in Relation to Land Use & Irrigation in the Eleven Western States, U.S. Department of Agriculture, Bureau of Agricultural Economics, Division of Land Economics, Berkeley, 1946, p. 15, Figure 10.

probability with respect to future events may be substituted for those presented here.

For Credit Agencies

Agricultural credit agencies could be of service in helping those farmers who appear to be in a reasonable sound financial condition to adopt a program for the establishment of a grassland type of organization. The extension of credit would have to be conditioned by the expectations with respect to costs and returns. A sound appraisal system must be established that recognizes the true value of assets. Repayments must be geared to the income pattern of a particular farm. This may mean that the outstanding loan balance will be allowed to rise during periods when costs exceed returns. This may be dependent upon the size of the outstanding balance and the security of the borrower. Commercial banks are restricted by monetary and fiscal policies that make it impossible for them to grant credit for an extended period of time. Production Credit Associations may be in a better position to assist farmers.

Limitations of the Study

The Budget Method

However useful the budget type of analysis may be in determining the type of organization that returns the greatest net farm income, it has certain weaknesses which should be recognized. Budgets are somewhat unreliable when applied to future results due to the uncertainty of prices and yields, although yields on irrigated farms may be more certain than for dry land areas. Allowance may be made by taking variability into

account when the budget is set up.

Variation may be taken into account either by the coefficient of variation about the mean or by the coefficient of variation about trends. The use of the coefficient of variation about the mean is limited because it is usually based on a long time average in which the parameters of the distribution may have an extremely wide range related consistently to "time". The coefficient of variation about the mean would then be quite large, and would not take into consideration the trends that may have occurred over time. The coefficient of variation about a trend would be more accurate to apply in budget analysis if the trend continues over future time. Both measures may give a comparison of variability, but they tell nothing of the sequence of events.

The analysis presented here applies only to the "typical" farms, and therefore does not necessarily coincide with any one farm. This makes the accuracy and adequacy of the analysis directly dependent upon the averages presented here. The construction of a budget also requires considerable time in assembling and compiling data. This might not be so difficult a task for an experienced farmer who may have more complete knowledge on the production relationships specific to his farm than that given by county averages.

The use of only a three year trend in the movement of prices is limited in determining what the financial requirements may be and the effect upon net worth after the adoption of a livestock operation. A three year period would be indicative as to what an entrepreneur could expect his financial position will be, but for a more complete study, it would be de-

sirable to follow a reorganization for a much longer period of time. A further research effort to determine the effect of income variation upon net worth and equity position over a 10 or 15-year period would give a better picture of the financial feasibility of adopting dairy-hog enterprises into the farm unit. A study of this type would involve readjusting the inventory of assets for each year as price changes occurred. If this type of study were carried out, the effect of indebtedness and changes in value of assets upon the equity position of the operator would give a more realistic approach than leaving assets at a constant value.

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APPENDIX

APPENDIX A

The Theory of the Firm

The theory of the firm is an analytical tool of economic theory that sets forth the necessary conditions for the most efficient use of resources or the maximization of profits from a given quantity of resources, state of technology, and prices for products and factors. As a tool to solve economic problems, the use of the concepts and principles of the theory of the firm to a business enterprise as a guide for the efficient combination of resources is invaluable.

The field of farm management parallels the theory of the firm to the extent that both are concerned with efficiency of resource use. To work within the framework as set up by the theory of the firm, the basic assumption is made that the entrepreneur strives for maximization of profits from available resources. As apparent in the problem situation of this study, the condition of survival of the firm may be inconsistent with maximizing profits in the "short-run", but it should be consistent with maximization of profits in the "long-run".

To obtain an optimum allocation of resources under perfect competition, two basic conditions must be met: (1) the proportional combination of inputs must be the cheapest combination of these inputs that yield a given quantity of product, and (2) the marginal cost of production must be equaled to marginal revenue; marginal revenue is equal to the price of the product.

Decisions relative to resource combination within enterprises and resource allocation among enterprises require knowledge about the technical

relationship between inputs and outputs or the production function. The production function is a qualitative relationship as well as a quantitative relationship. Certain kinds of inputs must be combined to obtain a certain kind of product. This is a qualitative relationship. A product can be produced in a multitude of ways, depending on the particular combination of resources and techniques employed. A quantitative relationship implies quantities of inputs varied to obtain varying quantities of product.

Under the simplest case of combining one variable input with a group of fixed inputs, and producing only one product, the equilibrium 1/ position of a firm is reached when the value of the marginal product is equal to the price of the factor. Value of the marginal physical product is obtained by multiplying the marginal physical product by the price of the product. When the value of the marginal physical product is equal to the price of the factor, then, given only one variable factor, marginal cost is equal to marginal revenue. Hence the maximum net returns are obtained when the added revenue is equal to the added cost.

Another condition necessary for a stable equilibrium position is that marginal physical product must be decreasing or that marginal cost must be increasing per unit of (added) output. This condition is consistent with the law of diminishing returns which is a basic empirical generalization derived from any production process. The law of diminishing returns states

1/ Equilibrium position of a productive service is defined in the alternative cost theory. If a productive service is used simultaneously in two or more industries, the values of the marginal products of a unit of service in each field must be equal.

7E.

that as equal increments of a variable input are combined with a fixed quantity of other inputs, the marginal physical product of the variable input must eventually decline. 1/ A third condition which must be met for the equilibrium position of the firm is that average product must be diminishing and that average cost must be a minimum or increasing. 2/

This sets forth the necessary conditions for the equilibrium position with only one variable input in the production of one product. But if the theory is related to a farm organization which uses more than one variable input and may produce more than one product, certain conditions are necessary to arrive at a minimum cost for any level of output and maximization of profits.

Given the price of factors and products under a given state of technology, the minimum cost resource combination can be determined for any level of output. The production process involving two variables can be looked upon graphically as a three dimensional figure where the quantities of variables are measured on the X and Y axes, and the quantity obtainable from various combination of inputs are shown as product contours which measure distance on a third (Z) axis. 3/ Where factors of production substitute for each other at an increasing rate in the production of a single

1/ See John A. Hopkins, Elements of Farm Management, Prentice-Hall, Inc., New York, Third Edition, 1949, Chapter 10.

2/ J. R. Hicks, Value and Capital, Oxford: Clarendon Press, 1946, p. 81.

3/ See Kenneth E. Boulding, Economic Analysis, (Revised Edition), Harper and Bros., Publishers, New York, 1948, p. 679, Figure 88.

product the cost is a minimum when the ratio of the factor prices is inversely equal to the marginal rate of substitution of the factors. For the minimization of costs from a given set of resources, the productive services must be combined as to equate the ratios of their marginal physical products inversely with the price ratios of the factors.

For further analysis, where the choice involves the allocation of given resources between competing products, they should be so arranged as to obtain the greatest marginal value product from the variable inputs. The choice criterion in this case is provided by the price ratios of the products. Maximum profits are attained, with costs or resources fixed in quantity, when the marginal rate of product substitution is inversely equal to the product price ratio. Under these conditions the value marginal product of variable inputs from the competing enterprises are equal. If this equality does not hold, then it would be possible to increase net income by producing one more unit of (say) product X, and one less of (say) product Y (or vice versa). In order to be at an absolute optimum, the "net marginal value product", which is the difference between the value of the marginal product of a factor and the cost of a factor, should be equal to zero for all factors, for here an additional dollar invested in any alternative product would yield a dollar in return.

The analysis represents the short-run situation in which only the variable costs must be met. In the long-run all costs are variable.

Adaptation of the Theory of the Firm

Agricultural economists have divergent opinions as to (1) the shape and (2) the stability of functional relationships of the theory of the firm

in the case of an agricultural firm. The farm firm is the unit of inquiry here, but if the aggregate output function of the firm is a conceptual miniature of the aggregate output function of the industry, then it is possible to carry on the analysis with the aggregate industry. For instance, it is often stated that aggregate output is unresponsive to price changes, which tends to make the agricultural supply function have an elasticity nearly equal to zero. The authors 1/ of this thesis state in general terms that when aggregate demand is strong, income expectations are favorable, which makes it possible for the firm to invest in a pool of unused, improved technology. This new technological advance creates a new production function with a shift to the right for aggregate supply of the industry. But once the technological advance has spent itself, aggregate output settles down at a new (higher) level which is (or tends to be) a constant with respect to wide variation in farm product prices due partly to the fact that many farmers are operating in the area where innovations make new production practical, irrespective of the level of farm prices. This analysis implies that agriculture is a comparatively "water-tight compartment" with no movement of resources between agriculture and non-agricultural sectors of the economy during the short-run period.

Professor Schultz takes an opposite viewpoint to this hypothesis. He states that agriculture is a highly competitive industry which makes

1/ Willard W. Cochrane and William Butz, "Output Responses of Farm Firms", Journal of Farm Economics, XXXIII (Nov., 1951), p. 445, and Walter W. Wilcox, "Effects of Farm Price Changes on Efficiency in Farming", Journal of Farm Economics, XXXIII, (Feb., 1951), p. 55.

it necessary for farmers to adopt new techniques or find themselves at a disadvantage with those who do so; therefore, new techniques of production are not stored up in "pools" to be used at some later date, but they are being adopted constantly. 1/

The quantity of inputs committed in the aggregate to farm production from one year to the next is quite stable. 2/ This would seem to indicate that in addition to the adoption of new techniques, which increases production, the aggregate of inputs remains fairly constant due to the flexibility of factor prices and the substitution of cheaper inputs for dearer inputs. Viewed historically, agriculture is not the watertight compartment commonly presumed. Farm inputs have become increasingly dependent upon the non-farm sector of the economy. Farm production expenses as a per cent of gross income have risen from 48 per cent in 1910 to 61 per cent in 1950. 3/

Both of these conflicting hypotheses may have some validity. The nature of physical production functions at a particular time is not a function of price at this moment, but was determined by an earlier attempt to predict future prices. For this reason, the costs that were variable in the initial planning stage, up to the present, have become fixed costs and have no bearing upon future variable costs.

1/ T. W. Schultz, Economic Organization of Agriculture, McGraw-Hill Book Co., New York, 1953, p. 112.

2/ Ibid., p. 104, Table 7-2.

3/ Ibid., p. 104, Table 7-3.

Although the inputs in agriculture are quite stable, farmers do restrict inputs in periods when the farm price situation becomes adverse relative to other prices. During two adverse periods, 1920 to 1924 and 1931 to 1934, nearly all inputs were restricted from the previous year. ^{1/} During adverse price periods farmers tend to substitute family labor for other types of inputs wherever possible. During a depression, the supply curve for agricultural labor is highly inelastic because laborers do not have the opportunity for employment elsewhere. Since the alternative return in some other industry may be zero, the farm laborer will work for only "board and keep" for himself. Expectations are important in explaining why farmers maintain production. Production and income can be substituted for future returns through disinvestment of the farm. Soil depleting crops may be substituted for grasses and legumes, which have a longer production period. Irrational farming practices may be justified by the perilous capital position of many farmers and the desire to maintain survival of the firm to realize the level of future income. Irrational production exists if resources can be arranged in a manner which would allow the same product from fewer resources.

The presence of high fixed costs in agriculture would mean that farms might continue production even if product prices declined. The fixed costs in the cost structure of a firm have no effect upon the marginal cost curve. The classification of land, family labor, and depreciation of buildings and equipment--due to weather and obsolescence rather than

^{1/} Ibid., p. 212-3, Table 13-2, 4.

use as fixed costs, would specify only that production be maintained at some level of selling price above average variable cost. The fixity of land and labor factors may not necessarily represent fixed costs to any individual farmer, but when these resources fall in proportion to product price, the opportunity return may be as great by maintaining production.

Another factor contributing to the maintenance of production is the interrelationship between firm and household. Many farm families suffer severe hardships during major price recessions to maintain control of resources. To avoid destruction of the home, the blow to prestige, and many other psychological losses, farm families lowered their standard of living to extreme levels to avoid the consequences mentioned above.

Production is maintained also because many of the factors used in production are as flexible price-wise as are product prices. An important portion of agricultural output is not only a primary product but also becomes a resource used in agriculture. When feed crops decline for the selling farmer, they also drop for the farmer who employs them as a resource in livestock production. Inter-year adjustments are made between competing enterprises to reflect factor-product price ratios.

These are some of the more important factors contributing to constant agricultural production. Complementary and supplementary enterprises on family farms also contribute to maintenance of production at any level of prices. Yet these enterprises cannot be said to reflect irrationality.

The foregoing discussion has endeavored to explain how the equilibrium position of the firm is constantly changing due to factors mentioned above. The functions of the variables are changing constantly and may

take uncommon shapes. This doesn't invalidate theory of the firm. It merely posits that fixed costs dominate in agriculture and variable costs are of such small significance that changes in prices and costs are of little effect. This may be empirically true and not invalidate theory of the firm, for the latter contains within it principles of management where "all" costs are fixed. These factors suggest the need for adaptation for greater relevance.

Risk and Uncertainty in Agricultural Production

The production of farm products requires time. The farmer must commit resources at time (t_1) for a product forthcoming at a future date (t_2). He must then try to estimate future prices for (1) products, and (2) resources not yet fixed in his operations.

Plans must be made where uncertainty is present. Farmers are unable to equate marginal value products with marginal cost of resources because of: (1) lack of knowledge of relevant input-output relationships; (2) uncertainty of future prices for products and productive services; and (3) capital limitations. ^{1/} The last reason comes from the first two.

Risk describes an expectation subject to a probability distribution, the parameters of which are statistically measurable. Hence it is insurable, externally or internally and thus a part of the firm's cost structure.

Uncertainty includes that range of events in which the entrepreneur does not have single-valued expectations, and where the parameters of the

^{1/} Earl O. Heady, Economics of Agricultural Production and Resource Use, Prentice-Hall, Inc., New York, 1952, p. 115.

probability distribution cannot be predicted empirically. The probability of an event becomes merely the "subjective" prediction on the part of the farmer. 1/ Farmers visualize future possible prices and yields in an ordinal rather than in a cardinal sense. They may visualize a most probable expected event, but the degree of uncertainty may not be the same for any two individuals even if the probable prices are equal. One individual may attach some form of greater subjective probability to a price or yield than another individual.

The types of uncertainty facing farm production planning are price uncertainty, yield uncertainty, and technological uncertainty. Heady outlines several subjective probability distributions that an entrepreneur may have concerning yield and price. 2/ Differences in uncertainty or loss prospects can be pictured in a set of probability distributions such as those indicated in Figure 1; the expected price (or yield) is plotted along the horizontal axis while the "subjective probability" (the expected values of prices or yields in the future) is plotted along the vertical axis.

Figure 1A represents a normal distribution of expected yield or price and the various probabilities that a farmer attaches to values being more or less than the mean. Figure 1B represents a skewed distribution in which the farmer anticipates that prices will be higher than the mode (x_2). In 1C the greater probability is in the direction of lower prices (yields).

1/ Ibid., p. 443.

2/ Ibid., p. 450.

The "U-shaped" distribution of 1D suggests that there is an equal possibility of either low (x_1) or high (x_3) prices (yields). The 1E figure has similar connotations to 1B, while 1F is similar to 1C. The changes of prices (yields) being higher or lower are the same in 1G and 1H, greater probability is attached to prices (yields) being near the modal value (x_2) for 1G.

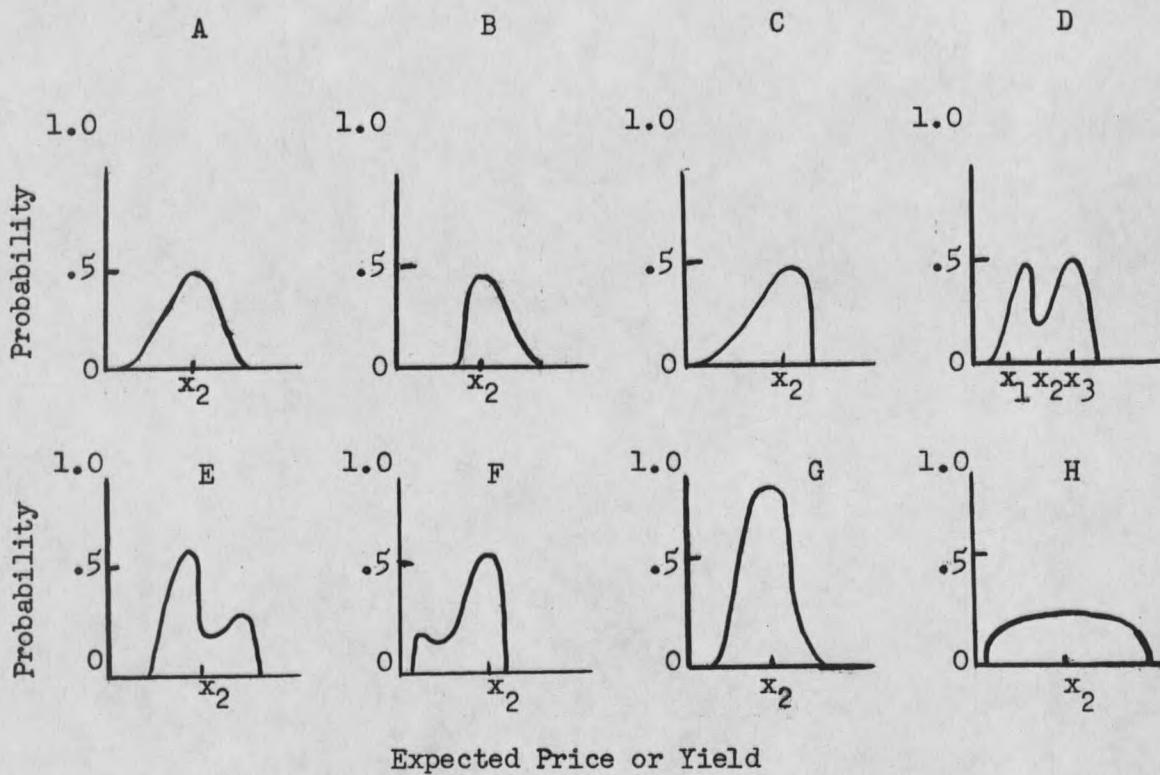


Figure 1. Relation of subjective probability (frequency) distributions and uncertainty.

The discussion above has been in terms of uncertainty of price or yield expectations. Similar properties of the probability distribution may characterize the income of the enterprise. The amount of capital and the income involved are also important in determining a person's selection of chance outcomes over more certain returns. Figure 2 suggests hypotheses of the manner in which people with different incomes might react to a given setting of uncertainty. This may be expressed in terms of indifference curves.

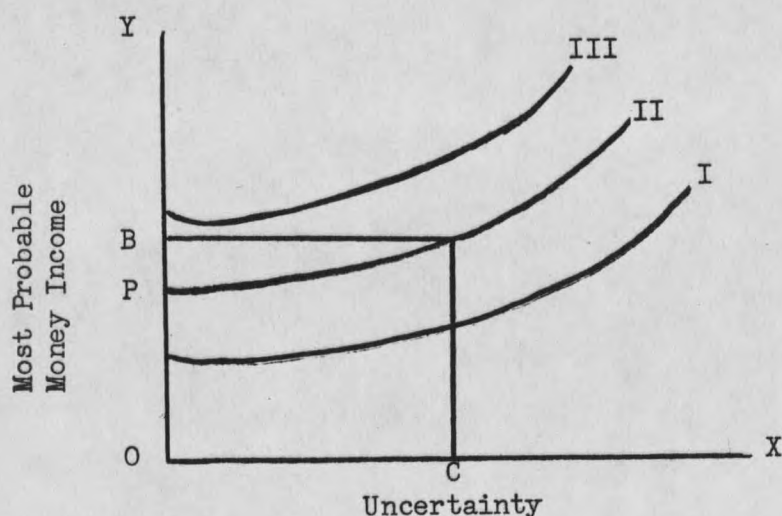


Figure 2. Relation of income to uncertainty.

The most probable income is measured on the OY axis and the range (uncertainty) of income is measured on the OX axis. The indifference curves relate the level of utility to expected income and the uncertainty of income. In this figure, where the range of incomes is OC, the most probable price is OB. This puts the individual on indifference curve II.

OP is what Lange calls the "effective income". ^{1/} The difference between OP and OB (PB) is the uncertainty premium which the individual attaches to this range of income.

Management must formulate some kind of plan in this type of an environment. Inasmuch as the future forecasts are the subjective valuation of the farmer, the "economic horizon" of the farmer is limited by his equity ratios and his risk-bearing attributes. Economic horizon is the time period over which individuals plan some form of economic activity. Time plans vary with the type of enterprise selected. In this particular study the time span of a livestock enterprise would be longer than that of a crop enterprise on the same farm. Investments made in livestock, pastures and buildings depend upon the future returns that can be expected from these resources. The impact of uncertainty upon the use of resources will be discussed in the following section.

Capital Use

Credit, both used and unused, is a means whereby the entrepreneur may obtain a greater quantity of resources to combine with the management factor. Unused credit may be classified as a form of liquidity to take advantage of (protect against) favorable (unfavorable) opportunities that may arise in the future. The result of used credit is conditional ownership on the part of the purchaser, subject to the debt contract held by the lender.

^{1/} Oscar Lange, Price Flexibility and Employment, The Principia Press, Inc., Bloomington, Indiana, 1944, p. 31.

Agricultural credit is usually classified into (1) short term credit, or (2) long term credit. The effective length of loan is often obscured where loans are renewed. The renewal of loans has given rise to a third class of credit known as "intermediate" credit. This type has developed for the purposes of providing for payment in two or three seasons if warranted by the income and security of the borrower. 1/ Short term loans are usually made for production of crops or livestock secured by a chattel mortgage upon crops, livestock, machinery, and other relatively short-lived assets. Long term credit is based on real estate, and is usually secured by a farm mortgage. These loans may run from three to thirty or forty years.

The extension of business credit 2/ by lenders is dependent upon certain attributes of the borrower as well as the economic position of the lenders. The position of lenders is determined by the general economic environment, which may determine their liquidity preference, existing monetary and fiscal policies, together with banking attitudes and policies. Given the economic environment of the lenders, general considerations of the position of the borrower must be taken into account. Baker 3/ lists these as: (1) the applicants net worth position; (2) social characteristics

1/ William G. Murray, Agricultural Finance, (Ames: Iowa State College Press, 1949), pp. 14-18, for classification of credit.

2/ A distinction between business credit and welfare credit is given by C. B. Baker, op. cit., Chap. I and II.

3/ Ibid., p. 203.

of the applicant and his family; and (3) liquidity of the asset structure of the firm, which determines (a) repayment plans that are possible, and (b) length of loan necessary. A weakness in any one of these factors may prove fatal to a prospective loan, irrespective of the strength of the other factors.

Assume for the present that the first two factors are given and in a favorable position. The third factor is dependent upon several factors. A typical lender is concerned with various measures derivable from a balance sheet, beginning with the net worth. A change in net worth is determined by subtracting all expenses (including living) from the gross farm income, plus or minus changes in inventory. Changes in net worth reflect earning (and "saving") capacity, but repayment capacity is dependent upon the net cash farm income. This is the difference between the cash income and all cash expenses. Cash expenses in this definition is meant to include only those resources that are hired or bought, excluding any payment for family labor or operators management. But to determine repayment capacity the net cash farm income must be refined still further by deducting family living expenses. This is a difficult figure to arrive at, for family living expenses vary with different farm families, the level of income, and other factors. Whatever level is maintained is peculiar to each individual family, but some standard should be established to maintain the health and morale of the farm household.

Repayment capacity can be expressed as a function of these factors:

- (1) quantity of product produced, (2) prices received for these products,
- (3) quantity of resources used in the production process, (4) prices paid

for resources, excluding a return to family labor and operators labor and management, (5) the level of living, and (6) prices paid for "inputs" employed in "producing" that level of living. In functional terms, repayment capacity would be determined by subtracting the sum of products, (3)(4) and (5)(6) from the product, (1)(2). 1/

No functional relationship will be developed here for these factors, but it can be reasonably assumed that living costs fluctuate in the same direction but more moderately than do fluctuations in net farm income. 2/

Capital Use and Uncertainty

Agricultural economists have implicitly assumed that the use of more credit in agriculture would represent an improvement in resource combination and enterprise combination in the farm firm in the sense that scale of operations could be expanded, and capital inputs could be substituted for labor. 3/

Farmers' reasons for not borrowing more capital are limited by uncertainty considerations. Equity limitations fall into this category because the decline in owners' assets in relation to liabilities causes additional borrowing to increase the financial vulnerability of the firm at an increasing rate. This principle has been termed by Kalecki, "the principle

1/ Ibid., p. 145.

2/ Ibid., Chap. V, for functional relationships.

3/ See Darrell F. Fienup, Resource Productivity on Montana Dry-Land Crop Farms, Montana State College Experiment Station, Mimeo Circular 66, June, 1952, pp. 47-49.

of increasing risk". ^{1/} This principle suggests that as a firm increases its use of borrowed capital, the chance of loss of its own capital increases. A hypothetical arithmetic example may be developed to illustrate the principle. Suppose that the total investment in a firm is \$10,000. In the first case considered, the owner has invested \$8,000 and borrowed the remaining \$2,000. If the outcome is a loss of 10 per cent to the firm (\$1,000), the owner suffers a loss of $12\frac{1}{2}$ per cent $\frac{(\$1,000)}{(\$8,000)}$. In the second case, the owner has invested \$5,000 of his own funds and borrowed the remaining \$5,000. A loss of 10 per cent to the firm would result in a 20 per cent loss to the owner $\frac{(\$1,000)}{(\$5,000)}$. In the third alternative considered, the owner has invested \$1,000 and borrowed the remaining \$9,000. A loss of 10 per cent to the firm would result in a 100 per cent loss to the owner $\frac{(\$1,000)}{(\$1,000)}$.

An optimum in borrowing to expand the size of firm is found where the expected (marginal) profit is just equal to the expected (marginal) "loss" from added risk. In Kalecki's analysis, this point is reached when the marginal value product of capital equals the interest rate (a constant) plus marginal risk (an increasing function of size of investment). This principle is illustrated in Figure 3.

The private capital of beginning farmers or those already in business differs greatly, but the equity-risk principle applies to all farmers. A beginner with \$4,000 capital cannot expand to the capital base of the beginner with \$12,000, due to the increasing risk principle.

^{1/} M. Kalecki, op. cit., pp. 95-106.

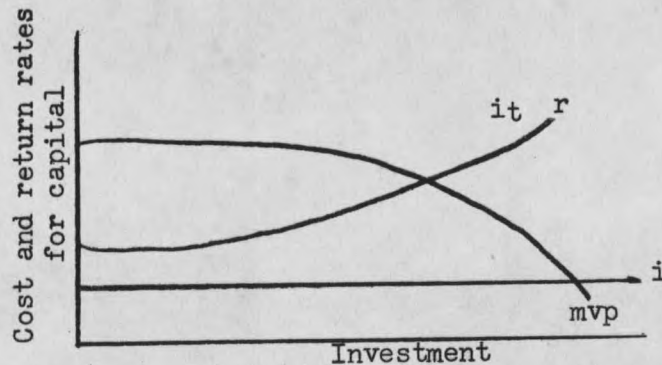


Figure 3. Equilibrium in size of firm.

i = interest rate (constant)

r = rate of risk

While the principle of increasing risk explains limits in the use of agricultural capital at one point in time, swings in the business cycle also affect the value of resources upon which the equity is dependent. A fall in value of assets has the same effect, in terms of the equity principle, as an increase in the amount of funds borrowed at a given price level.

Risk Aversion

The "principle of increasing risk" is reflected in two phenomena associated with uncertainty. One, risk aversion, is the situation in which limitations are imposed internally (within the firm) to resource use which requires a reduction in the per cent of equity. Farmers may refuse to borrow funds in the quantities to equate marginal cost to marginal returns because of the uncertainty surrounding the results of future yields and prices. Another category can be classified as factor limitations

such as inability to rent land, lack of limited labor, and restriction of operator's age or health as a limitation in the management factor. 1/

Capital Rationing

The other phenomenon, capital rationing, is the situation in which limitations are imposed externally because of the uncertainty of future income of the borrower, which may cause the equity position of the borrowing firm to be in an unfavorable position in relation to the amount of funds borrowed. For these reasons, loans in agriculture are extended on an institutional basis revolving around value of security rather than around capital productivity. Rules of thumb which are used state that the farmer must have assets that provide an equity of 40-50 per cent of his total capital, dependent upon the type of security given. The assets are usually valued by some "normal" concept, rather than the current value.

1/ Earl Heady and E. R. Swanson, "Resource Productivity in Iowa Farming", Agricultural Experiment Station Research Bulletin 388, Iowa State College, Ames, Iowa, June 1952, pp. 770-1.

APPENDIX B

Gross Receipts of Alternative No. I.

It was necessary to follow through the budget procedure in this alternative in order to determine the exact amount that each enterprise contributed to the gross farm income. It was assumed that the crop income in this alternative was from a wheat enterprise. Application of the same input-output relationship given in the original livestock budget to the livestock budget in this alternative gave a gross income that was \$1498 less than the amount given in the previous study. To correct this difference, adjustments were made by taking the percentage that each enterprise contributed towards the gross income from livestock times the \$1498. The gross receipts from each product are as follows:

Wheat - - - - -	\$215	
Butterfat - - - - -	\$4598	
40% of \$1498 - - - - -	<u>599</u>	\$5197
Beef from Cows - - - - -	\$900	
7.84% of \$1498 - - - - -	<u>117</u>	\$1017
Yearlings - - - - -	\$3708	
32.3% of \$1498 - - - - -	<u>484</u>	\$4192
Sows - - - - -	\$486	
4.23% of \$1498 - - - - -	<u>64</u>	\$550
Pigs - - - - -	\$1791	
15.6% of \$1498 - - - - -	<u>234</u>	\$2025

APPENDIX C

Gross Receipts of Alternative No. III

It was also necessary to determine the amount that each enterprise contributed to the gross farm income in this alternative. It was assumed that the crop income was from a sugar beet enterprise. Application of the same input-output relationship given in the original livestock budget to the livestock budget in this alternative gave a gross income that was \$601 less than the amount given in the previous study. To correct this difference, adjustments were made by taking the percentage that each enterprise contributed towards the gross income from livestock times the \$601. The gross receipts from each product are as follows:

Sugar Beets - - - - -	\$2974	
Butterfat - - - - -	\$4282	
27.14% of \$601 - - - - -	<u>163</u>	\$4445
Beef from Cows - - - - -	\$840	
5.77% of \$601 - - - - -	<u>35</u>	\$875
Yearlings - - - - -	\$3449	
21.4% of \$601 - - - - -	<u>129</u>	\$3578
Sows - - - - -	\$972	
10.64% of \$601 - - - - -	<u>44</u>	\$1016
Pigs - - - - -	\$3678	
34.9% of \$601 - - - - -	<u>210</u>	\$3888

APPENDIX D

Indexes Used to Adjust Costs

Cost Item	Index Item	
	1930-'32 & 1940-'42 Periods (a)	1950-'52 Period (b)
Seed	Seed	Seed
Fertilizer	Fertilizer	Farm Chemicals
Contract Labor	Wage Rates	Wages
Fuel, oil, grease & repairs	Motor Supplies	Motor Supplies
Harvesting & Hauling	Motor Vehicles } ave.	Motor Vehicles } ave.
	Farm Machinery }	Farm Machinery }
Veterinary	Farm Supplies	Farm Supplies
Mash	Feed	Feed
Machinery Repairs	Farm Machinery	Farm Machinery
Hired Labor	Wage Rates	Wages
Taxes	Commodities, Interest, Taxes & Wage Rates	Taxes
Insurance	ditto	Taxes
Building Repairs	Building and Fencing Materials	Building Materials
Harvesting	Farm Machinery	Farm Machinery

(a) The Farm Cost Situation, United States Department of Agriculture, Bureau of Agricultural Economics, Washington D. C., March, 1952, p. 2.

(b) Indexes of Prices Paid by Montana Farmers and Ranchers, 1935 to 1951, Montana State College Agricultural Experiment Station, Bozeman, Montana, in cooperation with Bureau of Agricultural Economics, U.S.D.A., Office of The Agricultural Statistician, Helena, Montana, 1952, p. 39.

Appendix Table I.- Budget Summary of Receipts. Original Organization.

Enterprise	1950-'52 type price Movement			1930-'32 type price Movement			1940-'42 type price Movement		
	1	2	3	1	2	3	1	2	3
<u>Crops</u>									
S. Beets	\$6284	\$6521	\$1726	\$5993	\$4921	\$4411	\$6267	\$8356	\$9013
Wheat	745	782	798	581	384	350	872	1036	1304
Hay	88	110	94	74	59	47	67	82	114
<u>Livestock</u>									
Butterfat	\$1238	\$1421	\$1494	\$1065	\$766	\$532	\$1674	\$2046	\$2418
Cows	293	357	336	240	168	126	321	387	471
Yearlings	1093	1328	1251	893	625	469	1194	1440	1752
Sows	146	150	142	154	102	60	135	222	308
Pigs	479	494	467	505	335	198	444	729	1010
<u>Poultry</u>									
Eggs	245	307	286	246	180	161	256	327	412
Meat	174	180	178	170	144	123	184	206	252
<u>Home Consumed</u>	462	534	520	416	294	215	523	667	830
Gross Farm Income	\$11247	\$12184	\$12292	\$10337	\$7978	\$6692	\$11937	\$15498	\$17884

Appendix Table II. Budget Summary of Receipts-Alternative No. I

Enterprise	1950-'52 type price Movement			1930-'32 type price Movement			1940-'42 type price Movement		
	1	2	3	1	2	3	1	2	3
<u>Crops</u>									
Wheat	\$215	\$226	\$230	\$168	\$111	\$101	\$252	\$299	\$376
<u>Livestock</u>									
Butterfat	\$4496	\$5160	\$5423	\$3867	\$2780	\$1933	\$6080	\$7432	\$8783
Cows	992	1210	1139	814	570	427	1088	1312	1597
Yearlings	4105	4987	4698	3354	2348	1761	4485	5408	6581
Sows	495	510	483	523	347	203	459	753	1045
Pigs	1823	1878	1776	1922	1276	753	1691	2774	3847
<u>Poultry</u>									
Eggs	245	308	287	246	180	161	256	327	412
Meat	175	180	178	170	144	123	184	206	252
<u>Home Consumed</u>	462	534	520	416	294	215	523	667	830
Gross Farm Income	\$13008	\$14993	\$14734	\$11480	\$8050	\$5679	\$14020	\$19178	\$23723

Appendix Table III.- Budget Summary of Receipts. Alternative No. III.

Enterprise	1950-'52 type price Movement			1930-'32 type price Movement			1940-'42 type price Movement		
	1	2	3	1	2	3	1	2	3
<u>Crops</u>									
S. Beets	\$3131	\$3249	\$3351	\$2986	\$2452	\$2198	\$3123	\$4164	\$4490
<u>Livestock</u>									
Butterfat	\$3844	\$4411	\$4637	\$3307	\$2378	\$1654	\$5200	\$6356	\$7512
Cows	853	1041	980	700	490	368	936	1129	1374
Yearlings	3504	4256	4010	2862	2004	1503	3828	4615	5617
Sows	932	961	909	964	640	378	848	1392	1930
Pigs	3500	3605	3411	3690	2449	1446	3246	5326	7387
<u>Poultry</u>									
Eggs	\$245	\$308	\$287	\$246	\$180	\$161	\$256	\$327	\$412
Meat	175	180	178	170	144	123	184	206	252
<u>Home Consumed</u>	\$462	\$534	\$520	\$416	\$294	\$215	\$523	\$667	\$830
<u>Gross Farm Income</u>	\$16646	\$18545	\$18283	\$15341	\$11031	\$8046	\$18144	\$24182	\$29804

Appendix Table IV.- Budget Summary of Expenses. Original Organization

	1950-'52 type price Movement			1930-'32 type price Movement			1940-'42 type price Movement		
	1	2	3	1	2	3	1	2	3
Enterprise									
<u>Direct Crop Exp.</u>									
Sugar beets	\$3625	\$3884	\$4084	\$3450	\$3093	\$2725	\$3576	\$3843	\$4499
Wheat	182	190	196	171	155	132	178	177	208
Oats	88	91	94	70	62	53	73	72	85
Barley	91	95	98	85	78	68	89	88	102
Hay	68	68	70	64	54	46	69	68	81
Pasture	98	98	98	95	77	80	95	95	104
Total Direct Exp.	\$4152	\$4426	\$4640	\$3935	\$3519	\$3104	\$4080	\$4343	\$5079
<u>Direct Lstk. Exp.</u>									
Cattle	\$221	\$255	\$265	\$210	\$173	\$165	\$231	\$253	\$294
Hogs	144	163	161	132	95	87	143	160	186
Poultry	188	194	223	170	127	101	201	216	259
Total Direct Exp.	\$553	\$612	\$649	\$512	\$395	\$353	\$575	\$629	\$739
<u>Indirect Expenses</u>									
Mach. Depr. & repairs	\$1330	\$1384	\$1363	\$1287	\$1283	\$1263	\$1283	\$1287	\$1311
Hired Labor	409	496	457	395	311	233	425	496	646
Total Indirect Exp.	\$1739	\$1880	\$1820	\$1682	\$1594	\$1496	\$1708	\$1783	\$1957
<u>Fixed Expenses</u>									
Taxes	\$397	\$434	\$406	\$342	\$291	\$255	\$371	\$393	\$451
Build. depr. & repairs	60	65	61	52	44	39	56	59	68
Insurance	157	165	162	152	145	141	155	159	165
Water Charge	305	305	305	305	305	305	305	305	305
Total Fixed Exp.	\$919	\$969	\$934	\$851	\$785	\$740	\$887	\$916	\$989
Total Expenses	\$7363	\$7887	\$8043	\$6980	\$6293	\$5693	\$7250	\$7671	\$8764

Appendix Table V.- Budget Summary of Expenses. Alternatives I and III.

Organization	1950-'52 type price Movement			1930-'32 type price Movement			1940-'42 type price Movement		
	1	2	3	1	2	3	1	2	3
Alternative No. I									
Crops (direct)	\$506	\$529	\$545	\$471	\$421	\$372	\$488	\$520	\$608
Livestock (direct)	3887	4302	4562	3599	2777	2481	4042	4421	5195
Indirect & Fixed	<u>4958</u>	<u>5137</u>	<u>5314</u>	<u>4725</u>	<u>4438</u>	<u>4171</u>	<u>4841</u>	<u>5035</u>	<u>5438</u>
TOTAL	\$9351	\$9617	\$10421	\$8755	\$7636	\$7024	\$9371	\$9976	\$11241
Alternative No. III									
Crops (direct)	\$2133	\$2286	\$2403	\$2033	\$1818	\$1603	\$2107	\$2243	\$2624
Livestock (direct)	3310	3663	3884	3065	2364	2113	3442	3765	4423
Indirect & Fixed	<u>6329</u>	<u>6558</u>	<u>6784</u>	<u>6032</u>	<u>5665</u>	<u>5324</u>	<u>6179</u>	<u>6427</u>	<u>6943</u>
TOTAL	\$11772	\$12507	\$13071	\$11130	\$9847	\$9040	\$11728	\$12435	\$13990

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