Order Number 1330524

# Risk perceptions and management responses of Arizona dairy producers

Luginsland, Timothy Ray, M.S.

The University of Arizona, 1987

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

# RISK PERCEPTIONS AND MANAGEMENT RESPONSES OF ARIZONA DAIRY PRODUCERS

BY

Timothy Ray Luginsland

---

A Thesis Submitted to the Faculty of the

DEPARTMENT OF AGRICULTURAL ECONOMICS

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 8 7

## STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at the University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgement of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department of Dean of the Graduate College when in his or her judgement the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

Signed: Timothy Ray Loginsland

## APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Paul N. Wilson — May 1, 1987

Dr. Paul N. Wilson — Date

Professor of Agricultural Economics

TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

LIST OF TABLES

## LIST OF ILLUSTRATIONS

## ABSTRACT

Most economic modeling has characterized risk as output price and yield variablity. However, recent research has revealed that other economic, social, and political factors contribute to risk in the decision making process. Arizona dairy producers were interviewed concerning their perceptions and responses to risk. Seventy producers out of a population of 105 responded to the questionnaire. It was found that the six most important sources of risk as perceived by dairymen were input prices, prices of output, weather, diseases, government programs, and concerns associated with hired labor. The top six management responses to risk were use of consultants, communication with hired labor, management information systems, forward contracting, maintaining feed reserves, and debt management. The socioeconomic characteristics of each dairyman was recorded and compared to his perceptions and responses to risk. The socioeconomic factors used were age, education level, years of dairy experience, income, size of dairy, legal form of business, net worth, and debt levels. How producers perceived and responded to risk was somewhat determined by their individual socioeconomic characteristics.

# CHAPTER 1

# INTRODUCTION

The society in which we live today is one of change. The continual emergence of problems due to the nature of our present world is known as environmental turbulence (Ansoff). This relatively new concept is becoming more important as the world specializes and progresses. However, this dynamic world is often overlooked by researchers when studying economic problems.

Agricultural economics research in the area of profit maximization has focused primarily on factors of production and how to reach the point of optimal returns. Research has concentrated on the operational decisions that a producer should make by assuming that his objective is to maximize profits according to yields and output prices. However, maximizing profits may only be one of several objectives. Furthermore, their decisions may largely be influenced by risk factors on the input side of production and not totally by yields and output prices.

## The General Firm

Profit maximization, as traditionally modeled, may not reflect the decision making environment of the firm. A few growing concerns are: environmental pollution,

fluctuations in economic activity, inflation, after sale service, governmental regulations, etc. Ansoff summarizes that over the past 20 years, a major escalation of environmental turbulence has taken place. For the firm it means a change from a familiar world of marketing and production to an unfamiliar world of strange technologies, strange competitors, new consumer attitudes, new dimensions of social control and a questioning of the firm's role in society. Ansoff lists the progression of challenges in terms of three characteristics: familiarity of events, rapidity of change, and visibility of the future. As the U.S. develops through a succession of levels of higher turbulence certain problems have evolved: events have become more discontinuous with no related experience; things have changed faster than firms can respond; and it has become more difficult to predict the future.

During the first one hundred years of existence of American business firms, the focal problems of the individual firm went through three phases: The entrepreneurial creation of the firm, perfection of the mass production technology, and development of mass marketing. These stages lasted from the mid-1800's through the 1940's. During these periods the firm largely remained immune from societal interference. Since the 1950's the challenges increasingly became simultaneous: the need for revival of entrepreneurship, increasing intensity of global

competition, and large scale societal involvement in determining how the firm is to be run and the role it should play in society.

Over the last century, increasing turbulence of the environment has enticed firms to invent more complex and elaborate systems of management. The positioning system consists of planning decisions that determine the firm's position in the environment. This system includes long range planning, strategic planning, and strategic position management. A company must know where they stand currently and where they intend to be in the future. Time planning of all stages is important if firms are going to progress and adapt to changing times.

Real time systems are management plans designed to react to problems which are detected at different time intervals. Until recently all of the decision systems were periodic, operated usually on an annual planning cycle. Firms must now be able to respond to problems detected far in advance, just recently, or even immediately. Responding to problems in this manner requires a flexible management system, which is becoming a necessity in today's dynamic world.

The choice of the system combination for a particular firm depends on the turbulence characteristics of the environments in which it participates. The choice of the

appropriate positioning system depends on the complexity, discontinuity, and newness of the environmental challenges. The choice of the real time system depends on the speed of change and predictability of the changes.

## The Agricultural Firm

The agricultural environment in which a farmer must operate is one of the most turbulent. Successful farms must have long range plans for expansion, asset replacement, and continuity of the estate. These long range plans provide a complete life cycle for the farm. Among a farmer's strategic plans are land purchases, up-dating his type of technology, selecting a legal structure, and marketing techniques. Short-term decisions such as those concerning feed and operating supplies are included in a good planning process and can be critical to smooth operation.

A farmer's environment is one of uncertainty. Future market prices are unpredictable. The variability of output prices leads to a fluctuating income. Farmers must be flexible in their planning in order to absorb the effects of an income that can be high or low. In recent years output prices have been depressed to sub-par levels. As shown by Table 1, agricultural output prices have flucuated widely. The instability in output prices limits the growers' forecasting ability and therefore contributes to their turbulent environment. Historically, dairy product prices

Table 1.

Index Prices Received by Farmers, United States 1973-84.

1977=100

| Year | Food Grains | All Crops | Meat Animals | Dairy Products |
|---|---|---|---|---|
| 1970 | 59 | 52 | 72 | 59 |
| 1971 | 61 | 56 | 72 | 61 |
| 1972 | 70 | 60 | 88 | 63 |
| 1973 | 138 | 91 | 118 | 74 |
| 1974 | 192 | 117 | 98 | 86 |
| 1975 | 155 | 105 | 100 | 90 |
| 1976 | 129 | 102 | 101 | 100 |
| 1977 | 100 | 100 | 100 | 100 |
| 1978 | 122 | 105 | 134 | 109 |
| 1979 | 147 | 116 | 166 | 124 |
| 1980 | 165 | 125 | 156 | 135 |
| 1981 | 166 | 134 | 150 | 142 |
| 1982 | 146 | 121 | 155 | 140 |
| 1983 | 148 | 127 | 147 | 140 |
| 1984 | 143 | 138 | 151 | 139 |

Source: U.S.D.A., Agricultural Statistics 1985.pg.404.

have been the most stable showing nearly constant increases.

The agricultural development of other countries has hurt the U.S. export market and created world surpluses. Third-world countries have been aided in developing their technology to become more self-sufficient. As a result the U.S. no longer holds a dominant advantage in the world market.

Flucuating input prices have presented additional problems. Table 2 shows the prices paid by farmers and Figure 1 illustrates how production expenses have increased with inflation and take the majority of a farm's income.

Another misfortune on the input side hit many farm borrowers in 1980. Interest rates rose to levels that could not have been anticipated. The volatility of interest rates has played a major role in the failure of many farms in recent years. The productive, inflationary period of the 1970's lulled farmers into believing that debt was good. Then as inflation slowed and prices dropped in the 80's those highly leveraged farmers were victims of their huge debts. Table 3 shows the devastating movements in interest rates and land values.

The agricultural sector's instability is further compounded by yearly variations in crop yields. The size of crop has a direct impact on the amount of income. From year to year many uncontrollable changes occur that influence what yields will be. Good management practices can reduce

Table 2.

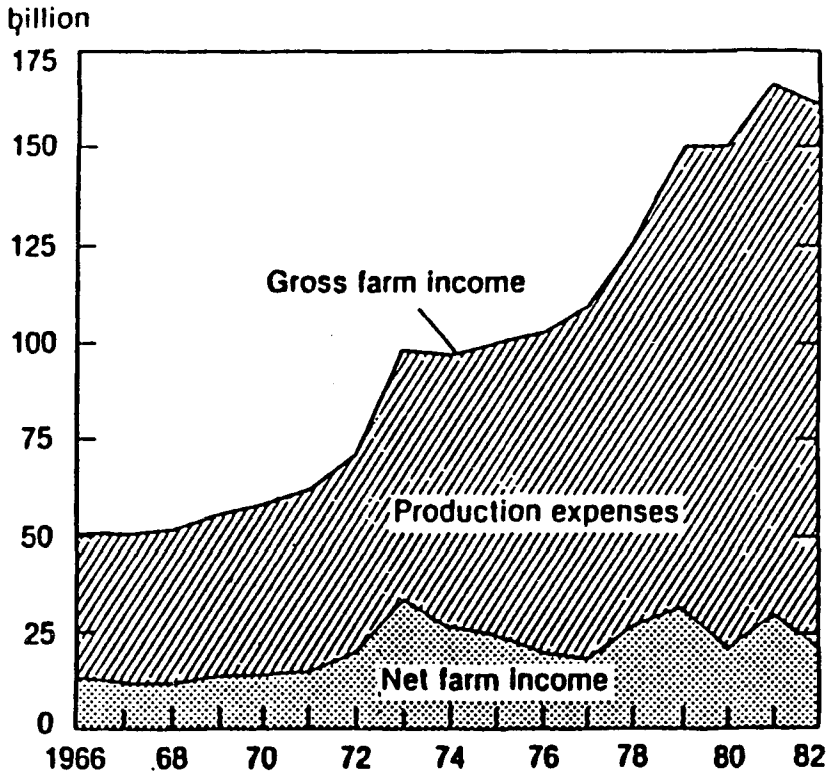
Prices Paid by Farmers: Index Numbers, United States, 1970-84

1977=100

| Year | Production | Interest | Taxes | Wage Rates |
|---|---|---|---|---|
| 1970 | 54 | 39 | 68 | 57 |
| 1971 | 57 | 43 | 72 | 59 |
| 1972 | 61 | 47 | 75 | 63 |
| 1973 | 73 | 55 | 77 | 69 |
| 1974 | 83 | 65 | 81 | 79 |
| 1975 | 91 | 77 | 87 | 85 |
| 1976 | 97 | 88 | 94 | 93 |
| 1977 | 100 | 100 | 100 | 100 |
| 1978 | 108 | 117 | 100 | 107 |
| 1979 | 125 | 143 | 107 | 117 |
| 1980 | 138 | 174 | 115 | 126 |
| 1981 | 148 | 211 | 123 | 137 |
| 1982 | 150 | 241 | 124 | 144 |
| 1983 | 153 | 250 | 129 | 148 |
| 1984 | 155 | 251 | 132 | 150 |

Source: Agricultural Statistics, U.S.D.A. 1985. pg.404.

Figure 1: Farm Income and Production Expenses for 1966-1982.




Source: U.S.D.A. 1983 Handbook of Agricultural Charts, Agricultural Handbook No. 619, Washington D.C., 1983. Chart 1.

Table 3.

Average Interest Rates and Land Values (1977=100)

Dec. 31, 1970-84

| Year | Real Estate Interest Rate | Prime Rate | Index of Land Values |
|---|---|---|---|
| 1970 | 6.0 | 7.72 | 42 |
| 1971 | 6.1 | 5.11 | 43 |
| 1972 | 6.3 | 4.69 | 47 |
| 1973 | 6.6 | 8.15 | 53 |
| 1974 | 6.9 | 9.87 | 66 |
| 1975 | 7.2 | 6.33 | 75 |
| 1976 | 7.3 | 5.35 | 86 |
| 1977 | 7.3 | 5.61 | 100 |
| 1978 | 7.7 | 7.99 | 109 |
| 1979 | 8.1 | 10.91 | 125 |
| 1980 | 8.6 | 12.29 | 145 |
| 1981 | 9.6 | 14.76 | 158 |
| 1982 | 9.9 | 11.89 | 157 |
| 1983 | 9.6 | 8.89 | 148 |
| 1984 | 9.7 | 10.16 | 146 |

Source: Agricultural Statistics, U.S.D.A.,1985, pgs.430,431, and 370.

yield variability to some extent. Table 4 depicts the variability involved in crop production which adds to the turbulent environment of agricultural producers.

## Other Sources of Risk

### Government Programs

The instability associated with agriculture has led to numerous government programs. Farm policy has attempted to remedy most problems with mixed results. Many of the policies have helped alleviate the symptoms of variability rather than cure the problem.

The government has imposed price support levels. These levels are minimum prices a farmer can receive for his product. If the price falls below a certain level, the government pays the difference between the support price and the actual price. Under the Commodity Credit Corporation's reserve loan program, the government issues loans to farmers and uses their crop as collateral. If the market price falls below support levels, the farmers can forfeit their grain and keep the loan money.

Programs have been implemented to attempt to reduce the surplus of grain on the market. These programs pay farmers to idle their land. The Payment-In-Kind program paid farmers with the government's stored grain in return for not planting their crops.

Table 4. Average Yields in the U.S., 1973-1984.

(Yields Per Acre)

| Year | Corn | Wheat | Soybeans | Cotton |
|---|---|---|---|---|
| 1973 | 91.2 | 33.1 | 27.7 | 520 |
| 1974 | 71.4 | 29.6 | 23.2 | 442 |
| 1975 | 86.2 | 32.0 | 28.4 | 453 |
| 1976 | 87.9 | 30.3 | 26.1 | 465 |
| 1977 | 90.7 | 30.6 | 30.6 | 520 |
| 1978 | 101.2 | 31.6 | 29.2 | 420 |
| 1979 | 109.7 | 34.2 | 32.1 | 547 |
| 1980 | 191.0 | 33.4 | 26.4 | 404 |
| 1981 | 109.9 | 34.5 | 30.4 | 542 |
| 1982 | 113.2 | 36.0 | 31.5 | 590 |
| 1983 | 81.1 | 41.8 | 26.2 | 508 |
| 1984 | 106.6 | 40.0 | 28.2 | 600 |
| Std. Deviation | 29.2 | 3.6 | 2.4 | 61.5 |
| mean | 103.3 | 33.9 | 28.3 | 500.9 |
| C.V. | .28 | .11 | .01 | .12 |

Source: Agricultural Statistics, U.S.D.A., 1985.

Other policies aiding agriculture include subsidized loans through the Farmers Home Administration. Under this program deserving farmers acquire loans at artificially low interest rates. Disaster relief payments are also alloted to deserving farmers.

Restricting Laws

The Environmental Protection Agency sets regulations that contribute to the farmer's changing world. The E.P.A. has banned certain pesticides and herbicides. Dairies must follow guidelines in waste disposal. With a growing population the E.P.A. must impose more stringent laws. For the farmer this means less freedom and a more comlicated operation.

The World Market

Today's agriculture is influenced by a world market. The U.S. has become increasingly dependant on foreign trade (Table 5). Events around the world now have impacts on American agriculture. The U.S., for the first time since 1917, has become a net importer of agricultural goods. As other countries support their agriculture it becomes more necessary for the U.S. government to support it's domestic agriculture.

## Economic Models of Decision Making

Economic decison making in a turbulent environment

Table 5.

Volume of Exports, and Percentage of Major Crops Exported

(1967=100)

| Year | Index of Export | % of Crop Production Exported Wheat | Corn | Soybeans |
|---|---|---|---|---|
| 1930 | 39 | 14.8% | .2% | - |
| 1935 | 26 | 2.5 | .1 | 6.4 |
| 1940 | 20 | 5.0 | .7 | .1 |
| 1945 | 35 | 28.8 | .9 | 2.6 |
| 1950 | 46 | 36.7 | 4.0 | 11.6 |
| 1955 | 50 | 36.7 | 3.8 | 22.2 |
| 1960 | 84 | 46.6 | 7.1 | 28.8 |
| 1965 | 98 | 64.8 | 16.7 | 42.6 |
| 1970 | 106 | 54.8 | 12.5 | 55.6 |
| 1975 | 147 | 55.1 | 29.3 | 49.2 |
| 1980 | 246 | 63.6 | 35.4 | 55.6 |

Source: Agricltural Statistics, U.S.D.A. 1981.

has been influenced by several different schools of thought. There is some question on how to appropriately model turbulence. Classical economics is based on the theory that firms make decisions that will result in obtaining maximum profits. A typical model used to determine factor levels associated with maximum profit is given by:

(1) Profit=$py-r_1x_1-r_2x_2-c$ where $y=f(x_1,x_2)$

p = price of output
y = output amount
r = price of input
$x_i$ = input amount (i=1,2)
$c^i$ = fixed costs

substituting, this becomes

(2) profit = $pf(x_1,x_2) - r_1x_1 - r_2x_2 - c$

First order conditions are then derived.

$d\pi/_{dx1}=pfx_1-r_1=0$, $pfx_1=r_1$

$d\pi/_{dx2}=pfx_2-r_2=0$, $pfx_2=r_2$

The point of maximum profit is found where marginal value product is equal to marginal factor costs. This model does not enter in turbulence. It's predictability potential is limited to the importance of output and input prices and amounts. An alternative model for economic decision making is presented by Sandmo. It attempts to maximize utility under uncertain prices of output.

An example would be as follows, where profit is given by:

$\pi=py-wL-rK$

where p = price of output
y = output amount
w = price of labor

L = amount of labor
r = price of capital
K = amount of capital

Expected utility is $E\{U[pf(L,K)-wL-rK]\}$

Maximization of utility is derived from the first-order conditions:

$$\partial E(U)/\partial L = E[U'(\pi)(pf_L - w)] = 0$$

$$\partial E(U)/\partial K = E[U'(\pi)(pf_K - r)] = 0$$

From the first-order conditions comes the inequality, MIC<=E(VMP). Which means that under uncertainty equilibrium, the expected marginal value product of each factor will exceed its price. By contrast, the certainty equilibrium is defined by the equality between marginal value productivity of each factor with its price. The optimal output produced under uncertainty will be lower than the certainty output because of less inputs being used. Under this utility maximizing model we can derive the following results.

1. For the risk adverse firm, output under uncertainty is less than output under certainty.
2. For the risk neutral firm, output is the same under uncertainty as under certainty.
3. For the risk-preferring firm, output is higher under uncertainty.

Baumol offers a different view. He suggests that firms maximize total revenue subject to a minimum profit

constraint rather than maximizing total profits. He rationalizes that the sales-maximization goal is the desire of the firm. This theory says that firms would rather maintain a competitive position in the market rather than make the most profit possible. The problem is to maximize total revenue, TR, subject to a profit constraint.

Consider a perfectly competitive, multiproduct, multifactor firm with total revenue and total cost given by

$$TR = P_k Y_k$$

and

$$TC = R_i X_i$$

where TC=total cost
TR=total revenue
P=price of outputs
Y=amount of outputs
R=price of inputs
X=amount of inputs

The problem is to maximize total revenue subject to the profit constraint

$$\Pi = TR - TC = \Pi_o$$

and the constraint imposed by the firm's production function,

$$Q(Y_1, \ldots, Y_p, X_1, \ldots, X_m) = 0$$

The Lagrangian function is then formulated

$$L = TR + \lambda Q + u(\pi_o - TR + TC)$$

where $\lambda$ and $\mu$ are Lagrangian multipliers and $\Pi_o$ is a constant. The first-order conditions for constrained revenue maximization are

for the products:

$L_k = P_k + \lambda Q_k - \mu P_k = 0$ where $(k=1,\ldots,p)$

and for the inputs:

$L_i = \lambda Q_i + \mu R_i = 0$ where $(i=1,\ldots,m)$

and for the multipliers.

$L_\lambda = Q = 0$

$L_\mu = \pi_o - TR + TC = 0$

The first-order conditions for the profit maximizing model of the perfectly competitive, multiproduct, multifactor firm can be expressed in the form of the following three desision rules.

1. The price ratio of any two products must equal the rate of product transformation between the two products.

2. The price ratio of any two factors must equal the rate of technical substitution between the two factors.

3. The price ratio of any factor-product combination must be equal to the marginal product for the particular factor-product combination.

Another decision making theory that has been widely accepted is the idea of satisficing. Radner describes saticficing as an option to use when all possible alternatives are not going to be examined. Criterion must then be used to determine that an adequate, or satisfactory, alternative has been found. Criteria that perform this function in decision processes are called aspiration levels. The term satisficing has been revived to denote problem solving and decision making that sets an aspiration level,

searches until and alternative is found that is satisfactory by the aspiration level criterion, and selects that alternative. In these situations, optimization becomes approximate optimization. Research on satisficing procedures has focused primarily on the efficiency of search; or the nature of heuristic methods that enable the rare solutions in enormous spaces of possibilities to be sought and found with moderate amounts of search effort.

Selecting the Best Model

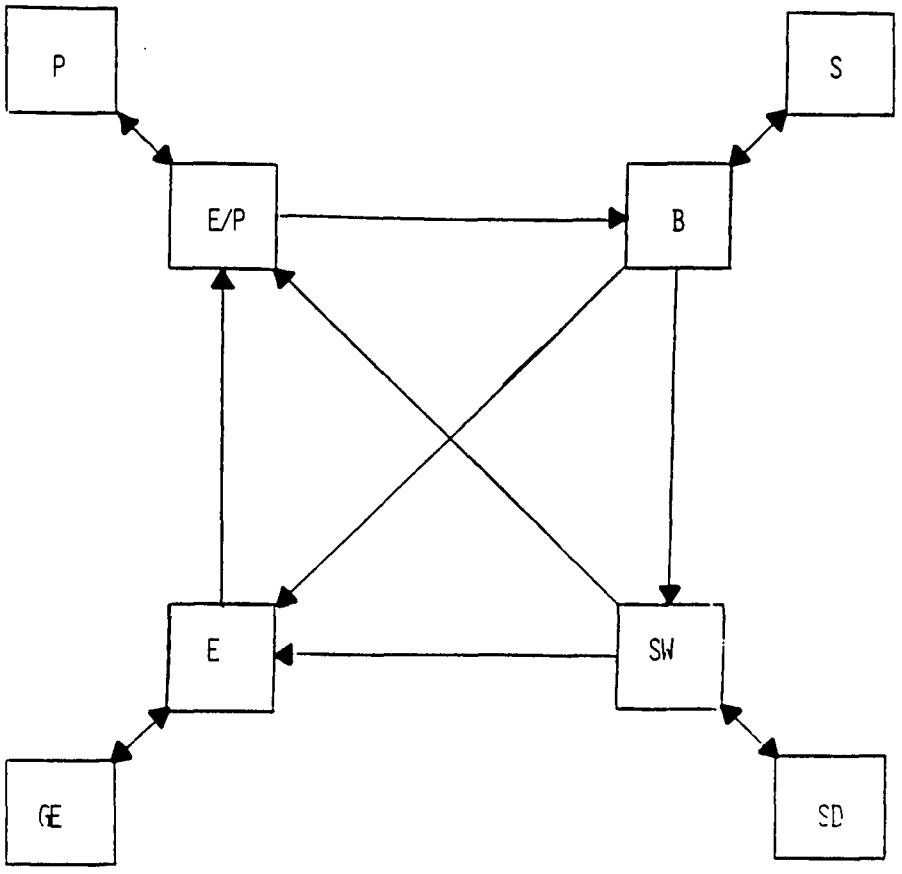
Which economic model provides the best alternative? All models are feasible in their own environments. Lanzillotti writes that among companies in pursuit of policies that will yield the maximum satisfaction of the company's community of interests, the findings show that one company will prefer stability, another will seek to expand it's market share, or to engage in continuous discovery of new fields, while others will be content to meet competition, to satisfy a goal, or to aim at variations of these goals. Company policies represent an order of priorities from competing objectives rather than policies tested by any simple concept of profit maximization. The author concludes that no single theory of the firm is likely to impose an unambiguous course of action for the firm for any given situation.

Raaij provides the argument that a strong bond

exists between economic decision making and psychology. He states that in pure economic research, only the effects of economic behavior are studied, such as supply-demand relationships, without considering the intervening psychological processes of evaluation, decision, and choice. Economic laws assume one-to-one relationships between economic variables without systematic behavioral disturbances. When economists deal with behavior they either assume that individual tastes and preferences cancel out against each other, or they assume a rational behavior of utility maximization, complete knowledge, and control over means. Recent approaches in behavioral economics make more realistic assumptions about economic behavior. Not utility maximization but utility optimization and bounded rationality have become the basic concepts. Economic behavior is the function of human motives, perceptions, attitudes, expectations, and bounded by the economic conditions. Figure 2 diagrams the psychological-economic relationships presented by Raaij.

The economic environment (E) of an industry is influenced by the general economy (GE). E/P represents the economic environment as perceived by the business operator. Personal factors (P) influence the perceived economic environment. For example, goals, values, beliefs, and decision making abilities cause people to perceive the world differently. Perceptions affect actual economic behavior (B)

Figure 2: Raaij's Model



more than the existing conditions in the particular industry. Unanticipated events (S) such as illness or injury also affect economic behavior. Finally, behavior will influence subjective well-being (SW) which is a consequence of economic decision making. Well-being is determined by the deviation between expected and actual economic performance and the level of societal discontent (SD) due to adverse affects caused by the business.

Three relationships are of special interest. One (E→ E/P) is an important relationship because perceptions regarding the economic environment influence economic behavior. A second relationship (E/P→B) determines how perceptions influence economic behavior. The third link pertinent to this research is (P→E/P→B) because it relates personal characteristics to the perception of economic reality and economic behavior.

Libby and Fishburn have shown that risk plays an important role in deterimining business' goals. They found managers to apply significantly different selection criteria in their choice between risky projects. The differences were explained by the subjects' different assumptions concerning the simulated investment situation, personal risk preferences, and the normal risk levels accepted by the subjects' businesses. These explanations correspond to the three avenues followed by psychologists attempting to investigate individual differences in risk

taking; the effects of 1)the risk-taking situation, 2)personal characteristics, and 3)training and experience. They add that the risk of loss plays a greater role in decisions involving a larger percentage of the total assets of the firm. Decision situations with different goals, such as plant expansion and research and development programs, elicit different types of risk-taking behavior. The models can be adjusted according to the weights applied to the parameters used in the consideration of the differing goals.

Research attempting to predict behavior of agricultural firms by use of maximization models is unique because it needs to account for a wide range of risk factors. Lin, Dean, and Moore, an early risk study, found that inadequate treatment of risk has been a major factor accounting for the discrepency between actual and predicted (profit maximizing) individual behavior in past studies. The authors found the Bernoullian and lexicographic utility formulations are more accurate predictors of farmer behavior than profit maximization models. None of the models that the researchers experimented with could predict farmer behavior well. They also found profit maximizing models to consistently predict people to accept significantly higher levels of risk than was actually observed.

Patrick and Blake compared different multiple goal models. They found the models differed in their view of the

decision making process as well as the information they require about goals. Among the goals studied were security, high level of living, farm production, success or prestige, and increasing leisure time. They noted several problem areas in the measurement and modeling of an individual farmer's goals for incorporating into models. Unless appropriate techniques are used to index farmers goals for inclusion in the models the full potential value of those models is not realized.

Hatch et.al., in a study of farming goals, determined how a farmer's characteristics affect his goals. The goals studied were increasing leisure time, making more profits, and increasing net worth. They used a paired-comparison technique to find the ranking of various goals. Fifty percent of the variation in the goal structure was explained by farm operator and farm firm characteristics. Some factors found to be most important in explaining differences in the ranking of goals were the operator's age, educational level, farming experience, number of dependents, level of assets, off-farm income, cropland acres, and net worth.

The objective of this research is to determine if economic models should take into account risk factors which are significant to the producers. Decisions made by producers are probably based on a wide array of factors other than the maximization of income. For example, do

factors on the input side have an influence on decision making or are yields and output prices the only important considerations?

The effectiveness of the modified total design method, a survey method, will be tested. This method has not been experimented with in the past. It will be tested in an attempt to take a census of the Arizona dairymen. Through this research a better understanding of what sources of risk play a role in the decision making process of Arizona dairymen will be revealed. Also, how they respond to those sources will be determined. Most importantly, a conclusion will be made as to whether or not a dairyman's personal characteristics has effects on his perceptions and responses to risk.

# CHAPTER 2

## AGRICULTURAL PRODUCERS' RISK PERCEPTIONS AND MANAGEMENT RESPONSES: A LITERATURE REVIEW

The instability of today's modern economic environment is of great concern to all agriculture and related industries. An adequate understanding of risk and risk management is necessary for the survival of farm firms in today's environment.

### Sources of Risk

Sonka and Patrick identify five major sources of risk. They include: (1) production risk; (2) market risk; (3) technological risk; (4) legal risk; and (5) human sources of risk.

#### Production Risk

Production risk is random variability inherent in a farm's production process. Weather, diseases, and pest infestations lead to risk in crop and livestock production. Fire, wind, theft, and casualties are other sources of production risk.

#### Market Risk

Market risk can occur for purchased inputs and saleable commodities. Short-run fluctuations in input prices

can cause considerable income losses and cash shortfalls. Concern about input price variability, interest rates, and relative price movements affects the farmer's decisions about enterprise selection, investments in durable assets, and other components of strategic planning.

Technological Risk

Technological risk is the potential that current decisions may be offset by technical improvements in the future. Investments in durable assets may be subject to technological changes. Technological developments in transportation, processing, and other nonfarm sectors can also affect farm incomes.

Legal Risks

As farms grow larger new marketing techniques, like forward contracting, present new legal risks. Government policies also impact on a farmer's operating environment. Examples include price and income support programs, as well as tax, trade, credit, and environmental policies. These policies can change and become important sources of risk for farmers.

Human Sources of Risk

Human risks are associated with the labor and management functions in farming. Examples are health problems of key operators, changing objectives of

individuals, and errors in judgement or decision making.

## Management Responses to Risk

According to Boehlje and Trede the actions a farmer uses to reduce risk are categorized by the production, marketing, and financial organizational areas of the farm firm. The degree of risk associated with each area varies from operation to operation. Therefore, each firm uses different actions to reduce risk.

### Production Responses

Production responses to risk are actions related to the production aspects of the operation. Examples would be enterprise diversification, geographic diversification, feed reserves, maintaining flexibility, and idling production capacity.

### Marketing Responses

Marketing responses to risk are becoming more important as farms become larger. Even a small price differential can result in large changes in profits or losses. Marketing responses include spreading sales, forward contracting, hedging, marketing information, and government programs.

### Financial Responses

Financial responses to risk are used to offset the chances of total financial loss. More methods exist for

reducing risk by financial responses than by either marketing or production responses. Among them are hail insurance, all-risk crop insurance, financial reserves, inventory reserves, credit reserves, debt management, government emergency credit, pacing investment, operator off-farm activities, and family off-farm activities. Melichar pointed out that the survival rate of a farm firm diminishes greatly as leverage increases.

Incorporating risk management strategies utilizing many production, marketing, and financial responses would benefit the producer substantially. Sonka and Patrick write that the best integrated strategy for an individual producer depends on the available resources, goals, risk attitudes, equity position, financing available, weather conditions, marketing availability, and other factors. As these factors change, the best strategy is also likely to change.

Patrick, et. al. used an F-test to determine that there were differences in importance of responses between different farm enterprises. Among the production responses, enterprise diversification was the most important response for cotton growers, Southeastern producers with mixed farming operations, and small grain producers. Ranchers gave the most importance to maintaining feed reserves. Corn, soybean, and hog farmers ranked production practice

diversification as their most important production response.

Marketing responses differed significantly among the farm type categories. Over 90% of producers obtained market information; however it is not as important to the mixed farming producers as it is to corn, soybean, and hog producers. Forward contracting is used mostly by mixed farming and cotton producers, while spreading sales was given more emphasis by the remaining groups. Hedging was regarded as the least important of the marketing responses. Government program eligibility was used by 90% of the cotton growers. In contrast, only 67% of the corn, soybean, and hog producers indicated use of government programs to manage risk.

Financial responses to variability were significantly different across farm types. Over 77% of the mixed farming producers had crop insurance and 19% had hail insurance. In contrast, 81% of the corn, soybean, and hog producers had hail insurance and less than 6% had all-risk crop insurance. The corn, soybean, and hog producers gave less importance to holding financial reserves than other farm types. Cotton growers gave less importance to inventory reserves. Mixed farming operations in the Southeast relied more on emergency credit programs, while ranchers gave less importance to pacing investments as a risk management tool.

Boggess, et. al. surveyed farmers in Alabama and Florida and found a large difference in the importance of

risk management tools between crop producers, livestock producers, and crop and livestock producers. They also found diversification and feed reserves were highly ranked management practices designed to combat production risks. Market information and spreading sales were the highest ranked practices in dealing with price risk. The farmers unanimously agreed that hedging in the futures market was not important. Highly ranked financial risk management practices included pacing of investments and maintaining financial reserves.

Boggess, et. al. attempted to determine correlations between farmers' socioeconomic characteristics and their use of risk management tools. The characteristics used were experience, education, size of farm, farm income, and leverage ratio. The authors determined less than half of the rankings of sources of risk and only a third of the responses on the use of management practices had significant relationships with any of the six socioeconomic variables. The size of farm was significantly related to six sources of risk. It was related to diseases, pests, costs of operating inputs, theft of farm equipment, inflation, and government agricultural programs. Experience was negatively related to risk of changes in family plans, availability of loan funds, and cost of credit. Education level was tied to climatic factors, leasing equipment, and changes in family plans. The

leverage ratio was inversly related to changes in technology, government regulation, and positively related to the use of leverage. On the response side, maintaining financial reserves was used more as the size of the farm increased. The strategy of holding credit reserves increased as the use of leverage increased as did debt management strategies. The utilization of government credit programs increased with leverage and experience. Off-farm activities was inversly related to the size of farm.

The conclusion reached by the authors was that a detailed breakdown by socioeconomic groups is unnecessary for production and market risk research and extension. The survey used, consisted of only 48 farmers; 25 from Florida and 23 from Alabama. Before the authors can say risk research is "unnecessary", wider populations must be analyzed from different geographic areas. Various enterprise types must also be researched.

## Research Of The Dairy Sector

Weston and Cary, in an Australian dairy study, found farmer decisions to be greatly influenced by their psychological views of their "life space". Life space is one's perception of the past, present, and future. The author's conducted two similar surveys, one in 1976 and the other in 1978. The dairy industry in 1976 was in an economic recession. Farmers were found to be stressful and anxious.

Their views of the future were bleak and operational plans were uncertain. High levels of tension were also linked to a variety of physical and mental illnesses, impaired decision making ability, and other behavioral problems.

The context in which the second survey took place was characterized by economic recovery. Farmers had a good view of their life space. They believed that they were making progress and tended to express optimism about the future. In this less stressful atmosphere the farmers made better management decisions and more long range plans. The optimistic outlook was accompanied by positive attitudes and better health.

Attempts have been made to classify dairy farmers into risk preference groups by socioeconomic characteristics. Tauer surveyed 72 New York dairy operators and found 26% were risk preferring, 39% were risk neutral, and 34% were risk adverse. Attempts to determine if characteristics of a farmer permitted that farmer to be placed into a risk-preference group were not successful. Limited success occurred in determining if a farmer's risk preference determined his or her farming actions or decisions. It appears that other factors are more important than risk preference.

Research on risk management of the dairy sector has been limited. Much of this neglect is attributed to it's uniqueness. The dairy industry has typically been considered

relatively risk-free. Dairies have a product for sale daily, therefore a constant cash flow and more probability of obtaining credit when needed. Dairy farmers are not as affected by adverse weather conditions as a grain farmer may be. The dairy industry has traditionally had strong political lobbyists. Dairy has been involved with more governmental programs that have provided substantial impacts than other agricultural sectors.

The dairy industry has recently become more risky as uncertainty has developed in dairy policy, input prices, and various financial risks. This recent turbulence has led the way for more dairy research to explore different strategies for reducing risk.

# CHAPTER 3

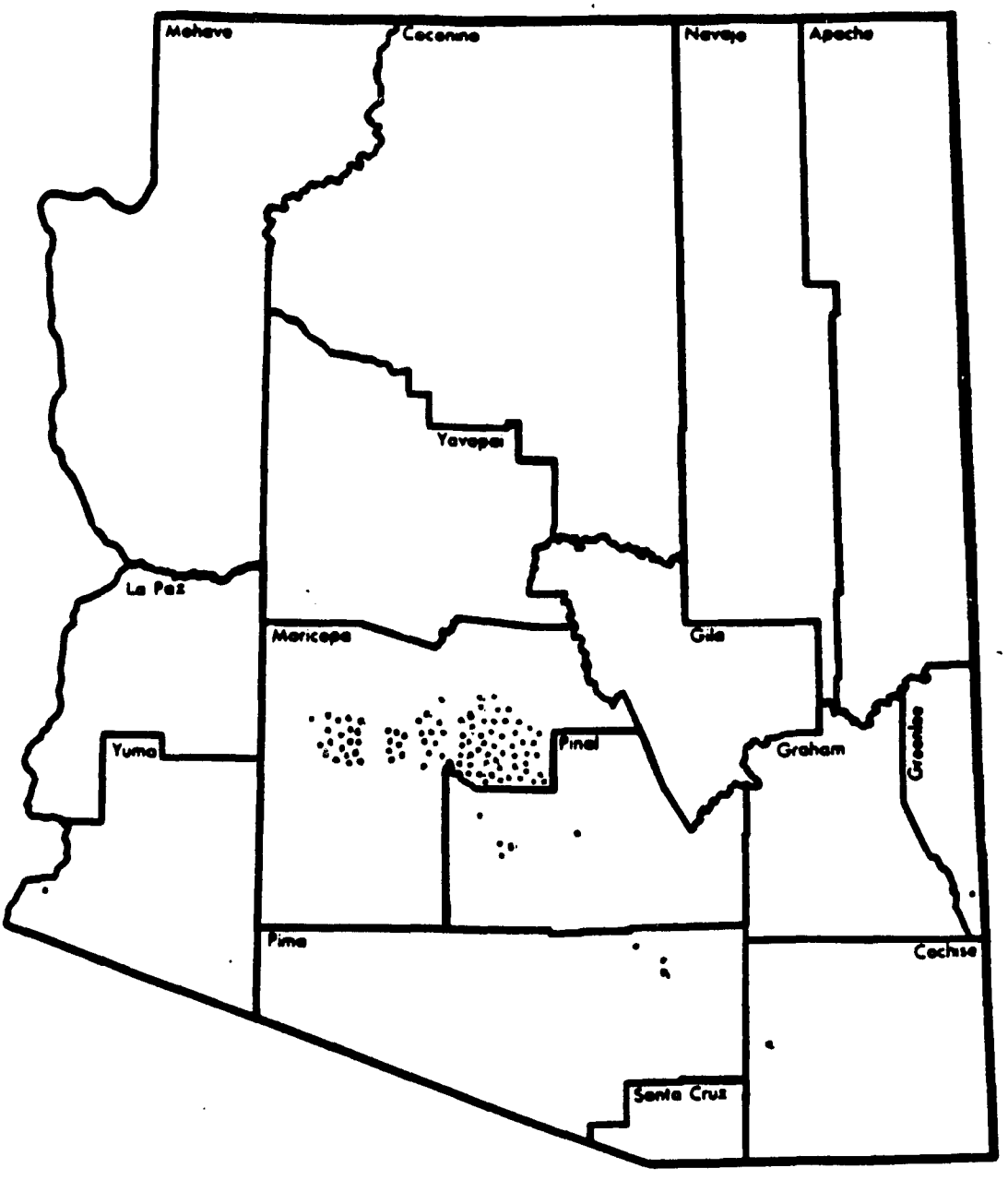
## DATA AQUISITION

Armstrong and Selley, in a 1985 extension publication, stated that the Arizona dairy industry consists of 110 producing operations. The dairies average 500 cows per herd and total 82,000 cows. These operations grossed $175 million in 1984. The average operation ships 22,905 pounds of milk daily. Arizona dairies supply the state with most of it's milk and dairy product needs. The highest concentration of dairies is in Maricopa County where 85% of Arizona's dairies are within 50 miles of Phoenix (Figure 3). The Holstein breed makes up 90% of the dairy cattle in the state. Other breeds are Guernseys, Jerseys, Brown Swiss, and Milking Shorthorns. Only 11% of the cows are registered. A typical Arizona dairy, consisting of 500 cows, would have assets totaling $2,556,100; an average of $5,011 per cow. This includes price of cows and replacement heifers, milking facilities, feed, land, and milk base.

Federal Marketing Order 131 regulates 96% of the milk produced in Arizona. The major purpose of the order is to insure consumers an adequate supply of milk. U.S.D.A.-supervised meetings are held between dairymen and milk handlers. Their objective is to establish minimum prices

Figure 3. Location of Arizona Dairies, 1986.

Legend:
·= Dairy Location



which handlers must pay dairymen. This price must encourage an adequate supply of milk but not a surplus. In December 1986, Federal Milk Marketing Order Class 1,2,and 3 prices were $14.40, $11.84, and $11.27 per hundredweight, respectively. Retail prices ranged from $1.00 to $1.12 per half gallon.

Ninty percent of Arizona's dairymen are members of the United Dairymen of Arizona. This cooperative operates a quota program which encourages members to adjust production to market needs. The co-op holds reserve milk to meet day-to-day fluctuations in demand. Excess milk is taken off the market by converting it into cheese, butter, and milk powder.

Arizona ranks first in the nation for cows in the Dairy Herd Improvement Association (DHIA). Arizona has 59,000 cows enrolled. The state ranks third in the nation in production per cow.

## Survey Design

The research in this project relies on a census of all dairy operations within the state of Arizona. Obtaining honest answers from an adequate number of the population is critical to deriving credible results. A proven strategy also must be used to maximize the response rate.

Dillman has developed a theoretically based system guided by principles of social exchange and administration

that insure high quality surveys. This process of conducting successful mail and telephone surveys is called the "total design method". This approach relies on a theoretical view of why people do and do not respond to questionnaires. It is based on the premise that to maximize both the quantity and quality of response, attention must be given to every administrative detail that might affect response behavior.

The total design procedures have proven highly successful. Previous use has shown that a response rate of 75% can be consistently attained in mail surveys, and 80-90% response rate can be attained in telephone surveys.

This research, involving the dairymen of Arizona, utilized a new approach which is labeled the "modified total design method". This approach consists of a combination of the telephone and mail surveys. The subjects were telephoned in advance to explain the objective and ask for their cooperation in participating. A questionnaire was immediately sent to the subjects. Several follow-up calls were then made to those producers who were slow in responding. It was hypothesized that implementing two different means of communication would boost the response rate markedly.

## Survey Construction

The questionnaire was constructed to be similar to the one used by Patrick, et al. in the earlier, nation-wide

S-180 project. The S-180 project did not include dairies, therefore the wording of the questions in this project was changed to pertain only to the dairy industry. Furthermore, the S-180 project requested that the producers rank each source of variablity in terms of importance. The responses available to the producers were "very important, moderately important, not important, and does not apply". This method of response cannot clearly distinguish which source is most important. For example, if a producer believes that all sources are very important, and indicates that on the questionnaire, then the researchers cannot determine the correct order of importance of the sources of variability. Therefore, this dairy project asked producers to select, from a list of 19 sources, the top 6. They were also asked to rank those top 6 in order of importance from 1 to 6. In this manner there was no question which sources of variability were more important than others.

This research is also unique in the fact that the entire population is being surveyed. The S-180 project and other similar studies took non-random samples of whole populations which could bias results. Boggess, et.al was a random sample, but only covered 2 counties. Each individual dairyman in Arizona has an impact on the results of this research since it is essentially a census.

The questionnaire was designed with several purposes in mind. First, the questions were asked which

would result in the kind of information desired. Secondly, the questions were structured in the appropriate way. The total design method was helpful in the structuring of the questions as to receive a good response rate. Finally, the precise wording was used which made the questions understandable.

## Survey Procedure

To insure an understandable questionnaire, the original version was pretested. The researchers met with selected dairymen that represented different types of operations. They offered their criticisms and suggestions. The questionnaire was then revised until a suitable version was derived.

Obtaining an up-dated mailing list is a key element in any survey. A survey involving the dairy industry is difficult as it is in a dynamic period. Dairies are continuously being sold and bought. Mailing lists were obtained from the United Dairymen Association and from the Cooperative Extension Service. Dennis Armstrong, the universities' dairy specialist, was helpful in keeping the list up-dated.

The next step involved contacting every dairyman by telephone and explaining the survey and asking for their participation. A mark was placed on the mailing list indicating whether they would participate or not. From the

group of 104 Arizona dairymen, only 7 said they would not like to participate. Thus, leaving a group of 97 dairymen to be surveyed. Results of the process are summarized in Table 6.

The mailings immediately followed the phone calls. First a questionnaire was mailed along with a letter of explantion and thanks. A stamped, self-addressed return envelope was included with the questionnaire. Of the 97 questionnaires mailed, 16 were returned.

After eight days, a postcard was sent to the people who did not respond to encourage them to send back a completed questionnaire. Twenty-five questionnaires were returned following the reminder. This increased the total number of responses to 41.

Ten days after the postcard was sent, a follow-up questionnaire was sent to those people who had not yet responded. This also included a letter encouraging their participation accompanied by a self-addressed, stamped envelope. This resulted in 7 more completed questionnaires being returned raising the total to 48.

Seven days later we called the remaining people and asked them why they had not yet responded. This calling provided the impetous for 10 dairymen to respond. We had then collected 58 questionnaires.

Ten of the returned questionnaires had been filled out improperly. In order to include them in our research it

Table 6.

Rate of Data Collection

| Type of Contact | Date of Contact | Response |
|---|---|---|
| Telephone | 10-26-86 | 97 Producers said they would respond |
| Mailed 97 Questionnaires | 10-28-86 | 16 Questionnaires Returned |
| Mailed Postcard Reminder | 11-5-86 | 25 Questionnaires Returned |
| Mailed Follow-up Questionnaire | 11-15-86 | 7 Questionnaires Returned |
| Telephone | 11-22-86 | 10 Questionnaires Returned |
| Personal Dairy Visits | 1-15-87 | Corrected 8 Questionnaires |
| Sent Questionnaires by Certified Mail | 1-29-87 | 12 Questionnaires Returned |
| Personal Dairy Visits | 2-5-87 | Corrected 2 Questionnaires |

was necessary to have the questionnaires corrected. The researchers made personal visits to these dairymen and had them fill in the nessecary information correctly. Eight of these questionnaires were then usable increasing the total usable to 56. Finally, questionnaires were sent by certified mail to the remaining dairymen. Twelve were returned bringing the total to 70. Of the 70, 6 were filled-out incorrectly or the dairymen refused to fill them out fully. Personal visits were made to 2 dairies to correct their questionnaires thus raising the final, usable total to 66.

## Survey Crediblity

Sixty-six usable questionnaires out of a possible 97 then raises a question. Could the survey be biased with respect to the size of dairy? A check was then made to see if a particular category of all the dairies returned relatively more questionnaires than the other categories. A close similarity was found between the percentage of dairies in each size category and the percentage of respondents from each category. The conclusion can then be drawn that dairies of all sizes responded equally and the information is not biased. Table 7 shows the percentages of population and respondents from each size category.

To insure that an adequate number of respondants represented the different size categories equally a statistical test was used called the Kolmogorov-Smirnov

Table 7. Percentages of Each Size Category Responding

| Herd Size | % of Population Constituting Category | % of Population Responding |
|---|---|---|
| <250 | 19% | 24% |
| 250-499 | 38% | 33% |
| 500-749 | 23% | 20% |
| 750-999 | 10% | 9% |
| >1000 | 10% | 15% |

test. This test compares the population distribution and the sample distribution to determine if they are similar. It is based on the D statistic which is the maximum difference found between the sample distribution, $F_n(x)$, and the population distribution, $F^*(x)$.

$$D_n = \sup [F_n(x) - F^*(x)]$$

The null hypothesis is that the two size distributions are equal. In this case $D_n$ was found to be 5% and the number of categories was 5. From the table of D statistics it was found that the rejection region at the .05 significance level was .56. The null hypothesis cannot be rejected since $D_n < .56$. Therefore, the conclusion can be made that the sample distribution agrees very closely with the population distribution.

# Chapter 4

## ANALYSIS OF THE DATA

The purposes of this chapter are to identify and quantify the various sources of risk affecting Arizona dairymen today and to analyze and evaluate production, marketing, and financial strategies which dairymen use in managing their risk.

### Aggregate Characteristics of Arizona Dairymen

The average age of Arizona dairymen is 46 years. Only six of the respondents were under 30 years of age (Table 8). The largest group, 19 (29%), was between 30 years and 40 years. Fourteen were between 40 and 50. Sixteen were between 50 and 60. Ten were over 60. The small number, 6 (9%), that were under 30 shows that the initial investment of a dairy causes a high barrier of entry into the sector.

The years of experience of the dairymen are evenly distributed from 6 years to 60 years (Table 9). The average is 25 years of experience. Consequently dairy farming in Arizona is very stable and people enjoy staying with their dairies.

The size of the dairies in terms of acres varied from 10 acres to 800 acres. The majority, 59%, were less than 100 acres with 41% less than 50 acres. Only 22% of the

Table 8. Ages of Arizona Dairymen

| Years | Number | Percentage |
|---|---|---|
| <30 | 6 | 9% |
| 30-39 | 19 | 29% |
| 40-49 | 14 | 22% |
| 50-59 | 16 | 25% |
| >=60 | 10 | 15% |

Table 9. Years of Experience

| Years | Number | Percentage |
|---|---|---|
| <10 | 9 | 14% |
| 10-19 | 13 | 20% |
| 20-29 | 18 | 27% |
| 30-39 | 13 | 20% |
| >=40 | 13 | 20% |

Table 10. Size of Dairy by Lactating Cows

| Cows | Number | Percentage |
|---|---|---|
| <250 | 16 | 24% |
| 250-499 | 22 | 33% |
| 500-749 | 13 | 20% |
| >750 | 15 | 23% |

dairies were over 200 acres which corresponds to the 20% which reported they raised crops in addition to their dairy operation.

The size of dairies in terms of lactating cows varied much more than in terms of acres and was more evenly dispersed (Table 10). The largest percentage, 35%, of the dairies had between 249 and 500 cows. Twenty percent of the dairies were less than 250 cows. Only 15% of the Arizona dairies had over 1000 milking cows. The largest operation had 3000 milking cows. The overall mean for Arizona dairies is 610 lactating cows.

The gross income of dairymen was found to come mostly from milk sales, however, cattle sales and other income plays a significant role in their operations. Milk sales average between $500,000 and $1,000,000. Costs of operating dairies matches the high revenues. Forty-six percent of the respondents reported their taxable business income as negative (Table 11). Eighteen percent reported taxable incomes between $0 and $19,000. These incomes are surprising considering typical revenues of nearly $1 million. The high costs associated with dairy farming may explain why approximatley 20 dairies have sold-out over the past year.

The net worth of dairies once again is evidence of the huge amounts of capital needed to start a dairy. The typical Arizona dairy is worth $1,000,000 to $2,500,000

Table 11. Taxable Business Income of Dairies

| Taxable Income | Number | Percentage |
|---|---|---|
| Negative-Loss | 27 | 46% |
| $0-$19,999 | 12 | 20% |
| $20,000-$49,999 | 8 | 14% |
| $50,000-$99,999 | 7 | 12% |
| $<100,000 | 5 | 8% |

Table 12. Net Worth of Dairies

| Net Worth | Number | Percentage |
|---|---|---|
| $100,000-$499,999 | 11 | 18% |
| $500,000-$999,999 | 9 | 15% |
| $1,000,000-$2,499,999 | 18 | 30% |
| $2,500,000-$4,99,999 | 13 | 22% |
| <$5,000,000 | 9 | 15% |

Table 13. Ownership of Arizona Daries

| Type of Ownership | Percentage |
|---|---|
| Individual Proprietorship | 56% |
| General Partnership | 17% |
| Limited Partnership | 6% |
| S-Corporation | 9% |
| Regular Corporation | 11% |

(Table 12). A third of the dairies fall into this category. It follows that debt is common to nearly all the dairies. It is common for a typical Arizona dairy to have a short-term debt of nearly $250,000. Long-term debt was even higher for Arizona dairymen with a high percentage falling between $250,000 and $500,000. Twenty-two percent of Arizona dairymen have long-term credit of over $1,000,000.

Ownership of Arizona dairies is mostly in the form of individual proprietorships (Table 13). Fifty-six percent of the respondents solely owned their dairies. Seventeen percent were general partnerships, 6% were limited partnerships, 9% were S corporations, and 11% were regular corporations.

The dairymen were asked if they would participate in a government buy-out program if another one would be implemented. Under this program the government would buy the dairy and sell the cows. The dairymen could not reenter the dairy business for 5 years. Twenty-six percent said they would seriously consider it. Forty-eight percent said they would not participate. Twenty-six percent were undecided. Since 26% would enter the program and 26% were undecided it is safe to assume that it is an attractive program and this explains why it was successful the first time it was introduced.

Each dairyman was then asked if they planned to relocate their operation. Forty-four percent said relocating

was in their future plans. Thirty-nine percent were not thinking of relocating while 16% were undecided. The large number of farmers planning to move is surprising especially since urban growth was not ranked very high amoung the sources of variation. Only 10 dairymen ranked urban growth at all. When asked if they would relocate and expand 42% replied "yes". Forty-three percent said "no", and 15% did not know. It is more difficult to expand for dairymen than for other agricultural producers because to expand economically dairies must purchase additional milk base.

The dairy producers were divided on the possibility of participating in a voluntary reduction program. Thirty percent indicated that they would reduce production while 39% would not participate. A large portion, 31% were undecided and it seems more information is needed before the industry can determine if a voluntary reduction program would be effective.

Producer's Perceptions of Variability Sources

Each dairy producer had a list of 19 sources of risk from which to choose the 6 they felt were of most concern to their operation. The aggregate results showed several sources which were consistently picked.

The sources were ranked by assigning weights to each response it received. For example, a first place response was worth 1 point, a second place response was worth 2

points, third place was worth 3 points, etc. The points were added together to give the total score for the particular source. The source with the lowest score is the one of most concern (Table 14).

Costs of Operating Inputs

Costs of operating inputs were chosen more often than any other response. Eighty-five percent of all respondents selected costs of inputs among their top 6 choices. However, only 11 of 66 placed it first. Twenty-one producers placed it second. Dairies have high costs associated with items that must be purchased regularly in order to continue to operate. Such costs are hay, grain, replacement animals, and wages. These items require a constant source of funds. Increases in costs of inputs cause lower returns per cow and directly lower profits. Many producers forward contract these necessary inputs, such as feed, to insure a smooth flow of operation.

Prices of Outputs

Prices of outputs was the second most common choice for most important source. Obviously prices of output goods are a significant factor in nearly all businesses. The dairy business is no exception because milk prices have the most visible impact on income. In the dairy business government programs play a major role in determing the price of milk. This correlation showed-up on the questionnaire. Government

Table 14. Sources of Variation

Ranking of Importance

(Number of Responses in Each Category)

| Sources | 1 | 2 | 3 | 4 | 5 | 6 | NR* | Score | Rank |
|---|---|---|---|---|---|---|---|---|---|
| Weather | 17 | 7 | 10 | 4 | 10 | 4 | 14 | 249 | 3 |
| Disease | 2 | 3 | 4 | 5 | 4 | 3 | 45 | 293 | 4 |
| Prices | 16 | 12 | 8 | 7 | 4 | 2 | 17 | 243 | 2 |
| Labor | 6 | 4 | 7 | 7 | 4 | 4 | 34 | 345 | 6 |
| Input Prices | 11 | 21 | 5 | 9 | 8 | 2 | 10 | 226 | 1 |
| Capital Equipment | 0 | 3 | 2 | 1 | 5 | 6 | 49 | 420 | 11 |
| Loan Availability | 3 | 4 | 4 | 2 | 5 | 5 | 43 | 387 | 7 |
| Cost of Credit | 1 | 1 | 7 | 6 | 4 | 6 | 41 | 412 | 9 |
| Leverage | 3 | 1 | 3 | 1 | 3 | 1 | 54 | 417 | 10 |
| Leases | 0 | 0 | 0 | 1 | 1 | 0 | 64 | 457 | 18 |
| Technology | 1 | 0 | 1 | 2 | 2 | 6 | 54 | 436 | 12 |
| Government Programs | 5 | 5 | 4 | 11 | 6 | 6 | 29 | 340 | 5 |
| Government Laws | 4 | 1 | 4 | 4 | 4 | 5 | 44 | 392 | 8 |
| Urban Growth | 0 | 1 | 1 | 2 | 2 | 4 | 56 | 439 | 13 |
| Inflation | 0 | 2 | 0 | 1 | 1 | 3 | 59 | 444 | 14 |
| World Situation | 0 | 0 | 2 | 1 | 0 | 3 | 60 | 448 | 15 |
| Health | 0 | 0 | 1 | 0 | 1 | 0 | 64 | 456 | 17 |
| Family | 0 | 0 | 0 | 1 | 0 | 4 | 61 | 455 | 16 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 66 | 462 | 19 |

*NR=No Response

programs had the fourth most number of responses. Similarly government laws were ranked by 33% of the producers. The government obviously plays a major role in the operations of the dairy sector. Personal discussions with dairy producers found they have mixed views on government involvment. Some producers believed they would be better off without it. Others felt the government was a vital part of the dairy industry's well-being. Regardless, it is certain that the government is a major cause of turbulence in the Arizona dairy industry.

Weather

Weather variability was the third most important concern to Arizona dairymen. Weather, in this case, is indicative only to Arizona or similar regions. Although Arizona has little worry of blizzards, cold, or wind, the heat and humidity are enough to make weather the utmost concern. During the summer months milk production drops significantly. The production of each cow has been found to drop as much as 25% in July, August, and September. Also shade and mist need to be provided for all the cows. The cows' appetite is lower and cows can die of poor health. Diseases such as mastitis are more common in these summer months when rainy weather begins. Also, the cows have reproductive problems during this hot, humid time. Reproductivity can drop as much as 50%. Twenty-six percent

of the producers ranked weather number one. Eleven percent of the producers placed it second, and 15% put it third. Only 21% did not rank it at all.

Diseases

Diseases affecting cattle is a natural source of risk. Diseases can spread quickly with devastating effects on the dairy. Dairymen need to be constantly alert for signs of disease and act quickly when detected. Thirty-two percent of the respondents ranked diseases in their top 6 sources of variabililty. Mastitus, an inflammation of the mammary glands, is one of the main diseases of concern to the dairymen. Milk fever, a calcium deficiencey, is another prevalent disease. Disease is an area in which universities are concentrating their efforts.

Hired Labor

Uncertainties are associated with hired labor. Forty-eight percent of all respondents selected it as a major source of risk, 9% ranked it first. Among the problems are hiring laborers that have a knowledge of milking cows. Experienced workers quitting is also a common problem. Probably the most frequent problem occurs in communication between managers and workers. A large majority of Arizona dairies employ Spanish speaking workers which creates communication problems. Dependable workers are critical to dairies since the milking process must be done

on a regular basis without fail.

Cost of Credit

Cost of credit was a common choice as 23 dairy operators checked it third, fourth, fifth, or sixth. Only 1 person put it first and 1 person put it second. This suggests that cost of credit is a top third source of risk but not one of the critical problems. Cost of credit is a problem due to the capital intensive nature of the dairy industry. Short-term and long-term debt is necessary to the continuity of nearly every dairy. A slight change in interest rates can cause major changes in net income.

Other Sources

Other factors were not ranked highly but still are important sources of variability. These include availability of loans, costs of capital equipment, changes in technology, urban growth, use of leverage, inflation, world situation, family plans, health, land leasing, and other factors. All these sources were ranked by at least one producer except other factors which was not marked.

## Producer's Management Responses to Variability

The methods producers use to counter risk in their operations are as numerous as the sources of risk. Likewise, there are several responses that are used more frequently than the rest. The producers were given a list of 19

responses to variability and asked to rank the top 6. Again each response was given a score based on how many times it was selected and how high it was selected. The lower the score the higher it's ranking will be (Table 15).

Use of Consultants

The use of consultants is easily the most important response to variability. Seventy-nine percent of the respondents ranked it in their top 6 selections. Sixteen producers, 31%, ranked consulting as the number 1 method of reducing risk. The most common type of consulting is that of nutritionists and veterinarians. Dairymen believe consultants make such a beneficial difference that they are willing to pay for their advice. The University of Arizona is also a source of consulting information but to a lesser extent.

Communication with Hired Labor

A close second to consulting is communication with hired labor. This emphasizes personnel relations to insure proper management.Eighteen percent of the producers placed communication first. Eighteen percent ranked it second and 15% put it third. Good communication involves accomplishing a timely flow of operations in a designated fashion. Spanish-speaking workers compound the problem. Good communicaton might entail spending time with employees to

Table 15. Management Responses to Variability

Ranking of Importance

(Number of Responses in each category)

| Responses | 1 | 2 | 3 | 4 | 5 | 6 | NR* | Score | Rank |
|---|---|---|---|---|---|---|---|---|---|
| Enterprise Diversification | 3 | 1 | 1 | 3 | 1 | 1 | 56 | 423 | 11 |
| Geographic Diversification | 0 | 0 | 1 | 0 | 0 | 0 | 65 | 458 | 18 |
| Production Diversification | 0 | 2 | 1 | 2 | 0 | 0 | 61 | 442 | 15 |
| Feed Reserves | 3 | 5 | 10 | 3 | 2 | 5 | 38 | 361 | 5 |
| Spreading Sales | 0 | 3 | 0 | 3 | 0 | 2 | 58 | 436 | 13 |
| Forward Contracting | 4 | 7 | 5 | 6 | 7 | 3 | 34 | 348 | 4 |
| Futures Markets | 0 | 1 | 0 | 2 | 1 | 1 | 61 | 448 | 17 |
| Consultants | 16 | 7 | 10 | 7 | 7 | 5 | 14 | 251 | 1 |
| Communication with Labor | 12 | 12 | 10 | 7 | 7 | 6 | 12 | 252 | 2 |
| Market Information | 1 | 1 | 2 | 2 | 6 | 10 | 44 | 412 | 10 |
| Government Programs | 0 | 2 | 0 | 2 | 4 | 2 | 57 | 443 | 16 |
| Farm Organizations | 0 | 0 | 1 | 2 | 3 | 7 | 53 | 439 | 14 |
| Financial Reserves | 1 | 5 | 4 | 1 | 2 | 2 | 51 | 406 | 9 |
| Credit Reserves | 3 | 4 | 3 | 6 | 6 | 1 | 43 | 381 | 8 |
| Debt Management | 6 | 6 | 4 | 4 | 2 | 1 | 43 | 363 | 6 |
| Management Info. Systems | 10 | 7 | 9 | 9 | 4 | 2 | 25 | 294 | 3 |
| Flexibility | 2 | 0 | 2 | 0 | 5 | 5 | 52 | 427 | 12 |
| Pacing Investments | 3 | 4 | 2 | 7 | 6 | 3 | 41 | 380 | 7 |
| Off Farm Activities | 0 | 0 | 0 | 0 | 1 | 1 | 64 | 459 | 19 |

*NR=No Response

increase their understanding of the process. It also involves enjoyable relationships and a pleasant working atmosphere.

Management Information Systems

Management information systems collected the third highest score of all responses. Forty-one of the 66 ranked it in their first 6 selections. Ten placed it first. Management information systems include keeping accurate and timely accounting and production records for decision making. Such practices have been becoming more necessary as agriculture has become more specialized. The more efficient operations make better returns and progress. The use of computers has been incorporated in many of the more organized dairies.

Forward Contracting

Forward contracting is used by dairymen for two different reasons. They indicated they liked to contract for feed when they felt the prices were most favorable. Also, the contracting gave them a known production cost to use in their planning. Four dairymen felt this was the most important of all responses to risk, 7 felt it was the second, and 5 felt it was the third. The popularity of this method of reducing risk is understandable since the cost of inputs was one of the major sources of risk.

Feed Reserves

Maintaining feed reserves was the next most common response with 42% of the respondents ranking it. It only received 3 first place rankings, but 15 producers put it either second or third. Use of physical reserves of feed is valuable to dairies to offset drought or other unfavorable weather or price conditions. The dairymen of Arizona keep hay reserves that will last from one to eight months with an average of 4 and one-half months. They have reserves of concentrate that will last an average of 2 months.

Debt Management

Debt management is working with primary lenders to carry over loans, defer payments, refinance or restructure indebtedness for orderly payoff under adversity. It is a result of the expensive nature of the dairy business. Debt is common among the younger half of all dairymen. Debt management often is the difference between continuing business and bankrupcy. Twenty-three producers checked it in their top 6 choices.

Pacing of Investments and Expansion

Pacing of investments involves planning capital expenditures such as machinery, facilities, livestock, and land purchases to avoid becoming overextended. This response was ranked by 38% of the respondents. Once again the high

cost of owning a dairy is shown to create problems. Starting an average dairy requires 2.5 million dollars. Plans must be made to upgrade the assets at staggered intervals; otherwise, a shortage of cash or credit burdens are created.

Maintaining Credit Reserves

Producers that do not borrow to their fullest capacity but leave room for future needs are maintaining credit reserves. This method of financial risk management was the eighth most important response to variability. Twenty-three producers ranked it. Only three placed it first but 13 placed it either fourth, fifth, or sixth.

Other Responses to Variability

The other forms of countering risk that were not ranked as highly as the previous forms include: maintaining financial reserves, market information, flexibility in plans, farm organizations, enterprise diversification, government programs, spreading sales, production diversification, use of futures markets, off-farm activities, and geographic diversification.

## Consistencies in Selections

Another interesting note was the fact that the dairymen were somewhat consistent in their rankings. The dairymen that ranked the pricing responses highly, such as forward contracting, also ranked the pricing sources highly,

such as prices of inputs. The main catergories showing consistencies were financial, governmental, and personal management. Table 16 shows the types of sources and responses that were the most common choices. Three sources of variability from the top 8 are under the production category and 4 responses from the top 8 were under the production management category. Obviously, such things as finances, production, and prices are the main concerns of Arizona dairymen while such things as government and personal aspects are secondary concerns.

## Statistical Techniques

The hypothesis to be tested is that economic models should take into account risk factors which are significant to the producer. To derive such a conclusion it is necessary to understand if certain socioeconomic characteristics of the farmer are related to his perceptions of risk and his management response.

The socioeconomic information included age, education level, years of dairy experience, income, size of dairy, legal form of business, net worth, and debt. The computerized statistical package SPSS was used to calculate the necessary statistics to find correlations between the socioeconomic factors and the sources of risk corresponding to them.

Chi-square analysis was used to determine the

Table 16. Types of Highly Ranked Sources and Responses

| Top 8 Sources | Type |
|---|---|
| 1.Input Prices | Pricing |
| 2.Output Prices | Pricing |
| 3.Weather | Production |
| 4.Diseases | Production |
| 5.Government Programs | Institutional |
| 6.Labor | Production |
| 7.Loan Availability | Financial |
| 8.Government Laws | Institutional |

| Top 8 Responses | Type |
|---|---|
| 1.Consultants | Production Management |
| 2.Communication | Production Management |
| 3.Management Info. Systems | Production Management |
| 4.Forward Contracting | Marketing |
| 5.Feed Reserves | Production Management |
| 6.Debt Management | Financial |
| 7.Pacing Investments | Financial |
| 8.Credit Reserves | Financial |

independence of each risk variable against the socioeconomic characteristic of the dairymen. Chi-square analysis involves classifying data into rows by one criterion and into cloumns by another criterion. The data are represented as frequency counts in each cell of this contingency table. The expected cell count is what would be found if there is no relationship between the two variables. This fiqure is compared to the observed cell count. The degree of independence exhibited by the frequency table involves computing the difference between the observed and expected cell counts. This statistic is not good if the cell counts are small. In this circumstance several similar rows and columns were combined in order to raise these low values. To do this the categories were collapsed. For example, instead of having 5 categories of herd size there are now two.

The comparisons revealed very few relationships between the dairymens' individual characteristics and their perceptions and responses. There were 304 possible relationships and of those 21 comparisons showed significance levels of .20 or less. Nine comparisons were less than .10. Table 17 lists the relationships found.

Socioeconomic Factors and Sources of Risk

A strong relationship was found to exist between the producer's education level and his ranking of uncertainties associated with hired labor. This relationship has a Chi-

Table 17A: Sources of Variability for Dairy Producers

| Variables | Chi-Square Test (Significance Level) | Explanation |
|---|---|---|
| Cost of Operating Inputs by Herd Size[1] | .14 | Large dairies rank input costs higher than do small dairies. |
| Availability of Loan Funds by Age[2] | .20 | Younger dairymen perceive credit as a greater concern. |
| Changes in Hired Labor by Education[3] | .02 | More educated dairymen view hired labor as more important. |
| Weather Variability by Net Worth[4] | .18 | Impacts of heat on production will have greater affects on large dairies. |
| Changes in Hired Labor by Net Worth | .15 | Large dairies rank hired labor as a major concern. |
| Cost of Credit by Net Worth | .13 | Larger dairies with larger loans are affected more by credit costs. |
| Government Programs by Long-Term Debt[5] | .11 | Heavily leveraged dairies make use of government programs. |

1 Two Herds Sizes: Less than 500 cows, greater than or equal to 500 cows.
2 Two Age Groups: Less than 50, greater than or equal to 50.
3 Two Education Levels: High school graduate or less, more than high school.
4 Two Net Worth Levels: Less than one million, one million or greater.
5 Two Groups of Long-Term Debt: Less than $500,000, greater than or equal to $500,000.

| Variables | Chi-Square Test (Significance Level) | Explanation |
|---|---|---|
| Government Laws by Short-Term Debt[6] | .03 | Dairies with little production credit are more concerned with government laws. |
| Changes in Hired Labor by Buyout Program[7] | .02 | Dairies objecting to the program have more labor concerns. |
| Weather Variability by Relocating[8] | .18 | Perceptions of weather affect decisions concerning relocation plans. |
| Product Prices by Relocating | .11 | Dairies planning to relocate rank product prices higher. |
| Changes in Hired Labor by Relocating | .02 | Dairies wishing to relocate have more labor concerns. |

6 Two Groups of Short-Term Debt: Less than $500,000, greater than or equal to $500,000.
7 Three Groups of Buyout Program Decisions: Yes, No, Undecided.
8 Three Groups of Relocation Decisions: Yes, No, Undecided.
9 Three Groups of Expansion Decisions: Yes, No, Undecided.
10 Three Groups of Voluntary Reduction Decisions: Yes, No, Undecided.

Table 17B: Management Responses to Variability by Dairy Producer

| Variables | Chi-Square Test (Significance Level) | Explanation |
|---|---|---|
| Maintaining Feed Reserves by Herd Size | .01 | Large dairies are more dependent on maintaining feed reserves. |
| Management Information systems by Herd Size | .13 | Small dairies placed more emphasis on management systems. |
| Forward Contracting by Age | .05 | Younger dairymen believe forward contracting is a useful tool. |
| Communication with Hired Labor by Age | .05 | Younger dairymen are more concerned with communication with labor. |
| Debt Management by Age | .12 | Younger dairymen place more emphasis on debt management as as a risk management tool. |
| Maintaining Feed Reserves by Education Level | .12 | Higher educated dairymen keep more feed reserves. |
| Maintaining Feed Reserves by Long-Term Debt | .14 | Dairies with high debt view feed reserves as more important. |
| Market Information by Long-Term Debt | .02 | Dairies with large debt follow market information more. |
| Use of Consultants by Short-Term Debt | .08 | Dairies with less short-term debt use consultants much more. |

square significance level of .0190. This suggests that more educated producers perceive hired labor as a major part of their operation and possibly employ more labor than less educated producers.

A similar relationship was found to exist between the amount of production credit an operator had in use and government laws and regulations. The dairymen with less short-term debt ranked government laws significantly higher as a source of risk. The relationship between short-term credit and government laws has a significance level of 0.0267.

Similarities were found between the producer's opinion on the buyout program and hired labor. Producers saying they would not participate in another buyout program ranked hired labor much higher than those who would participate. This had a significance of .0239. Those producer's planning to relocate their operation also ranked hired labor very highly. The relationship has a significance of .0218.

The strongest correlation found was that between the number of lactating cows and maintaining feed reserves. As the milking herd size increased so did the importance placed on feed reserves. This relationship was significant at 0.0098.

Socioeconomic Factors and Responses to Risk

Age was a large factor when determining what group of producers use forward contracting. Operators under 50 used forward contracting as a method of reducing risk much more than those over 50. Those operators under 50 years of age probably are more flexible to change; whereas, those over 50 are comfortable with their traditional methods of purchasing and marketing and do not wish to change. The significant level was .0520. Age was also an influencial factor when tested with communication with hired labor. Younger dairymen ranked communication with hired labor much higher than older dairymen. It was significant at .0511.

Long-term debt seemed to be related to how much a producer uses market information. Heavily indebted dairymen use market information to lower their risk of changing prices much more than dairymen with lower levels of debt. This has a Chi-square significance of .0207.

Short-term credit was found to be tied to the reliance a dairyman places on consultants. Dairymen with a high operating debt do not use consultants as much as those with low operating debts. This could suggest that producers feel they will be further ahead by making loan payments than by paying consultants. This is significant at 0.0849.

Those operators not wishing to participate in another buyout program seem to use forward contracting to hedge against risk much more than those indicating that they

would participate. Chi-square analysis was significant to 0.0694.

Dairymen not wishing to expand their operation size tend to place more importance on keeping adequate feed reserves. This was a strong correlation with a significance of 0.0165.

Dairymen in favor of a voluntary reduction plan ranked communication with hired labor as an important risk management tool. The significance was found to be 0.0230.

There are some definite correlations between the sources and responses to risk and a dairymen's socioeconomic make-up. This implies that there are certain psychological variables that are present that cause producers to make decisions and have definite tendencies. The hypothesis that all dairymen perceive the world differently is true, however. There was little noteable commonality among the producers of Arizona based on their individual socioeconomic factors.

# Chapter 5

## SUMMARY AND CONCLUSIONS

Environmental turbulence is a fairly new concept that is used to describe the wide range of problems encountered by modern business firms. Firms today are becoming more specialized and therefore more dependant upon outside firms for inputs necessary for operation. For example, few modern farms produce their own feed, fertilizer, food, or seed. Instead they utilize the services of consultants, bankers, and farm supply companies. This increased dependence on the surrounding environment causes a more turbulent working world with more emphasis on human interaction. In addition, firms may not solely be as concerned with profit maximization as traditional theory will state. Businesses may be more concerned with maximizing sales, not profits, in order to maintain a competitive position within the industry. Others may be more concerned with company size by total assets or employee number while meeting a required profit constraint. Some firms prefer stability, market share, research, or meeting goals over maximizing profits. Firms must plan for things besides methods of profit maximization. A few other considerations are: pollution, fluctuations in economic activity,

inflation, after sale service, governmental regulations, etc.

Studies have shown that psychology plays an important role in economic decision making. People making decisions for themselves will think differently than when making decisions for their company. Risk is one of the most important reasons why people are not consistent in their decisions and goal planning. Everybody perceives risk differently. Some people are risk lovers and others are risk averse and they plan their lives accordingly.

Agricultural firms operate in an extremely uncertain environment. Farm operators must face uncertain yields and flucuating input and output prices. Agriculture is now in a world wide market where events around the world can affect domestic prices. Government programs have created an unstable environment for farmers. Many different programs have been tried but few have made lasting impacts. For example, the Environmental Protection Agency has changed the farming world by setting new laws and regulations. For the farmer the current environment means less freedom and increasing uncertainty.

Research on risk in the agricultural sector has focused primarily on profit maximization and has been based on output prices and yields. However, discrepencies have been shown to exist between actual farming behavior and predicted farming behavior. The hypothesis that was tested

was if certain risk factors on the input side should be included in risk research models. Do such things as weather, hired labor, or interest rates play a role in an operator's decision making process? Another objective of this research was to determine if the decisions of farm operators are influenced by their socioeconomic characteristics. Do such things as age, education, or wealth influence how operating decisions are made?

The dairy sector has historically been overlooked by agricultural risk researchers. This is because it has been unique and less exposed to risk than other sectors of agriculture. Dairymen have a product for sale daily, therefore a constant cash flow and more chance of obtaining credit when needed. Dairy has been involved in beneficial government programs as result of powerful political lobbyists. Furthermore, they have had a very organized marketing structure with surpluses being converted into cheese and butter.

Risk has become more prevalent in the dairy business today as dairy policy is uncertain, input prices are variable, and financial risks are more common. This unstable environment has prompted more research on risk in dairy farming.

The research in this project is based on a survey of all dairy operations within the state of Arizona. A modified

version of Dillman's "total design method" was used. The modified total design method is a combination of telephoning and mailing each person in the population to be tested. It was also necessary to make personal dairy visits to gather the needed information. A typical response rate in a census of an agricultural group is expected to be rather low. However, the modified total design method resulted in a 70% response rate from the population of Arizona dairymen.

The questionnaire asked the dairymen their socioeconomic information such as age, education level, years of experience, income, size of dairy, legal form of business, net worth, and debt. These statistics were then used to classify dairymen into groups to find correlations between their individual characteristics and how they perceive and respond to risk.

The average age of the dairymen was found to be 45 years with an average of 25 years of dairy experience. The dairies had a mean of 610 milking cows. The dairies had a wide range of gross incomes with the largest percentage being between $500,000 and $1,000,000. However, most dairies reported negative taxable incomes or less than $20,000. The net worth of an average Arizona dairy is between $1,000,000 and $2,500,000. The dairymen also have sizeable debts. A typical Arizona dairy has a short-term and long-term debt of $500,000. Most dairies are owned by one individual. However, general partnerships and corporations are not uncommon in

the industry.

The top 6 sources of variability were selected, in order, from a list of 19 by each respondant. The data was compiled and analyzed by use of the computerized statistical package SPSS. The sources of risk which caused the greatest concern were costs of operating inputs, prices of outputs, weather, diseases, hired labor, and cost of credit. Other factors included cost of capital equipment, availability of loan funds, changes in technology, urban growth, use of leverage, inflation, world situation, family plans, health, and land leasing.

Producers were given a list of 19 management responses used to manage risk and asked to select the top 6 in order. The overall ranking of the most popular choices were calculated. The most common selections were use of consultants, communication with hired labor, management information systems, forward contracting, maintaining feed reserves, and debt management. Other factors were pacing of investments, maintaining credit reserves, financial reserves, market information, flexibility in plans, farm organizations, enterprise diversification, government programs, spreading sales, production diversification, futures markets, off-farm activities, and geographic diversification.

The theory that each individual producer makes

decisons uniquely and unpredictably is true. A few relationships were found to exist among the producers concerning the reasons they made certain decisons. Overall, it was determined that each producer has different motivations and is unique in his decsion making process. Chi-square analysis was the statistical technique used to reveal correlations that did exist between the producers' socioeconomic information and their perceptions of risk. Relationships were found to exist between the producers' education level and their ranking of changes in hired labor; between amount of short-term debt and their ranking of government laws and regulations; between their opinion of the buyout program and hired labor; also between those planning to relocate and hired labor.

Chi-square analysis was again used to identify relationships. The relationships analyzed were those between management responses to risk and socioeconomic characteristics. The number of lactating cows determined the importance placed on feed reserves. Age was a large factor influencing the use of forward contracting. Long-term debt dictates to what extent producers use market information, while short-term debt was tied to the reliance a dairyman places on the use of consultants. Those operators not wishing to participate in another buyout program also do not wish to use forward contracting. Dairymen wishing to expand placed more importance on feed reserves. Those in favor of a

voluntary reduction plan ranked communication with hired labor as an important risk management tool.

The commonality between a producers' socioeconomic characteristics and the decsions they make is proof that psychology and economics are closely related. This is not surprising since economics is a science of decison making and decisions are largely based on how an individual thinks and perceives risk. Risk perceptions are a key factor in the decision making process. Therefore, risk variables should be used more often in agricultural economic models. Rather than focusing on output yield and price variability, factors from the input side of production should enter into risk research models. Specifically, the risks associated with input prices, weather, diseases, government programs, labor, and financing should be entered into risk research of the dairy sector.

Further research may find that a producer's actions are more influenced by his risk perceptions than by his desire to make the most profit possible. Research should be conducted to determine to what degree a producer will trade his reputation and integrity for profit. To what extent will a producer profit at his neighbor's expense? Issues concerning production and psychology are beginning to arise and the two are not separable. Psycho-economics is a relatively new field that is just beginning to be explored.

REFERENCES


Ansoff, H. Igor, Implanting Strategic Management, Prentice-Hall, Inc., Englewood Cliffs, N.J., 1984.

Armstrong, Dennis and Roger Selley, 1985 Arizona Dairy Industry, Cooperative Extension Service, University of Arizona, 1985.

Baumol, William J. Business Behavior, Value and Growth, New York: Macmillan, 1959.

Boehlje, M.D. and L.D. Trede "Risk Management in Agriculture",Journal of American Association of Farm Managers and Rural Appraisers, 41(1977):20-29.

Boggess, W.G., K.A. Anaman, and G.D. Hanson, "Importance, Causes, and Management Responses to Farm Risks: Evidence from Florida and Alabama" Southern Journal of Agricultural Economics, December, 1985. pp.105-116.

Dillman, Don A., Mail and Telephone Surveys: The Total Design Method.John Wiley and Sons, New York,1978.

Hatch, R.E., W.L.Harman, V.R. Eidman and P.L. Claypool, "An Evaluation of Factors Affecting the Hierarchy of Multiple Goals". Oklahoma Agricultural Experiment Station Technical Bulletin T-134, June 1972.

Lanzilloti, Robert F. "Price Objectives in Large Companies",American Economic Review. December 1958, pp.921-40.

Libby, R. and P.C. Fishburn. "Behavioral Models of Risk Taking in Business Decisions: A Survey and Evaluation", Journal of Accounting Research. 15(1977):272-92.

Lin,W., G. Dean, and C. Moore. "An Empirical Test of Utility Versus Profit Maximization in Agricultural Production." American Journal of Agricultural Economics. 56:497-508.

Melichar, Emanuel. "A Financial Perspective on Agriculture", Federal Reserve Bulletin. January 1984.

Patrick, G.F. and B.F. Blake "Measurement and Modeling for Farmers' Goals: An Evaluation and Suggestions", Southern Journal of Agricultural Economics 12(1980):199-204.

Patrick, G.F., P.N. Wilson, P.J. Barry, W.G. Boggess and D.L. Young."Risk Perceptions and Management Responses: Producer-Generated Hypothesis for Risk Modeling" Southern Journal of Agricultural Economics. 17(1985):231-238.

Raaij, W. Fred van,"Economic Psychology",Journal of Economic Psychology. (1981): pp. 1-24.

Radner, Roy and C.B. McGuire, Decision and Organization, North-Holland Publishing Co., 1972.

Sonka, Steven T. and George F. Patrick, "Risk Management and Decision Making in Agricultural Firms", Risk Management in Agriculture. Iowa State University Press, Ames, Iowa, 1984 pp.95-115.

Tauer, Loren W. "Risk Preferences of Dairy Farmers" North Central Journal of Agricultural Econimics.,Vol.8 No.1 January 1986.

U.S.D.A., 1981 and 1985. Agricultural Statistics.

Weston, R.E. and J.W. Cary, A Change for the Better: Stress, Attitudes, and Decision Making of Dairy Farmers 1976 to 1978.University of Melborne, November, 1979.