Demand for Extension Education and Perceived Farm Risks

By

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STATEMENT BY AUTHOR

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Dr. Tauhidur Rahman Date

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THESIS SUMMARY

Objectives of this thesis are two-fold: one is to examine the determinants of demand for extension education in the rural Southwest, and other one is to examine the determinants of perceived farm risks in the rural Southwest. In doing so, I provide new insights in the determinants of both demand for extension education and perceived farm risks in the West, which in turn, provide useful information for the effective delivery of extension education.

Using representative survey data of small farms in Arizona, Colorado, and Wyoming, in chapter 1, I examine the demand or participation in extension education. In this case, the dependent variable is participation in extension education that takes the value of 1 if small farm operators have ever received education from University outreach program; otherwise it takes the value 0. Thus, the dependent variable is a binary variable. Therefore, we estimate a probit regression model for the demand for extension education. The results show that supplementing family income is the primary motive for farm activities. Gender, educational achievements, the residency of farm operators, their access to internet, level of income diversification, and total acres of land managed are the main determinants of demand for extension education.

In chapter 2, using the same survey data I examine the determinants of perceived farms risks. I also study the role of Extension Education in agricultural risk managements. I clarify the relationships between perceived production, financial, marketing, legal/institutional, and human risks and various socioeconomic, institutional,

environmental, demographic, and farm structure variables. I find that extension education has a significant role in household's evaluation of agricultural risks.

CHAPTER ONE

Demand for Extension Education: Evidence from rural Southwest

Abstract

Agricultural extension service at the Land-Grant Universities is one of the most important education programs that offer farm management educational opportunities to farmers. Extension educators have been challenged by the technically and economically dynamic environment to provide information regarding the changing demand for the products of the system. This chapter aims at providing a better understanding of factors associated with demand for extension education. Using a representative survey data of small farms in the states of Arizona, Colorado, and Wyoming, we explore the determinants of demand for extension education. The results show that supplementing family income is the primary motive for farm activities. Gender, educational achievements, the residency of farm operators, their access to internet, level of income diversification, and total acres of land managed are the main determinants of demand for extension education.

1.1 Introduction

Agricultural extension services at the Land-Grant Universities is one of the most important agencies that offer farm management educational opportunities to farmers which simplify technical information to various farm activities. Extension educators have been challenged by the technically and economically dynamic environment to provide information regarding the changing demand for the products of the system. Agricultural extension service has the main purpose of increasing the social efficiency of agricultural production. As Carter and Batte (1993) stated, extension educators must develop

educational programs that reflect both expressed and unrecognized needs and interests of people.

Changes in demography, technology, market, economy, input prices, and government policies increase the heterogeneity of the U.S. farmers. Small farm holders generally do not adopt new technological advances in agriculture as fast as large farm holders due to a lack of knowledge, limited managerial skills and resources. As a result of technological change, changes in the markets for farm product such as the development of mass retailing and transportation give rise to the decreased competition power for small-farm operators in the system. Input prices and government policies have been varying over time which makes production agriculture more complex. Besides, it is small farm holders that have been affected mostly by these changes due to the inability to economically justify the adoption of the technology. In spite of these facts, small-farm operators have not usually participated in extension programs in farm management, marketing, and rural development although programs in these areas have been available. Thus, it is appropriate to look at the demand side of extension education to develop a more effective delivery of extension education.

Agricultural extension educators are searching for more efficient ways in deliver their programs to provide valuable information. In order to deliver these programs effectively, it is necessary to determine the factors which affect the demand of extension program which will guide educators to find new extension clientele, methods of instruction, and identify the perceptions held by participants. Extension educators should be responsive to the changes in needs of farmers due to the rapid changes in technology.

Various segments of the agricultural industry should focus on factors associated with participation of farmers in agricultural extension programs. In this regard, it is important to understand the characteristics of the participants in terms of reasons for participation and who participates.

Martin and Omer (1987) found that young farmers placed a very high priority rating on marketing, production records, and production management. Farmers aged 40 and over rated the importance of extension methods and areas lower than did the younger farmers in Iowa. Female respondents rated livestock production and horticulture, educational displays, and use of computers significantly higher than male respondents. According to these results, the demographic characteristics of the farmers such as age and sex should be considered when planning and revising the educational programs.

A farmer's managerial ability can be indicated by the farming experience and education because they increase the ability of a farmer to interpret and modify new information. It is legitimate to expect a more educated and experienced farmer to be better in formulating his farm plans. Therefore, both farming education and experience have high probabilities to increase the demand for extension education services.

The demand for extension service seems likely to increase with the acres of total land a farmer owns due to the reason that it is becoming more difficult to deal with the problems and adopt the changes in technology. Agricultural research at Land-Grant Universities should take this fact into account in planning programs. Reasons for involvement in an agricultural operation, information sources and preferences, income

status, and resource management are shown as important factors as demographic factors such as gender, age and education in articulating the demand for extension education.

This chapter develops a suitable econometric framework in order to determine the demand for extension education in the rural Southwest (AZ, CO, and WY). In considering the problems of farmers, agricultural research and extension activities should be relevant to the needs and interests of farm operators. Since financial support for extension is declining, it should be well reminded that research to develop more effective approaches to extension is needed along with funding of such services. The diversity of clients and the need for a change in delivery methods has a great deal on the demand on extension education changes. For the purpose of measuring the demand for extension education, this study attempts to determine the factors that affect the participation in Cooperative Extension Programs.

The rest of the chapter is organized as follows. In section 2, we briefly summarize the relevant literature on demands for extension education. Section 3 describes survey data used in this study and characterizes the small farms in the rural Southwest. In Section 4, we present the econometric model used explore the determinants of extension education. Section 5, we discuss the empirical results. We conclude in Section 6.

1.2 Previous Studies

Many factors affect the demand for various farm management educational topics. Past studies suggest that the high priority farm management educational needs of farmers should be investigated to measure the demand for extension education programs. Carter

and Batte (1993) studied farmers' perceptions of the importance of different farm management educational topics. A multivariate logit model was used to demonstrate an audience targeting model for alternative farm management topics using a five scale; 1 being not important and 5 being very important. Results of the study show that income tax management, agricultural input prices, and year-end financial analysis are the topics rated highly by farmers regardless of size or enterprise type in an Ohio extension district. The study identifies the important predictors of topic preference as well. Farmers who are most likely to attend the program are identified by the age of operator, tenancy, and size of the farm business, whereas operator education level and off-farm employment are not statistically significant indicators.

Bagi and Bagi (1989) examined the determinants of demand for extension education in selected counties of West Tennessee. They find that small farm operators have lower demand for extension education in comparison to large-farm operators; small farm operators with less farming experience and education have even lower demand for extension programs; and the level of farm assets, farming experience, and level of education are the main factors that affect the demand for extension service. Moreover, the demand for extension information is significantly higher for white farmers compared to black farmers. Thus, Bagi and Bagi (1989) suggest a need for consideration of increasing the extension service on small farm operations. West (1979) studied the changes affecting small farms and documented the defining characteristics of small farms. He showed that small-farm operators have not usually participated in extension programs even though such programs are available in these areas. One of his arguments is that small farmers

have difficulties in adopting technology depending on the limited sources they have. Uko and Miller (1987) suggested farmer educational needs were not related to age, farm size, marital status, educational attainment, and sex. Carter and Marvin (1993) find that the types of principal enterprise have a strong relation with the educational needs for small scale Ohio farmers. Blezek and Post (1989) analyzed the differences between the mean level of competencies possessed and that needed in farm credit among members of the Nebraska Young Farmers/Ranchers Education Association. They recommended that the study should be made available to the Executive Secretary of the Nebraska Young Farmers/Ranchers Education Association since there was a great need for additional training and understanding regarding financial management.

Emmalou Van Tilburg (1981) aimed at investigating the factors related to participation and persistence, the differences between them, and the predictors of satisfaction with participation and persistence. The Ohio Cooperative Extension Service (OCES) adult clientele was targeted for the purpose of this study. What they found is that the main factors related to persistence and participation seems to be same which are information, social, arrangements, and internal motivation. They showed that individuals are more satisfied when they experience self-improvement and do not have negative learning experiences.

Martin and Omer (1987) emphasized the importance of factors associated with participation of young farmers in agricultural extension education. They found that Iowa farmers rated the local community meetings which are a method of instruction by the Cooperative Extension Education as the highest rank. The results indicated that they have

a high awareness of Cooperative Extension Education and a high level of satisfaction provided by the Cooperative Extension Education. The respondents placed a high priority rating on production records, marketing, and production management educational programs. Results of this study revealed the needs of Iowa farmers and types of participation as well.

We examine the determinants of demand for extension education in the Western United States. In order to determine the factors affecting the decision in participating extension services, we estimate a Probit Model, where the dependent variable is the binary dummy variable that takes the value of 1 if a small farm has received extension education in the past; otherwise it takes the value of 0. The set of potential explanatory variables include factors reflecting the demographic characteristics of the operator, income status, resource management related variables, reasons for involvement in farm operation, information sources and preferences, and many others.

1.3 Data

According to the 2002 Census of Agriculture, there are 48,085 farmers and ranchers in the states of Arizona, Colorado, and Wyoming. Census data indicate a decreasing number of "traditional" producers and a significant increase in the number of small farms in these three states. Farms with sales of less than $50,000 account for 78% of all farms. Thus, the survey target population consisted of farm operations with annual sales of less than $50,000, and in order to comprehensively examine the importance, sources, and causes of farm risks in the West, a survey of farm operations in Arizona,

Colorado, and Wyoming was conducted in the spring of 2006. A total of 4,939 survey instruments were mailed to small farm operators in these states. In order to ensure a representative sample from each state, the numbers of survey instruments mailed to states were allocated based on the population of small farm operators in each state. The total response rate was 53.6%. A total of 2,645 surveys were completed, which constitutes the sample size of empirical analyses.

Data were collected on small operator's demographics, reasons for involvement in the rural family ventures, sources of risks, vulnerability factors, information sources and preferences, resource management, and income status, and thus enabling us to empirically examine the importance and determinants of perceived farm risks and the role of extension education in agricultural risk management in the Western rural United States.

1.3.1 Characteristics of Small Farms in the Rural Southwest

Extension Education is a binary variable that takes the value of 1 if the farm operator has ever received information from Cooperative Extension and takes value 0 otherwise. The objective of this study is to examine the determinants of demand for extension education. For this purpose, the probit model uses data on participation in extension education to estimate the probability of participation in extension education programs.

With regards to Figure 1.1, most respondents (1301, 79.62%) indicated they have received information from Cooperative Extension; whereas 333 (20.38%) respondents had not.

Figure 1.1: Overall Participation in Cooperative Extension

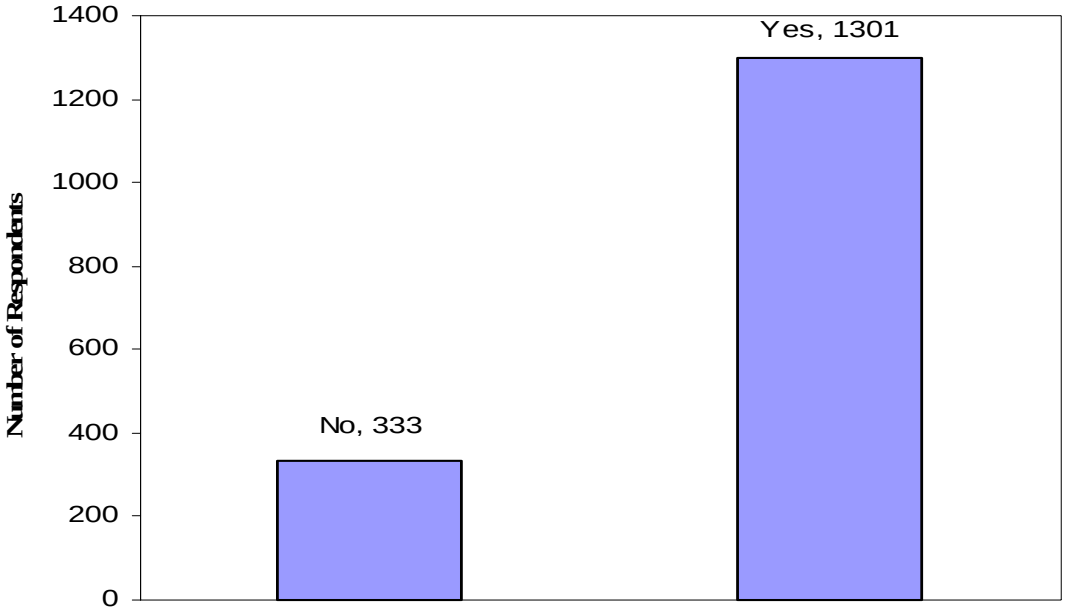


Figure 1.2: Participation in Cooperative Extension in Arizona

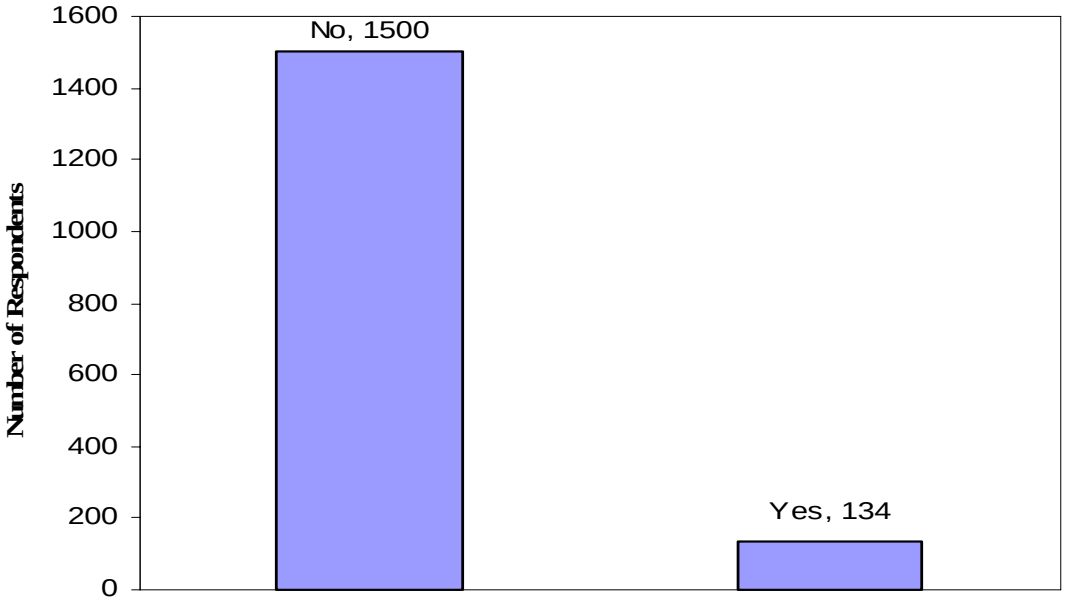


Figure 1.3: Participation in Cooperative Extension in Wyoming

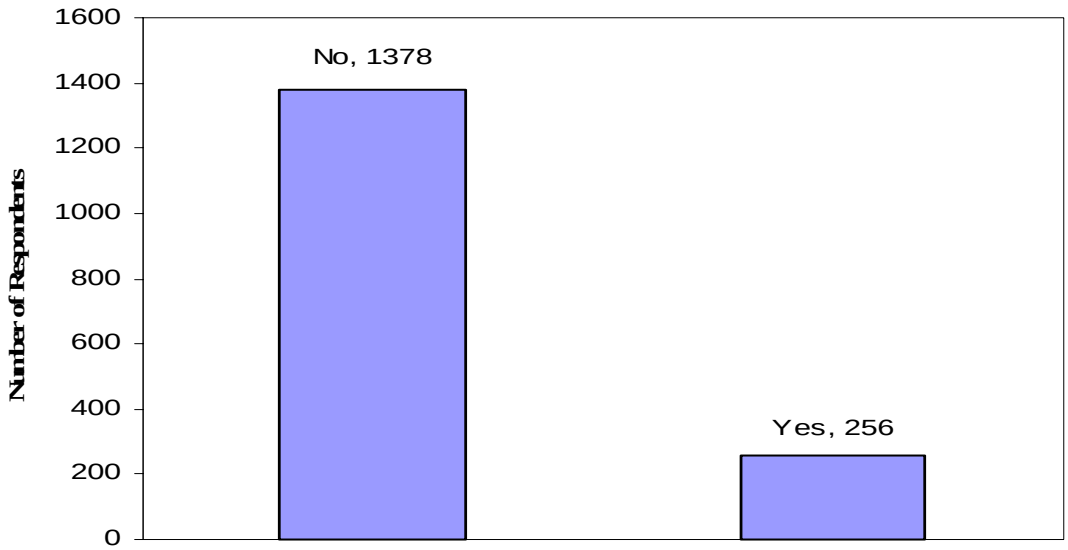
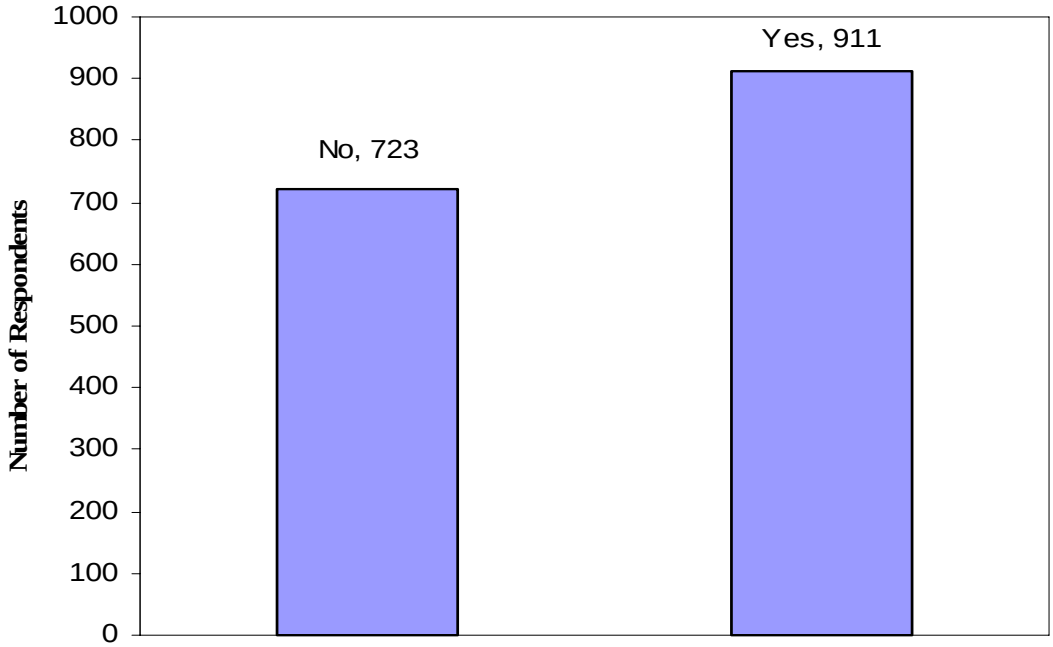


Figure 1.4: Participation in Cooperative Extension in Colorado



We can see the participation in Cooperative Extension by state; Arizona, Wyoming, and Colorado from Figure 1.2, 1.3, and 1.4 respectively. As shown in these figures, participation is high in Colorado compared to Arizona and Wyoming.

Risk is the possibility of loss and risk perception is the subjective assessment held by people about the severity of a risk. Five primary sources of risk for agricultural operations are identified by the United States Department of Agriculture: production, financial, marketing, human, and legal. Respondents were asked to evaluate how important each risk to their operation; 1 being the most important and 5 being the least important.

The major sources of *production* risk are weather, diseases, pests, and other factors that affect both the quantity and quality of commodity produced. Overall, production risk was ranked as the second most important source of risk (Figure 1.5). As we can see from Figure 1.6, more respondents rank production risk as either first or second important to the operation.

Financial risk's main sources are increased interest rates, restricted credit availability, and the ability to meet cash flow needs in a timely manner. Financial risk is ranked as the most important source of risk by a majority of respondents as seen from Figure 1.7. In addition, respondents ranked financial risk higher than the other sources of risk as seen from Figure 1.5.

Marketing risk refers to uncertainty in the prices of commodities that producers will receive or pay for inputs. Overall, marketing risk was ranked as the fourth important to the operation (Figure 1.5). However, the highest number of respondents (434) ranked it

as the third highest risk which is a sign that they were less definite in this area compared to any other (Figure 1.8).

The category of *human* risk includes factors such as problems with human health, interaction with family, accidents, and illness that can affect farm business. More respondent ranked human risk as the least important to the operation (525) after legal risk given in Figure 1.9. On the other hand, more respondents ranked human risk more important than marketing or legal risk as shown in Figure 1.5.

Legal or institutional risk issues can be explained by the government actions such as tax laws, regulations for chemical use and torte liability. 1,050 respondents rank legal risk as the fourth or fifth least important to the operation (Figure 1.10). In addition to this, fewer respondents overall ranked this source of risk as the most important to the operation (Figure 1.5).

Figure 1.5: Highest Rank of Risks Types

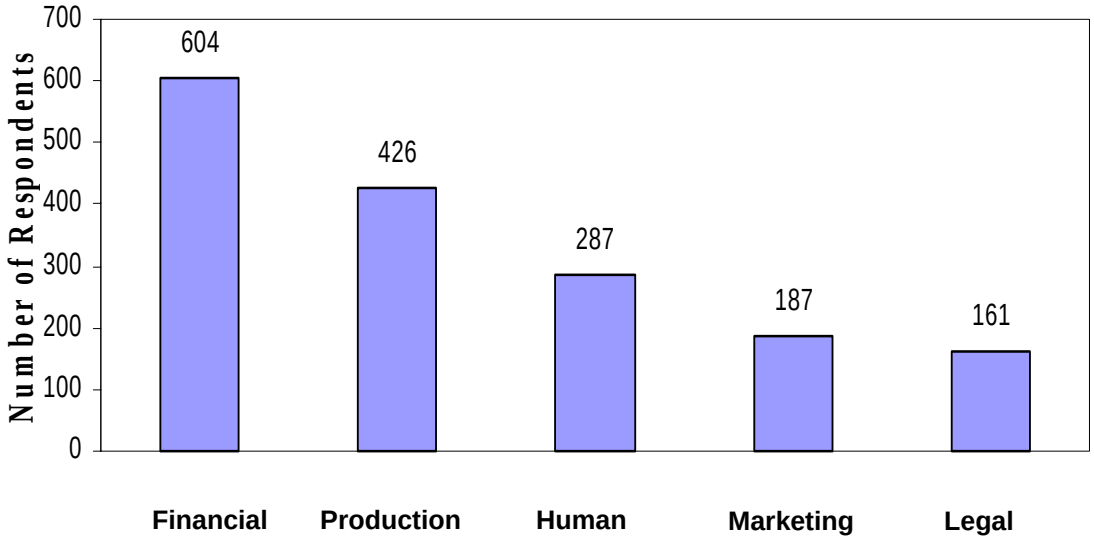


Figure 1.6: Production Risk

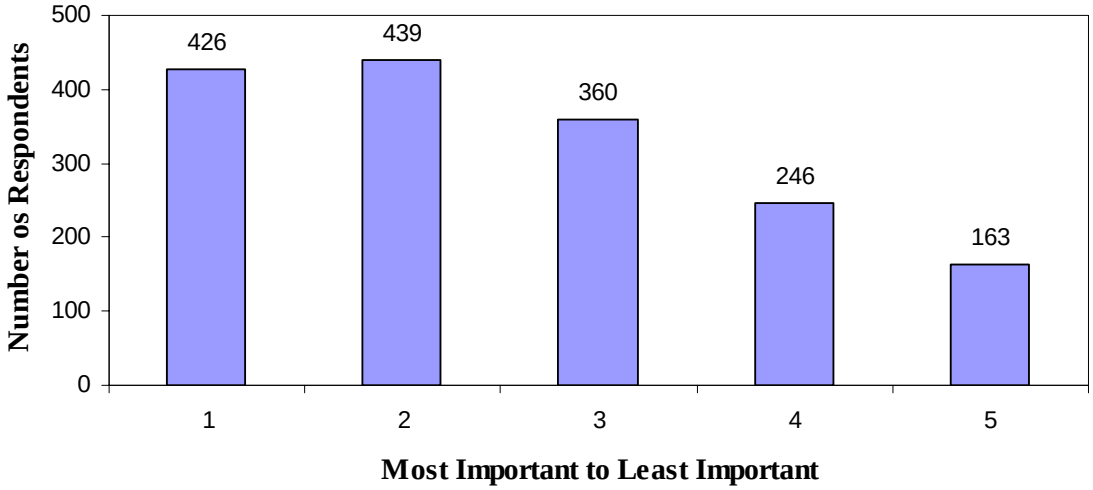


Figure 1.7: Financial Risk

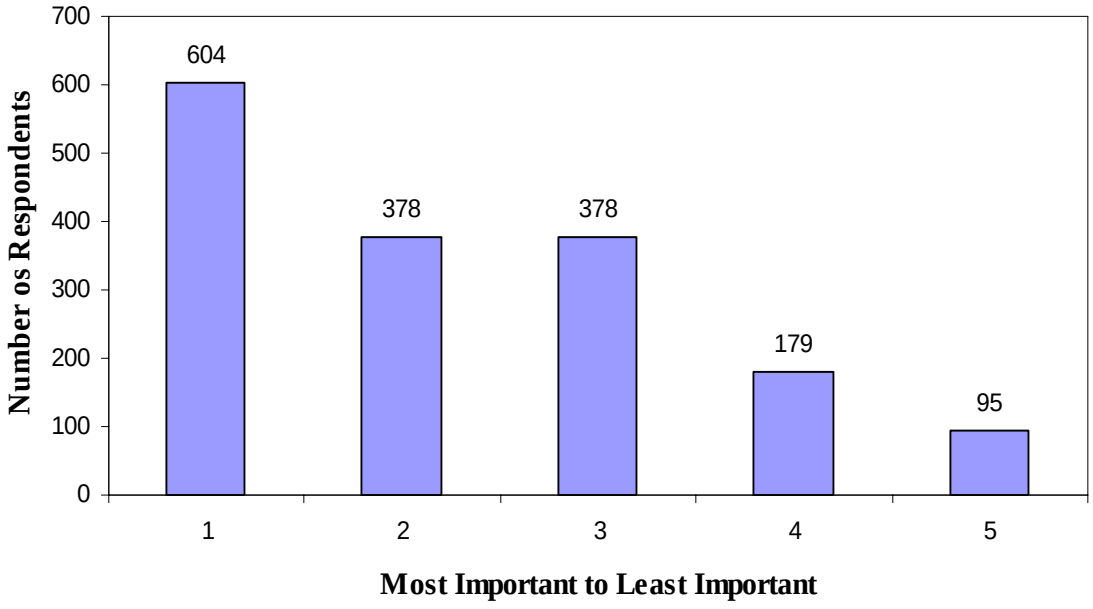


Figure 1.8: Marketing Risk

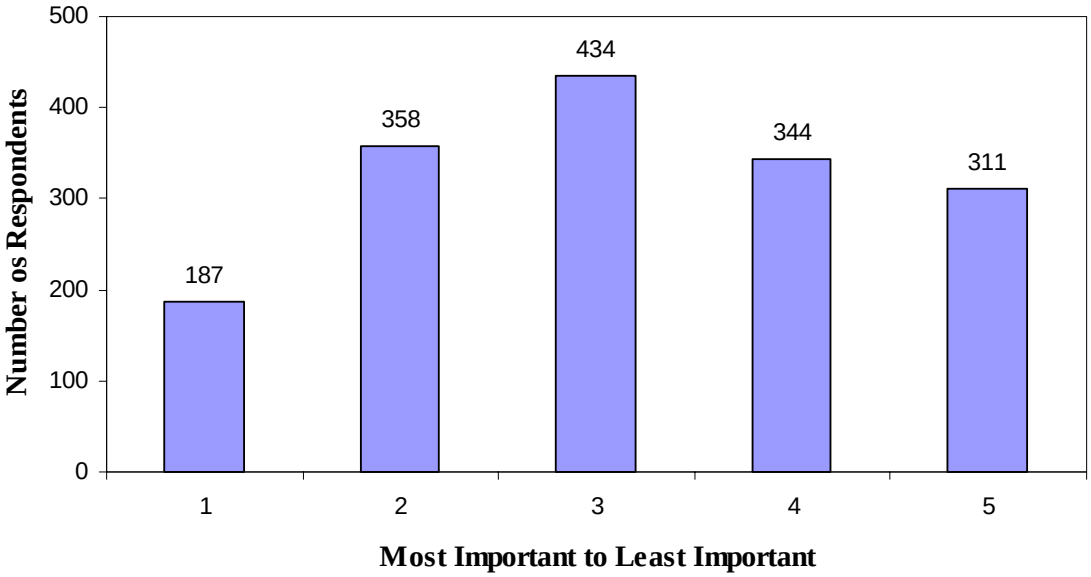


Figure 1.9: Human Risk

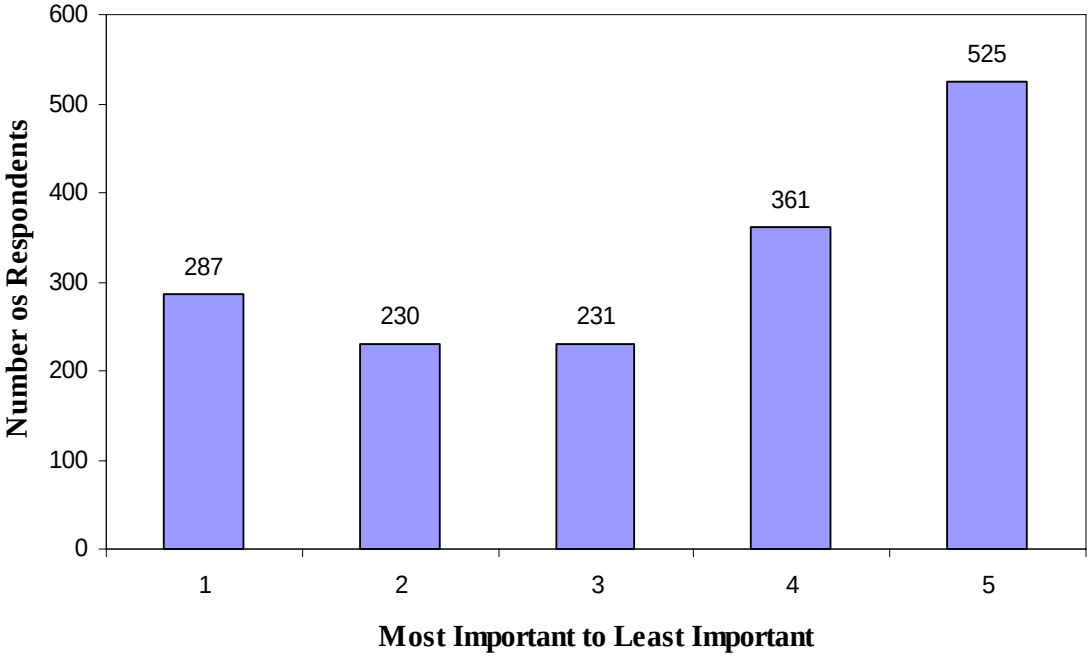
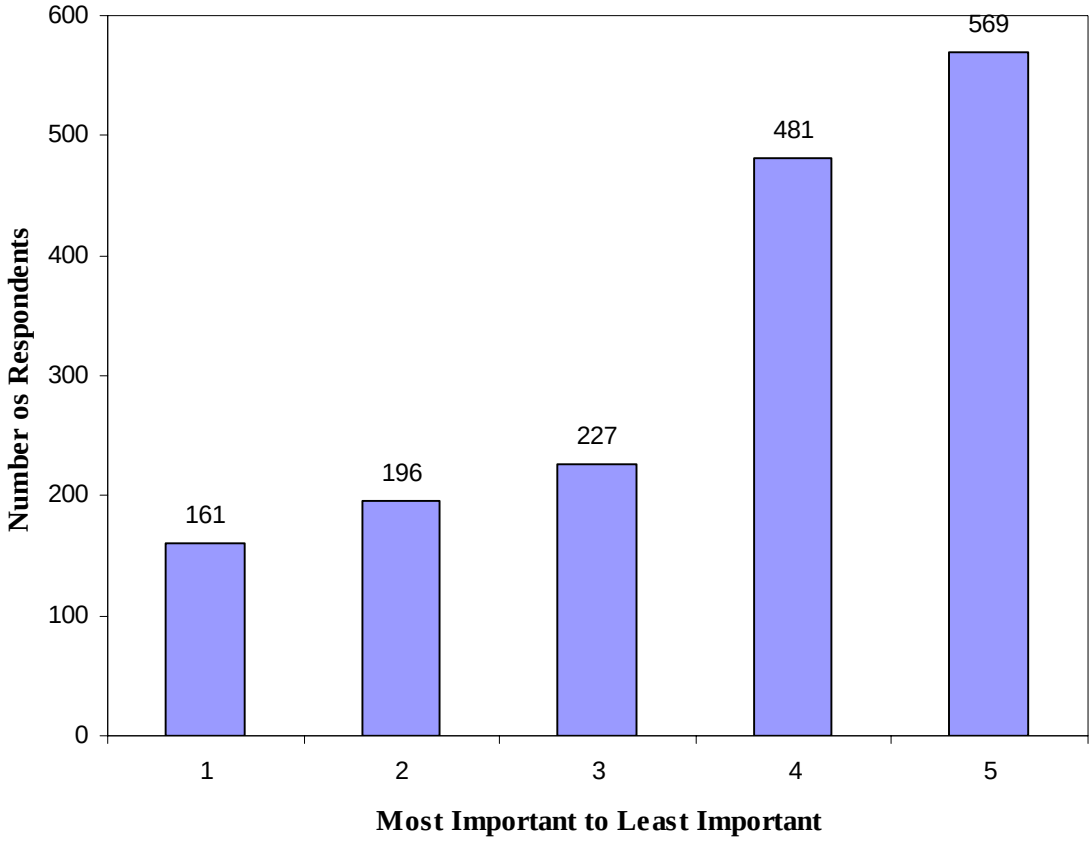
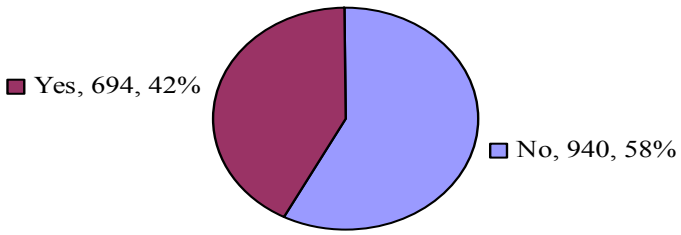


Figure 1.10: Legal Risk



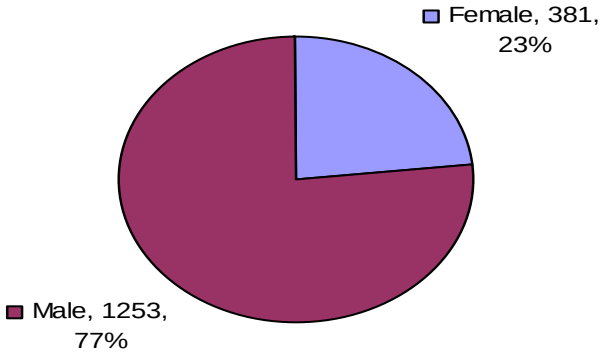
There are several sources of financing for the farm operation such as personal savings, cash flows from product sales, retirement accounts, and loans from relatives. One of them is the financing source of off-farm income. Respondents were asked whether their operation was financed by off-farm income in 2005 or not. 42% of the small farm holders reported that they provided their financing from off-farm jobs (Figure 1.11). Type of financing is one of the major determinants of demand for extension education and it is important to examine off-farm job effects on the demand side of extension education in order to provide more information to educators.

Figure 1.11: Source of Financing



The variable *gender* is a dummy variable which indicates the primary farm operator's gender; taking a value of 1 if the operator is male and 0 if the operator is female. As depicted in the Figure 1.12, 77% of the operators are male, and the remaining 23% are female according to the study data. This suggests that small-scale farming in the West is male dominated for management decisions and daily operation.

Figure 1.12: Gender of the Operator



Age is an ordered variable that can take a value between 1 and 6 depending on the age range of the farm operator.

$$Age = \begin{Bmatrix} 1 & if & under & 25 & \\ 2 & if & 25 & - & 34 \\ 3 & if & 34 & - & 44 \\ 4 & if & 45 & - & 54 \\ 5 & if & 55 & - & 64 \\ 6 & if & 65 & \& & Over \end{Bmatrix}$$

Figure 1.13 shows the distribution of operators by their age range. As survey results show, most of the operators are in the age group 45-54 (523) years and 55-64 (499) years which is given by Figure 1.13. This observation is important since an older demographic group may be less likely to be open to new technologies and risk management strategies. Moreover, it is uncertain that farms will be still used for farming other than non-farm uses after these older operators retire. This variable is a good indicator not only of demand for extension education but also perception of farm holders.

Figure 1.13: Distribution of Operator Age

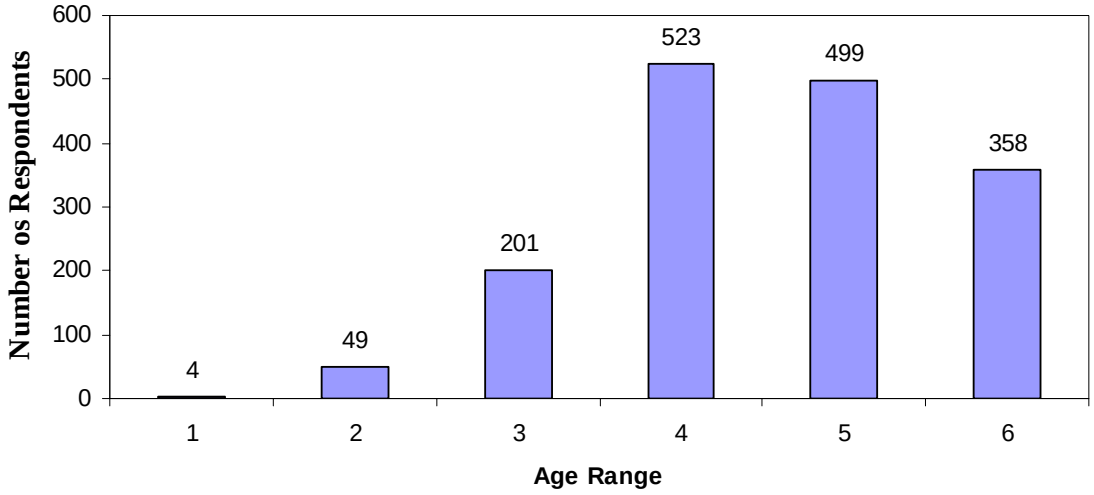


Table 1.1 lists the variables by type and their definitions. Summary statistics of the variables (mean, standard deviation, minimum and maximum values) are provided in Table 1.2.

Table 1.1: Variables and Definitions

VARIABLE NAME	***VARIABLE DEFINITION***	***TYPE***
Primary Sources of Risk		
Production	Order of production risk in terms of its' importance to operation	Ordered
Marketing	Order of marketing risk in terms of its' importance to operation	Ordered
Financial	Order of financial risk in terms of its' importance to operation	Ordered
Legal	Order of legal risk in terms of its' importance to operation	Ordered
Human	Order of human risk in terms of its' importance to operation	Ordered
Reasons for Involvement		
Profit	={1, if engaged in rural family agricultural operation to make profit; 0, if not}	Binary
Family Income	={1, if engaged in rural family agricultural operation to supplement family income; 0, if not}	Binary
Information Preferences		
Internet	={1, if Internet web sites are used to seek information; 0, if not}	Binary
Trade Magazine	={1, if Trade magazine is used to seek information;	Binary

	0, if not}	
Extension Education	={1, if received information from Cooperative Extension; 0, if not}	Binary
Resource Management		
TotalLand	Total acres of land managed (owned + leased) in thousands	Continuous
Specialty Market	={1, if produce any commodities indicating a specialty market; 0, if not}	Binary
CRP	={1, if any land enrolled in Conservation Reserve Program; 0, if not}	Binary
Sources of Water		
Wells	={1, if source of water on the land are wells; 0, if not}	Binary
RuralWaterSystem	={1, if source of water on the land is rural water system; 0, if not}	Binary
Income Issues		
Sole Proprietorship	={1, if business type in 2005 is sole proprietorship; 0, if not}	Binary
Agricultural Income	Percent of income comes from the agricultural operation	Continuous
Paid Employee	={1, if they have paid employees in 2005; 0, if not}	Binary
Offfarmy	={1, if the operation was financed in 2005 by off-farm income; 0, if not}	Binary
Demographics		

AZ	={1, if the primary residence is Arizona; 0, if not}	Binary
WY	={1, if the primary residence is Wyoming; 0, if not}	Binary
Rural	={1, if most of the property managed by the operation is completely rural; 0, if not}	Binary
Distance	The distance of the property from the nearest 'metro area' in miles	Continuous
Offproperty	={1, if they currently hold an off-property job; 0, if not}	Binary
Gender	={1, if the operator is male; 0, if the operator is female}	Binary
Age	Age of the respondent	Ordered
Educ_high	={1, if the highest level of education is high school; 0, if not}	Binary
Educ_trade	={1, if the highest level of education is trade school; 0, if not}	Binary
Educ_col2	={1, if the highest level of education is college degree, 2 yr; 0, if not}	Binary
Educ_col4	={1, if the highest level of education is college degree, 4 yr; 0, if not}	Binary
Educ_grad	={1, if the highest level of education is graduate degree; 0, if not}	Binary

Table 1.2: Summary Statistics

Explanatory Variables	Mean	Std. Dev	Min	Max
Production	2.560	1.292	1	5
Financial	2.255	1.224	1	5
Marketing	3.143	1.276	1	5
Human	3.371	1.488	1	5
Legal	3.674	1.322	1	5
Profit	0.414	0.493	0	1
Family Income	0.422	0.494	0	1
Internet	0.452	0.498	0	1
Trade Magazine	0.420	0.494	0	1
TotalLand	0.648	2.973	0	50.08
Specialty Market	0.129	0.335	0	1
CRP	0.084	0.277	0	1
Wells	0.535	0.499	0	1
RuralWaterSystem	0.201	0.401	0	1
Sole Proprietorship	0.808	0.394	0	1
Agricultural Income	14.687	23.377	0	100
Paid Employee	0.154	0.361	0	1
Offfarmy	0.425	0.494	0	1
Az	0.124	0.329	0	1
Wy	0.189	0.392	0	1
Distance	25.391	37.586	1	350
Rural	0.622	0.485	0	1
Offproperty	0.736	0.441	0	1
Gender	0.767	0.423	0	1
Age	4.553	1.068	1	6
Educ_high	0.312	0.463	0	1
Educ_trade	0.069	0.254	0	1
Educ_col2	0.183	0.387	0	1
Educ_col4	0.237	0.425	0	1
Educ_grad	0.145	0.352	0	1

1.4 Econometric Model and Estimation

The dependent variable of interest, the demand for extension education (denoted by, Y), is a binary response variable that takes the value of 1 if a small farm has ever received or participated in extension education; otherwise it takes the value 0. *X* is a vector of explanatory variables that includes the small farm operator's age, gender, educational level, sources of income, and many others variables.

Since the dependent variable is binary in nature, we estimate alternative specifications of probit model.

The probit model allows us to estimate the 'probability of participation' in Outreach Extension Education Programs. The structural model is defined as

(1) $$y_i^* = X_i\beta + \varepsilon_i$$

$$\varepsilon \sim N(0,1)$$

where ε is the stochastic disturbance which is assumed to follow a normal distribution with mean 0 and variance 1, X_i is the set of explanatory variables, and y_i^* is the latent variable which we do not observe in fact. But rather, what we observe is y_i, which takes on values of 0 or 1.

(2) $$y_i = \begin{cases} 1 & if \quad y_i^* \succ 0 \\ 0 & otherwise \end{cases}$$

y_i is the participation in extension education in our case which is showing us whether a farm operator has ever received information from Cooperative Extension. It is structured as below:

$$y_i = \begin{cases} 1 & if \quad farmer \quad has \quad received \quad extension \quad educatin \\ 0 & if \quad not \end{cases}$$

The empirical model to be estimated is given by the following:

(3) $extension\ education\ (y=1) = \beta_0 + \beta_1 production + \beta_3 financial + \beta_4 marketing + \beta_5 human + \beta_6\ legal + \beta_7\ profit + \beta_8 familyIncome + \beta_9 internet + \beta_{10} tradeMagazine + \beta_{11} totalLand + \beta_{12} specialtyMarket + \beta_{13} CRP + \beta_{14} wells + \beta_{15} RuralWaterSystem + \beta_{16} Sole\ Proprietorship + \beta_{17} AgriculturalIncome + \beta_{18} PaidEmployee + \beta_{19} offfarmy + \beta_{20} az + \beta_{21} wy + \beta_{22} Distance + \beta_{23} Rural + \beta_{24} offproperty + \beta_{25} gender + \beta_{26} age + \beta_{27} educ\_high + \beta_{28} educ\_trade + \beta_{29} educ\_col2 + \beta_{30} educ\_col4 + \beta_{31} educ\_grad$

in which extension education (y=1) is defined by the explanation above. The explanatory variables that are used in the estimation are described in Table 1.1.

Probit model analysis is used to relate the probability of receiving extension education with potential explanatory variables representing demographic characteristics, income status, perception of farm risks, reasons for involvement in agricultural operations, and many others. Corresponding to each perceived farm risk of production, financial, marketing, human and legal, 6 econometric models are specified and estimated: (a) a model with all the perceived farm risks, (b) a model with only production farm risk among the perceived farm risks including all the other explanatory variables, (c) a model with only financial farm risk among the perceived farm risks including all the other explanatory variables, (c) a model with only marketing farm risk among the perceived farm risks including all the other explanatory variables, (d) a model with only human farm risk among the perceived farm risks including all the other explanatory variables,

and (e) a model with only legal farm risk among the perceived farm risks including all the other explanatory variables. These six models are specified and estimated to determine the demand for extension education corresponding to each perceived farm risk and the accuracy of the empirical model by using all the perceived farm risks as explanatory variables at the same time. The first model is estimated by (3), the second model is estimated by (3) without the "$\beta_3 financial + \beta_4 marketing + \beta_5 human + \beta_6 legal$" components, the third model is estimated by (3) without the "$\beta_1 production + \beta_4 marketing + \beta_5 human + \beta_6 legal$" components, the fourth model is estimated by (3) without the "$\beta_1 production + \beta_3 financial + \beta_5 human + \beta_6 legal$" components, the fifth model is estimated by (3) without the "$\beta_1 production + \beta_3 financial + \beta_4 marketing + \beta_6 legal$" components, and finally the sixth model is estimated by (3) without the "$\beta_1 production + \beta_3 financial + \beta_4 marketing + \beta_5 human$" components.

Each model specified above are estimated by a maximum likelihood procedure which is a statistical method maximizing the probability of the data that uses the CDF (Cumulative Density Function) of the normal distribution.

1.5 Empirical Results

The results of the probit model based on equation (3) and the results for each specified model corresponding to each perceived farm risk are given in Table 1.3. The parameters of the probit model are not the marginal effects as in the linear regression model. In the probit model, the derivative of the probability with respect to a specific X_k in the set of variables X is

$$\partial E(y) / \partial X_k = \varphi (X\beta) \beta_k$$

$$\varphi (z) = (1/ (2\pi)^{-1/2}) \exp (-1/2 (z^2))$$

where ϕ is the standard normal density.[1]

We report the coefficients of probit model since we are interested in the sign and significance of the coefficients. The marginal effect of each explanatory variable is given under Table 1.4. The sign of the marginal effects in the probit estimation are the same with the sign of the slope coefficients due to the derivation above.

Table 1.3: Probit Estimates for Demand for Extension Education

Explanatory Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Production	-0.0339	-0.0630**				
	(0.0358)	(0.0279)				
Financial	0.0314		0.0165			
	(0.0354)		(0.0298)			
Marketing	0.0153			-0.0164		
	(0.0354)			(0.0290)		
Human	0.0258				0.0248	
	(0.0328)				(0.0246)	
Legal	0.0436					0.0503*
	(0.0352)					(0.0276)
Profit	0.0639	0.0696	0.0773	0.0741	0.0699	0.0698
	(0.0808)	(0.0805)	(0.0803)	(0.0804)	(0.0806)	(0.0804)
Family Income	0.2287**	0.2289**	0.2384**	0.2337**	0.2333**	0.2284**
	(0.0790)	(0.0787)	(0.0786)	(0.0787)	(0.0786)	(0.0788)
Internet	-0.1503*	-0.1563**	-0.169**	-0.165**	-0.1633**	-0.156**
	(0.0776)	(0.0773)	(0.0770)	(0.0773)	(0.0772)	(0.0773)
Trade Magazine	-0.0605	-0.0664	-0.0654	-0.0700	-0.0719	-0.0681
	(0.0754)	(0.0750)	(0.0752)	(0.0748)	(0.0749)	(0.0749)

[1] Johnston J., and J. DiNardo, Econometric Methods, 4th ed. McGraw-Hill, New York, 1997.

TotalLand	-0.0195*	-0.0203*	-0.0208*	-0.0204*	-0.0208*	-0.0191*
	(0.0115)	(0.0114)	(0.0114)	(0.0114)	(0.0114)	(0.0115)
Specialty Market	0.1291	0.1276	0.1190	0.1194	0.1267	0.1193
	(0.1130)	(0.1127)	(0.1125)	(0.1125)	(0.1128)	(0.1126)
CRP	0.1975	0.2033	0.2269	0.2256	0.2212	0.2035
	(0.1505)	(0.1501)	(0.1499)	(0.1499)	(0.1499)	(0.1500)
Wells	-0.0555	-0.0527	-0.0610	-0.0612	-0.0617	-0.0643
	(0.0806)	(0.0804)	(0.0802)	(0.0802)	(0.0801)	(0.0802)
RuralWaterSystem	-0.0901	-0.0879	-0.0984	-0.1003	-0.0959	-0.1040
	(0.0964)	(0.0962)	(0.0958)	(0.0957)	(0.0959)	(0.0959)
Sole Proprietorship	-0.0737	-0.0670	-0.0675	-0.0671	-0.0619	-0.0786
	(0.0973)	(0.0968)	(0.0968)	(0.0967)	(0.0968)	(0.0971)
Agricultural Income	0.0027	0.0026	0.0029*	0.0028	0.0027	0.0027
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Paid Employee	0.0661	0.0663	0.0537	0.0562	0.0583	0.0608
	(0.1062)	(0.1062)	(0.1057)	(0.1057)	(0.1058)	(0.1057)
Offfarmy	0.1608**	0.1626**	0.1613**	0.1576**	0.1564**	0.1571**
	(0.0789)	(0.0787)	(0.0786)	(0.0787)	(0.0787)	(0.0787)
Az	-0.4262**	-0.4231**	-0.420**	-0.4194**	-0.4202**	-0.421**
	(0.1095)	(0.1093)	(0.1092)	(0.1091)	(0.1092)	(0.1092)
Wy	0.0843	0.0922	0.0998	0.1005	0.0988	0.0962
	(0.0988)	(0.0985)	(0.0984)	(0.0984)	(0.0984)	(0.0985)
Distance	0.0010	0.0011	0.0010	0.0010	0.0010	0.0010
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Rural	0.1144	0.1137	0.1183	0.1170	0.1167	0.1166
	(0.0776)	(0.0776)	(0.0774)	(0.0774)	(0.0774)	(0.0775)
Offproperty	-0.0095	-0.0147	-0.0131	-0.0127	-0.0121	-0.0150
	(0.0945)	(0.0942)	(0.0942)	(0.0942)	(0.0941)	(0.0941)
Gender	0.1751**	0.1768**	0.1818**	0.1844**	0.1850**	0.1802**
	(0.0851)	(0.0849)	(0.0848)	(0.0847)	(0.0848)	(0.0849)
Age	0.0074	0.0090	0.0074	0.0076	0.0094	0.0078
	(0.0380)	(0.0379)	(0.0380)	(0.0379)	(0.0379)	(0.0379)
Educ_high	-0.1224	-0.1182	-0.1244	-0.1286	-0.1284	-0.1288
	(0.1652)	(0.1651)	(0.1646)	(0.1648)	(0.1648)	(0.1647)
Educ_trade	-0.0424	-0.0375	-0.0433	-0.0466	-0.0478	-0.0452
	(0.2044)	(0.2042)	(0.2037)	(0.2039)	(0.2040)	(0.2038)
Educ_col2	0.0990	0.0953	0.0944	0.0932	0.0966	0.0927
	(0.1753)	(0.1752)	(0.1747)	(0.1748)	(0.1749)	(0.1748)

Educ_col4	0.3072*	0.3032*	0.2908*	0.2914*	0.2933*	0.3043*
	(0.1734)	(0.1732)	(0.1727)	(0.1728)	(0.1729)	(0.1729)
Educ_grad	0.0999	0.1058	0.0992	0.0990	0.1015	0.0978
	(0.1808)	(0.1807)	(0.1803)	(0.1804)	(0.1804)	(0.1803)
Probit Threshold						
μ1	0.2518	0.6789**	0.4844	0.5803*	0.4329	0.3619
	(0.4825)	(0.3007)	(0.2990)	(0.3103)	(0.3047)	(0.3046)
Sample Size	1634	1634	1634	1634	1634	1634
Log Likelihood	-778.7214	-779.6436	-782.0326	-782.0265	-781.6810	-780.5383
Pseudo R2	0.0574	0.0563	0.0534	0.0534	0.0539	0.0552
LR chi2(30)	94.92	93.07	88.29	88.31	89.00	91.28
Prob>chi2	0	0	0	0	0	0

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 1.4: Marginal Effects Table

Explanatory Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Production	-0.0092	-0.0171**				
	(0.0097)	(0.0076)				
Financial	0.0085		0.0045			
	(0.0096)		(0.0081)	-0.0045		
Marketing	0.0042			(0.0079)		
	(0.0096)					
Human	0.0070				0.0067	
	(0.0089)				(0.0067)	
Legal	0.0118					0.0137*
	(0.0096)					(0.0075)
Profit	0.0173	0.0188	0.0209	0.0201	0.0189	0.0189
	(0.0217)	(0.0216)	(0.0216)	(0.0217)	(0.0217)	(0.0216)
Family Income	0.0611**	0.0612**	0.0638**	0.0626**	0.0625**	0.0611**
	(0.0207)	(0.0206)	(0.0206)	(0.0207)	(0.0206)	(0.0207)
Internet	-0.0411*	-0.0427**	-0.0462**	-0.0451**	-0.0447**	-0.0428**
	(0.0213)	(0.0212)	(0.0212)	(0.0213)	(0.0213)	(0.0213)
Trade Magazine	-0.0165	-0.0181	-0.0179	-0.0192	-0.0197	-0.0186
	(0.0207)	(0.0206)	(0.0207)	(0.0206)	(0.0206)	(0.0206)
TotalLand	-0.0053*	-0.0055*	-0.0057*	-0.0055*	-0.0057*	-0.0052*
	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
Specialty Market	0.0336	0.0332	0.0312	0.0313	0.0331	0.0312
	(0.0281)	(0.0281)	(0.0283)	(0.0283)	(0.0282)	(0.0282)
CRP	0.0497	0.0511	0.0566*	0.0563*	0.0553	0.0512

	(0.0349)	(0.0346)	(0.0340)	(0.0340)	(0.0341)	(0.0346)
Wells	-0.0150	-0.0143	-0.0166	-0.0166	-0.0168	-0.0175
	(0.0218)	(0.0218)	(0.0218)	(0.0217)	(0.0217)	(0.0217)
RuralWaterSystem	-0.0250	-0.0244	-0.0275	-0.0280	-0.0268	-0.0291
	(0.0274)	(0.0273)	(0.0274)	(0.0274)	(0.0274)	(0.0275)
Sole Proprietorship	-0.0196	-0.0179	-0.0181	-0.0179	-0.0166	-0.0209
	(0.0254)	(0.0254)	(0.0254)	(0.0254)	(0.0255)	(0.0253)
Agricultural Income	0.0007	0.0007	0.0008*	0.0008	0.0007	0.0007
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Paid Employee	0.0176	0.0177	0.0144	0.0150	0.0156	0.0162
	(0.0277)	(0.0277)	(0.0279)	(0.0278)	(0.0278)	(0.0277)
Offfarmy	0.0432**	0.0437**	0.0435**	0.0425**	0.0421**	0.0423**
	(0.0209)	(0.0209)	(0.0209)	(0.0210)	(0.0209)	(0.0209)
Az	-0.1310**	-0.1300**	-0.1294**	-0.1290**	-0.1292**	-0.1293**
	(0.0372)	(0.0371)	(0.0371)	(0.0370)	(0.0371)	(0.0371)
Wy	0.0224	0.0244	0.0264	0.0266	0.0262	0.0255
	(0.0256)	(0.0254)	(0.0253)	(0.0253)	(0.0253)	(0.0254)
Distance	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Rural	0.0314	0.0313	0.0326	0.0322	0.0322	0.0321
	(0.0216)	(0.0216)	(0.0216)	(0.0216)	(0.0216)	(0.0216)
Offproperty	-0.0026	-0.0040	-0.0036	-0.0035	-0.0033	-0.0041
	(0.0256)	(0.0254)	(0.0255)	(0.0255)	(0.0255)	(0.0254)
Gender	0.0494**	0.0500**	0.0516**	0.0523**	0.0525**	0.0510**
	(0.0249)	(0.0249)	(0.0250)	(0.0250)	(0.0250)	(0.0250)
Age	0.0020	0.0024	0.0020	0.0021	0.0026	0.0021
	(0.0103)	(0.0103)	(0.0103)	(0.0103)	(0.0103)	(0.0103)
Educ_high	-0.0339	-0.0327	-0.0346	-0.0358	-0.0357	-0.0358
	(0.0466)	(0.0466)	(0.0466)	(0.0467)	(0.0467)	(0.0466)
Educ_trade	-0.0117	-0.0103	-0.0120	-0.0129	-0.0132	-0.0125
	(0.0573)	(0.0570)	(0.0573)	(0.0575)	(0.0575)	(0.0573)
Educ_col2	0.0261	0.0252	0.0250	0.0247	0.0256	0.0246
	(0.0450)	(0.0451)	(0.0451)	(0.0451)	(0.0451)	(0.0451)
Educ_col4	0.0774*	0.0766*	0.0738*	0.0740*	0.0744*	0.0769*
	(0.0403)	(0.0404)	(0.0406)	(0.0406)	(0.0406)	(0.0403)
Educ_grad	0.0263	0.0278	0.0262	0.0261	0.0267	0.0258
	(0.0460)	(0.0458)	(0.0461)	(0.0461)	(0.0460)	(0.0460)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

The results in Table 1.3 for the first specified model by equation (3) show that the demand for extension education is positively related to *family Income, offfarmy, gender and educ_col4* variables; whereas it is negatively related to *internet, total Land and az* variables. According to the results, *family Income, offfarmy, az and gender* are significant at 95% CI, while *educ_col4, internet and total Land* are significant at 90% CI. These results indicate that a farm operator who is engaged in a rural family agricultural operation to supplement family income, who financed his operation by off-farm income or whose primary residence is Arizona is more likely to receive Cooperative Extension information. On the contrary, a farm operator who uses the internet to seek information and whose highest degree is college degree of 4 years are less likely to receive information from Extension Service. As the total acres of land managed increases, the farm operator's participation probability is declining. As we can see from Table 1.4, marginal effects of *family income, internet, total Land, offfarmy, az, gender and educ_col4* variables are significant like the parameter estimates of these variables.

The second column of Table 1.3 shows the results for participation in Extension Programs for Production farm risk. Results are very similar to the results for the first specified model. Signs and interpretations of the coefficients are the same for the significant variables which are same as above except the *production* variable. The negative and significant coefficient of *production* indicates that the possibility of receiving information from Cooperative Extension is decreasing as the farm operator perceives the production farm risk as the least important to the operation. This can be inferred by the Table 1.4 Marginal Effects as well.

From the third column of the Table 1.3, we can see the results for the specified model to the financial farm risk. In addition to the significant explanatory variables of the first model, *agricultural income* is significant at 10% level. The estimate for this variable is positive. That is a very legitimate result implying that the farm operators who have a higher percentage of income coming from the agricultural operation have a higher demand for the extension information. Third column of Table 1.4 shows the marginal effects for the specified model. In addition to the significant parameter estimates we got from the probit estimation, *CRP* has a significant effect at the 10% level on the probability of receiving extension information. If any land is enrolled in the conservation reserve program, then the operator is more likely to receive information from extension service.

The results of the estimated probit model (4) specified for the marketing farm risk demonstrate similar results with respect to significant levels and signs of the coefficients with the first model. We can conclude the same results as explained above in the results for model (1). We can infer from Table 1.4 that *CRP* is a significant variable and increase the probability of receiving extension information as in the case of the model specified for the financial farm risk.

The probit model results for the human farm risk specified model are given in the fifth column of Table 1.3. These results denote similar results as in the first and fourth model. The coefficients and their standard errors are slightly different from the results of the other models. However, the significant variables which are the same with the first and fourth specified models have the same signs with these models. The fifth column of

Table 1.4 presents the marginal effects. Consistent with the results of a probit model estimation for this model, marginal effects of the coefficients which are significant in the fifth column of Table 1.3 are also significant in the fifth column of Table 1.4.

The last specified model (6) shows the factors that affect the demand for extension education for legal farm risk. From the results, it can be seen that the same explanatory variables are significant as in the first, fourth and fifth model. Besides, they have the same signs with the models mentioned. The *Legal* variable is also significant compared to the other models with its marginal effect given in the last column of Table 1.4. It is positive and significant at 10%. That is, the demand for extension education is decreasing as the farm operator perceives the legal farm risk as the most important risk among the other risks to the operation.

1.6 Conclusions

This chapter examined the determinants of demand for extension information. With regards to the perceived farm risks of production, financial, marketing, human, and legal, six different types of models are specified. Since the dependent variable which is binary in nature is the same for all the models, probit estimation is used for all of them in order to model farm level demand for extension education.

We find that supplementing family income, demographic variables such as gender, education and the residency, internet, income percentage coming form agriculture, total acres of land, and off-farm income are the main determinants among many other factors that affect the demand for extension information. Furthermore, male farmers have

a higher demand for extension information than female farmers in the Western United States. We also find that farmers in Arizona have less demand for receiving extension information compared to the farmers in Colorado and Wyoming**.** Findings from the estimated models also suggest that the education level is an important determinant of demand for extension education. Farm operators who have higher education are more likely to participate in extension programs.

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CHAPTER 2

Determinants of Perceived Farm Risks: Evidence from Rural Southwest

Abstract

In this chapter, I examine the determinants of perceived farm risks in the West. I also study the role of Extension Education in agricultural risk managements. I clarify the relationships between perceived production, financial, marketing, legal/institutional, and human risks and various socioeconomic, institutional, environmental, demographic, and farm structure variables. I find that extension education has a significant role in household's evaluation of agricultural risks.

2.1 Introduction

The land grant university and the extension service were distinctive American inventions (Chin and Benne, 1976). The 1914 Smith-Lever Act launched extension education in the U.S. in order to aid the diffusion among the people of United States useful and practical information on the subjects relating to agriculture and home economics and encourage the application of the same. The extension purpose has been to help bring about changes in society, behavior and in the economic and social environment designed to promote well-being by individuals, households, firms and governments. Thus, it is appropriate to look at what evidence exists about the value of extension in meeting its stated objective and the needs of today's society.

There have been several studies which have found that the land grand university research and extension efforts for agricultural commodities have made a major

contribution to the rate of technical change in agriculture and the adoption rates if value can be measured in terms of the effect of extension on agricultural productivity (Sim and Gardner, 1980; Araji, 1980; Peterson and Hayami, 1977; and Huffman, 1981). However, these studies do not give much insight into the possibilities for improving the value of extension through changes in program delivery.

According to USDA, since the introduction of extension, there have been dramatic changes in agriculture production and the rural communities which extension serves. Production agriculture has become more complex as a consequence of demographic and economic transformations that the rural America has experienced in the past decade. The make-up of farm operators has altered significantly and agricultural operations are increasingly facing greater production, financial, marketing, legal/institutional, and human risks. Therefore, the role of and demand on extension education have changed: *first*, the diversity of the clients for the traditional programs has increased a great deal; *second*, delivery mechanisms such as meetings and publications are less useful for new audiences which include operators with low education and income levels; *third*, extension education is facing increasing demands for improved efficiency of program delivery; and *fourth*, financial supports for extension is declining, and empirical evidence shows that funding for extension programs are positively related to demonstrated efficiency and effectiveness.

In order to remain a viable educational force, extension has to demonstrate its value, and enhance its effectiveness through improvement in program delivery. Doing so requires at least two things: (1) there is a need for suitable econometric frameworks that

allows us to examine the effectiveness of extension education, and demonstrate its value to agriculture and rural communities; and (2) developed frameworks and analyses should have capability to provide, unlike past approaches and studies, insight into the possibilities for improving the value of extension through changes in program delivery.

Moreover, farming in America has changed dramatically over the past few years. Increasingly, farmers and ranchers are learning that it is now a game with new rules, new stakes, and, most of all, new risks (USDA, 1997). We know a great deal about the role of risks and uncertainty in agriculture in the West and in other regions. Firm growth models incorporate to varying degrees production, marketing, and financial risks (Hanson et al., 1983; Richardson and Condra, 1981). Further treatment of risk is found in simulation analyses and specifically in areas such as irrigation (Boggess et al., 1983; Mapp and Eidman, 1975), biophysical/bioeconomic analyses (Carlson, 1970), decision analyses in general (Anderson et al., 1977), and financial analyses (Barry, 1983a; Barry et al., 1983b).

Much less is known about producers' perceived importance and causes of various farm risks in the U.S. Patrick et al. (1985) indicated that perceptions of sources and responses to risk varied across geographic regions and by farm type. Boggess et al. (1985) and Wilson et al. (1988) found that perceptions varied so much among individuals that a risk classification based on socioeconomic variables was not possible. Patrick and Musser (1997) concluded that, besides geographic location and farm type, institutional structures and other factors affecting the operating environment of producers were also likely to influence farmers' perceptions of sources and responses to risk. However, we note that these U.S. studies were for producers of a specific agricultural crop or livestock.

Therefore, results derived from these studies neither can be generalized and nor are applicable to all agricultural operations. Moreover, it is small farms that are increasingly at greater risks due to new global markets, industrialization of agriculture, tremendous demographic shifts, vertical integration, and increasing competition for farm land for non-agricultural uses. The long term viability of these farms is critical to the prosperity of rural communities as these farms account for a significant percent of all farms in the United States. Within this context there is a need to understand the importance and determinants of the various farm risks perceived by small producers in the West. Such knowledge is an important precondition for devising risk reducing strategies and education.

In context of the preceding background, this chapter develops a suitable econometric framework that allows us to examine the effectiveness of extension education, demonstrate its value to agriculture and rural communities, and have capabilities to provide, unlike past approaches and studies, insight into the possibilities for improving the value of extension through changes in program delivery. In particular, first, we develop two alternative econometric frameworks that allow us to examine the role of Extension Education in agricultural risk managements; and second, using developed econometric frameworks, we systematically evaluate the value and the role of extension education in agricultural risk management in the West.

Specifically, the principal objective of this chapter is to (1) examine the importance and determinants of perceived farm risks in the West; (2) develop a

multivariate ordered probit model for evaluating the role of Extension Education in perceived farm risks in the West.

The remainder of this chapter is organized as follows. Section 2.2 provides a brief review of related literature on determinants of perceived farm risks and the role of the extension education. Section 2.3 provides a description of the data used in the analysis. Section 2.4 contains the objectives and the econometric model to examine the importance and determinants of perceived farm risks in the West. This section also develops a framework for evaluating the role of extension education in perceived farm risks by using a multivariate ordered probit model. Section 2.5 provides a discussion of empirical results and findings. Finally, we summarize the work followed by conclusions and policy implications under 2.6.

2.2 Literature Review

The land grant university and extension service has been playing a considerable role on agricultural and home economics since the 1914 Smith-Lever Act launched extension education. Due to the dramatic changes in agricultural production, marketing and the rural communities which extension serves, the 1914 Smith-Lever Act has been amended and rewritten in 1953. According to Hildreth and Armbruster (1981), the role of extension has changed in farmers' production and marketing decisions as a consequence of structural changes throughout the farm, changes in government programs, fluctuation in prices and the evolvement of agricultural marketing systems. It is important to assess the value of extension in meeting the needs of today's society because of the diversity of

the clients, new demands and technological changes which affect the extension delivery mechanisms. Therefore, extension education should give much insight into the possibilities for improving the value of extension through changes in program delivery such as increasing extension specialization and use of electronic networks.

There are several studies that have showed that current and future research and extension programs for agricultural commodities have a profound role on the rate of technical change in agriculture and the adoption rate of research results. Araji, Sim and Gardner (1978) analyzed the expected returns to investment in current research and extension programs in sheep, fruits and vegetables, potatoes, cotton, and rice for the western region. To estimate the contribution of extension to research effectiveness, they used the measures of benefits and costs, the benefit-cost ratio which is defined as the ratio of the present value of the expected flow of benefits to the present value of expenditures, and the internal rate of return which is calculated by equating the present value of the expected expenditures and the present value of the expected flow of benefits. The results indicated that cooperative extension involvement is a significant factor that affects the expected returns to public investment realization. An important aspect of their study was that it showed that the time and the adoption rates influence the returns to investment with agricultural industry which are changing by commodity, technology, and the farm organizations. Another important finding of their study was that the implementation of national policy in the areas of energy, water, and natural resource conservation utilizes research and cooperative extension programs. Although they tried to measure the extension effectiveness on agricultural productivity in their study, they did not consider

the possibilities for improving the value of extension through changes in program delivery.

There is a vast literature examining the causes of structural and total factor productivity (TFP) change for U.S agriculture. A study done by Huffman and Evenson (1997) aimed at identifying the causes of changes in U.S farm structure and TFP by using farm size, farm specialization, and part-time farming as the structural dimensions. They not only linked agricultural productivity to these dimensions, but also tested that input prices, public and private research, public extension, and government commodity programs have caused structural and TFP changes. Three-staged least squares method was used for the empirical analysis with forty two states during 1950-82 to estimate the agricultural productivity and structure of U.S. As a result of the estimation, the hypothesis that input prices, public and private research, public extension, and government commodity programs directly or indirectly caused structural and TFP changes in U.S. agriculture during 1950-82 was supported. They computed implied reduced-form coefficients for the model in order to simplify the model to interpret the relationships among farm structural variables and between TFP and farm structure by holding the exogenous variables constant. Their earlier research (1993) showed a positive contribution of public extension, farmer's schooling, and agricultural commodity programs to agricultural productivity. However, they did not take into account the contributions of farm size, specialization, private and public research, and part-time farming to agricultural productivity. In a 1997 study, they concluded that technology (private and public research) is the main factor for increasing productivity in the livestock

sector. In contrast, input price changes are the dominant factor for increasing crop specialization. They emphasized the importance of public extension on agricultural productivity and total factor productivity changes.

There is a considerable literature that addresses the Extension program restructuring in order to ensure that critical needs are being met and the interests of the participants in these programs are being satisfied. Musser, Patrick, Ortmann and Doster (1992) examined farmers' perceptions of sources of risk in the mid-west and reported the results of a survey of the farmers who participated in a three-day 1991 Top Farmer Crop Extension Workshop at Purdue University. They concluded that new technologies, marketing, and expansion of business which are parts of the traditional Extension programs are consistent with farmers' perceptions. In addition to that, marketing was the common significant response on the farm management problem questions. They suggested that Extension marketing programs should be related to the past financial and production emphasis. As a result of their survey, they indicated that family relationships, labor changes, finance, environmental issues, lower costs of production, and financial progress are significant responses to the farm management problems as well as the other traditional areas. Human relations with family farmers were found to have a very important role on the restructuring of Extension programs and these relationships with the labor quality should be considered carefully in planning future Extension programs. In a study done by Patrick and Musser (1997), it is also concluded that institutional structures and other factors affecting the operating environment of producers were also likely to

influence farmers' perceptions of the sources and responses to risk besides geographic location and farm type.

Farm size, beginning equity levels and the tenure situations (full ownership, combined ownership-lease, and full lease) are important determinants of perceived farm risks because of their effects on the farm success and survival. There have been various studies to determine the effects of different size farms on economic efficiency. Richardson and Condra (1981) analyzed the success of four alternative farm sizes (160, 320, 640, and 960 acres) for El Paso Valley by using a dynamic Monte-Carlo simulation programming model. In contrast to the past studies, they incorporated uncertainty in production and marketing activities over time by the model used. They pointed out the importance of farm size and beginning equity compared to the relationship between tenure situations and the survival and success farm possibilities. Their second major conclusion was that the cash-lease traditional growth strategy does not seem to be as successful as land ownership for a given farm size. They reached the result that limiting acreage would restrict farms to a nonviable size which means that there would be a little chance of survival and economic success. Besides, small farms have been facing greater risks and long term economic viability of these farms is crucial as they have a very considerable place in U.S. From this point of view, it is very important to understand small farm holder's perceptions of farm risks and uncertainty.

Another study by Wilson, Dahlgran, and Conklin (1993) was also interested in the risk perceptions and uncertainty concept in explaining management responses and sources of risks. They collected data on the socioeconomic characteristics such as total

farm size, age of the respondent, education, and the type of legal business structure. In their study, an ordered logit model was used to analyze the relationships between personal and socioeconomic factors and perceptions towards the economic environment and economic behavior. It was found that firm size, age, and the ownership structure (sole proprietorship, partnership, corporation, etc.) were consistently important in explaining perceptions and management responses. According to the results, a risk classification based on socioeconomic characteristics was not a good approximation to manage uncertainty because of the variability of perceptions among individuals. Personal characteristics, experiences, and present environmental conditions are factors that determine perceptions, management responses, and legal business characteristics in dealing uncertainty. Another important aspect of their study is that they empirically showed the importance of enterprise size and land ownership indicating the impact of income on the perceptions towards the economic environment.

Legesse and Drake (2005) examined the determinants of smallholder farmer's perceptions of risk in the Eastern Highlands of Ethiopia. Their study consisted of data collected from March 2000 to September 2001 of 178 smallholder farmers from Fedis and Meta which are two contrasting areas in the Eastern Highlands of Ethiopia. Binary logistic regression analyses were used in order to establish the relationships between perceptions of risk and various socioeconomic, institutional and policy and farm structure variables. Empirical results revealed that asset endowments, locational settings and livelihood diversification strategies are the crucial factors influencing smallholder's perceived risks in the study area. Contrary to the empirical hypotheses made in this study,

human capital characteristics such as level of education, gender and religion/ethnic origin of households play a little role on perception of risks. It is suggested that diversification of assets, incomes and activities that are the ways to spread risk are essential smallholder farmer's ways of managing risk and they should be supported through development of non-farm rural markets and improving household skills as they point the ways in which households enable to reduce risks.

Some studies shed light on the effect of investments in education and agricultural extension on the off-farm labor supply of farmers. Huffman's study (1980) is one of the most striking studies among them. Logistic regression was chosen to report the estimated equation for the odds of participating in off-farm work. In addition to that, weighted least squares were reported from fitting the off-farm labor supply model to 276 observations of county averages per farm of Iowa, North Carolina and Oklahoma. Important findings of this study are that increasing farmer's education level and the agricultural extension input raise the off-farm labor supply of farmers. Reallocation of farmers' labor services between farm and non-farm labor markets is effected by the increased education of economic agents. In this sense, the role of human capital in agriculture is fundamental in comprehending the farm and off-farm work decisions.

In a similar study by Weersink (1992), it is proved that human capital has effects on off-farm labor decisions. The probability of off-farm employment of Ontario pig producers is increasing with the increases in education. This study has the same conclusion with Huffman which emphasizes the impact of increasing the education level as a determinant of human capital on off-farm labor supply of farmers.

The effects of human capital on size and growth among dairy farms were investigated by Sumner and Leiby (1987). Age and experience as being the representative of human capital determine faster growth and larger size through lowering the costs of borrowing. Human capital is a risk reducing factor that increases the ability of farmers to adapt more rapidly to the changes in prices and technology. Depending on this study, it is proved that human capital has significant effects on the dairy herd size. On the other hand, the expected effects are more complicated on growth. The only clear result was that experience reduces the growth rate. They concluded that the human capital of a potential farmer determines the characteristics of his or her farm which consequently affects the size distribution and growth.

Weather and output price variability are the most important sources of production risk. Musser, Patrick, and Eckman (1996) studied risks and grain marketing behavior of large-scale farmers in order to determine the effects of risk and farm characteristics on a variety of marketing techniques, such as forward contracting, minimum-price contracts, hedging, and options contracts. They hypothesized that alternative theories of risk preferences may be complementary. Results from maximum-likelihood Tobit estimation had interesting results such as the significant effects of age and education of the operator on short run marketing decisions compared to insignificant effects of them on long run marketing decisions and the negative impact of business size. The results also provide the hypothesis that alternative formulations of risk behavior are complementary rather than alternative themes. One of their intriguing results is that marketing techniques influence

both price and risk. Thus, analysis of risk should be related to marketing decisions to understand farmer behavior.

There is no doubt that technology has been one of the most important factors that affect perceived risks. Economists have been interested in simulation analyses of physical and biological phenomena which will be useful in evaluating technology. Further treatment of risk in irrigation has been emphasized by Mapp and Eidman (1975). Mapp and Eidman demonstrate that simulation analyses are very helpful in evaluating irrigation strategies. Coping with risk is closely related with the technology changes and there are many arguments of incorporating technology into the models in the literature to handle the effects of these changes. Mapp and Eidman's study is noteworthy in the area of irrigation as an example of the simulation models by incorporating it into a farm firm simulator for the purpose of taking advantages from newly adopted irrigation strategies. They provided that these models can be modified to have the information on the biological input-output process at a lower cost and in less time than the typical multi-period procedure.

A similar study by Boggess and Amerling (1983) on a bioeconomic simulation analysis of irrigation investments also found interesting results. As opposed to previous studies done on irrigation scheduling in the arid areas by using bioeconomic simulation models, they analyzed irrigation decisions in humid areas and the risks of those investments. They showed that uncertainty of the weather patterns introduces risks in humid areas. They also found that irrigation investments are very risky under some specific cases although irrigation is mostly known to be a risk-reducing input.

In an influential study, Bosch and Eidman (1987) discussed the effect of risk attitudes on the value of information during the irrigation strategy decisions. They used simulation method to show how risk attitudes and weather information affect the timing and use of water applied and the yields of irrigated corn and soybeans. In terms of the empirical results, tendency for irrigation and the value of information both increase with level of risk aversion. This study points out the importance of risk attitudes and irrigations decisions. In this context, it is crucial to investigate farm holder's risk perceptions and agricultural risk managements.

In another study done by King, Lybecker, and Regmi (1993) to assess the effects of technology, importance of bioeconomic models are emphasized as one of the ways to understand production systems and effects of new technologies. Bioeconomic models have been useful in evaluating irrigation strategies as simulation analyses. However, these models have become more supportive in crop production management decisions with increased improvements in techniques for modeling. They examined design objectives for bioeconomic models, discussed technical challenges and showed the areas that will facilitate the adaptation of these models for management decision support. With regard to their examinations, risk and uncertainty with the technological improvements in crop production should be investigated carefully for the purpose of management decisions.

2.3 Data

According to the 2002 Census of Agriculture, there are 48,085 farmers and ranchers in the states of Arizona, Colorado, and Wyoming. Census data indicate a decreasing number of "traditional" producers and a significant increase in the number of small farms in these three states. Farms with sales of less than $50,000 account for 78% of all farms. Thus, the survey target population consisted of farm operations with annual sales of less than $50,000, and in order to comprehensively examine the importance, sources, and causes of farm risks in the West, a survey of farm operations in Arizona, Colorado, and Wyoming was conducted in spring 2006. A total of 4,939 survey instruments were mailed to small farm operators in these states. In order to ensure a representative sample from each state, the numbers of survey instruments mailed to states were allocated based on the population of small farm operators in each state. The total response rate was 53.6%. A total 2,645 surveys were completed, which constitutes the sample size of empirical analyses.

Data were collected on small operator's demographics, reasons for involvement in the rural family ventures, sources of risks, vulnerability factors, information sources and preferences, resource management, and income status, and thus enabling us to empirically examine importance and determinants of perceived farm risks and the role of extension education in the agricultural risk management in the Western rural United States.

2.3.1 Characteristics of Small Farms in the Rural Southwest

Extension Education is a binary variable that takes value 1 if the farm operator has ever received information from Cooperative Extension and takes value 0 otherwise.

With regards to Figure 2.1, most respondents (1301, 79.62%) indicated that they had received information form Cooperative Extension; whereas 333 (20.38%) respondents had not.

Figure 2.1: Overall Participation in Cooperative Extension

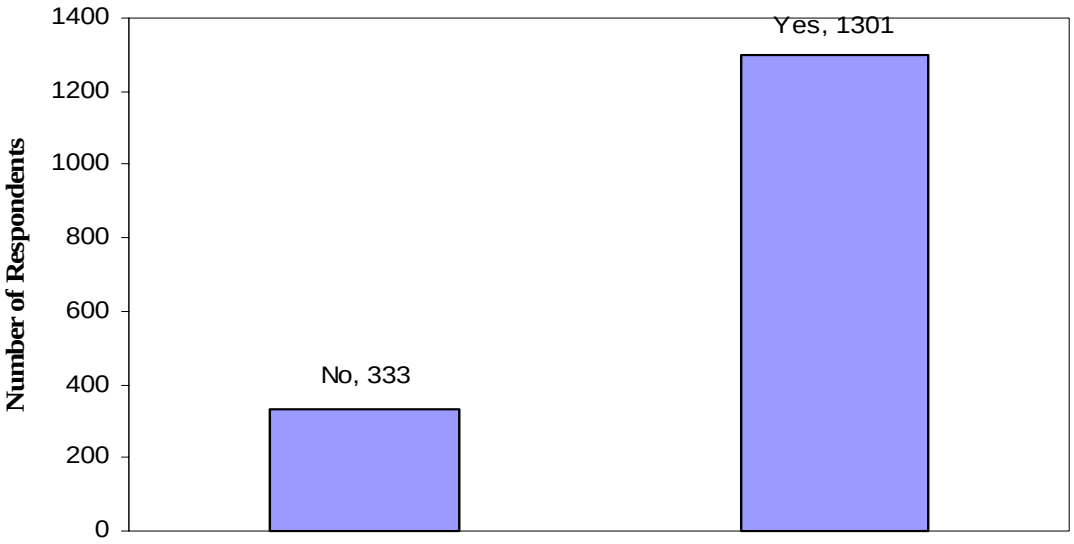


Figure 2.2: Participation in Cooperative Extension in Arizona

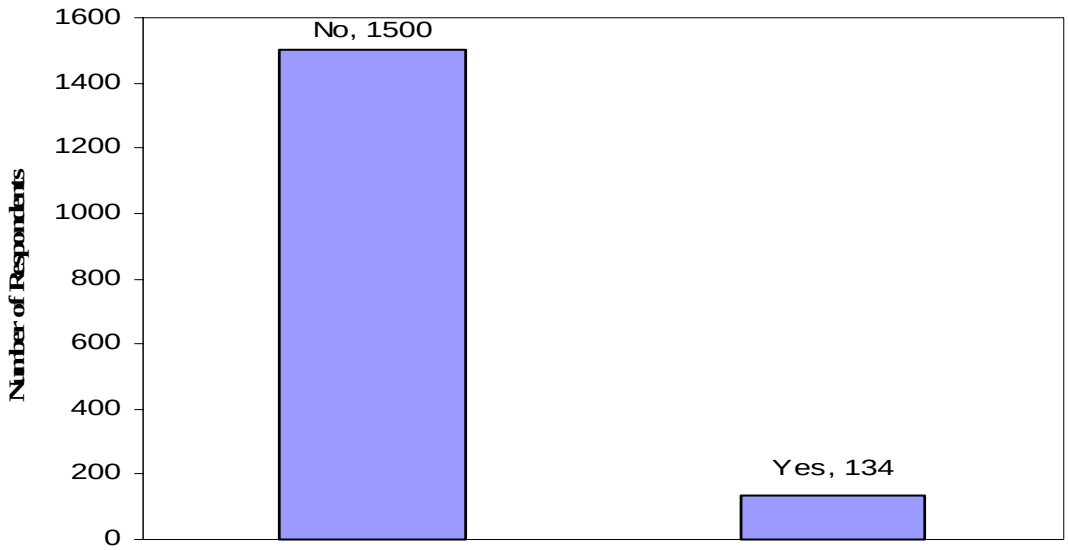


Figure 2.3: Participation in Cooperative Extension in Wyoming

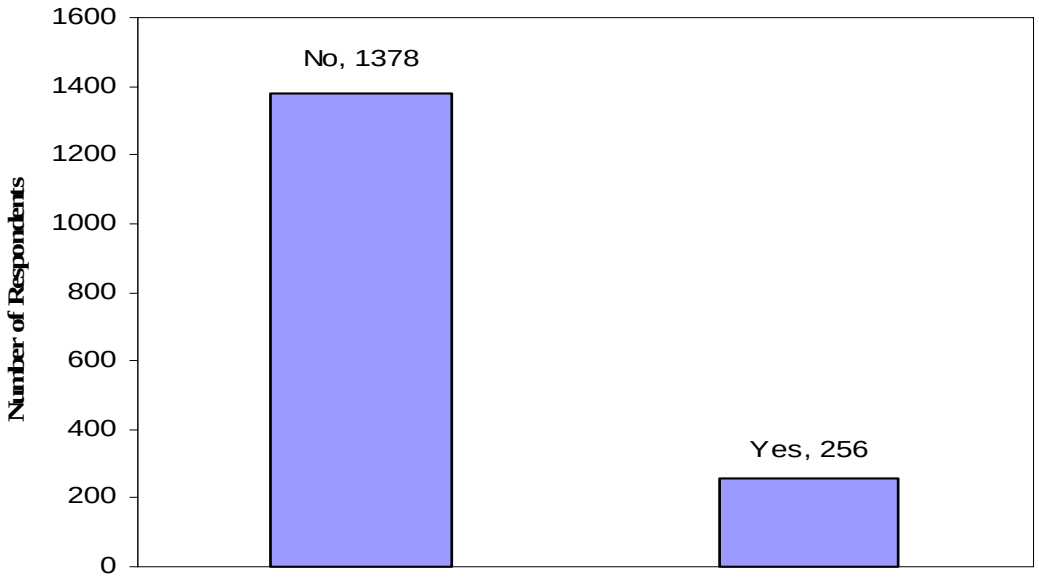
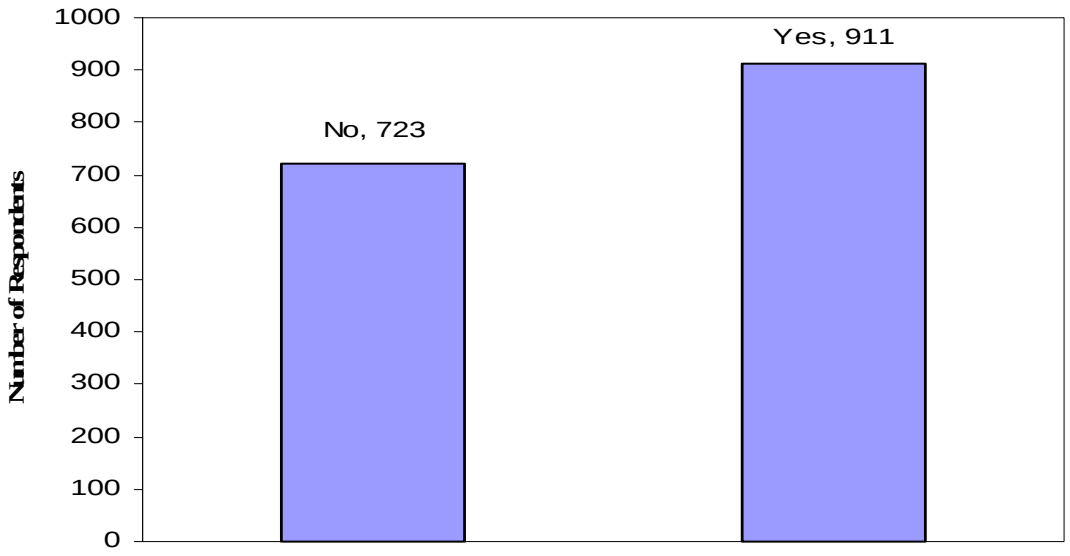


Figure 2.4: Participation in Cooperative Extension in Colorado



We can see the participation in Cooperative Extension by state; Arizona, Wyoming, and Colorado from Figure 2.2, 2.3, and 2.4 respectively. As shown in these figures, participation is high in Colorado compared to Arizona and Wyoming.

Risk is the possibility of loss and risk perception is the subjective assessment held by people about the severity of a risk. Five primary sources of risk for agricultural operations are identified by the United States Department of Agriculture: production, financial, marketing, human, and legal. Respondents were asked to evaluate how important each risk to their operation; 1 being the most important and 5 being the least important.

The major sources of *production* risk are weather, diseases, pests, and other factors that affect both the quantity and quality of commodity produced. Overall, production risk was ranked as the second most important source of risk (Figure 2.5). As

we can see from Figure 2.6, more respondents rank production risk as either first or second important to the operation.

Financial risk main sources are increased interest rates, restricted credit availability, and the ability to meet cash flow needs in a timely manner. Financial risk is ranked as the most important source of risk by a majority of respondents as seen from Figure 2.7. In addition, respondents ranked financial risk higher than the other sources of risk as seen from Figure 2.5.

Marketing risk refers to uncertainty in the prices of commodities that producers will receive or pay for inputs. Overall, marketing risk was ranked as the fourth important to the operation (Figure 2.5). However, the highest number of respondents (434) ranked it as the third highest risk which is a sign that they were less definite in this area compared to any other (Figure 2.8).

The category of *human* risk includes factors such as problems with human health, interaction with family, accidents, and illness that can affect farm business. More respondent ranked human risk as the least important to the operation (525) after legal risk given in Figure 2.9. On the other hand, more respondents ranked human risk more important than marketing or legal risk as shown in Figure 2.5.

Legal or institutional risk issues can be explained by the government actions such as tax laws, regulations for chemical use and torte liability. 1,050 respondents rank legal risk as the fourth or fifth least important to the operation (Figure 2.10). In addition to this, fewer respondents overall ranked this source of risk as the most important to the operation (Figure 2.5).

Figure 2.5: Highest Rank of Risks Types

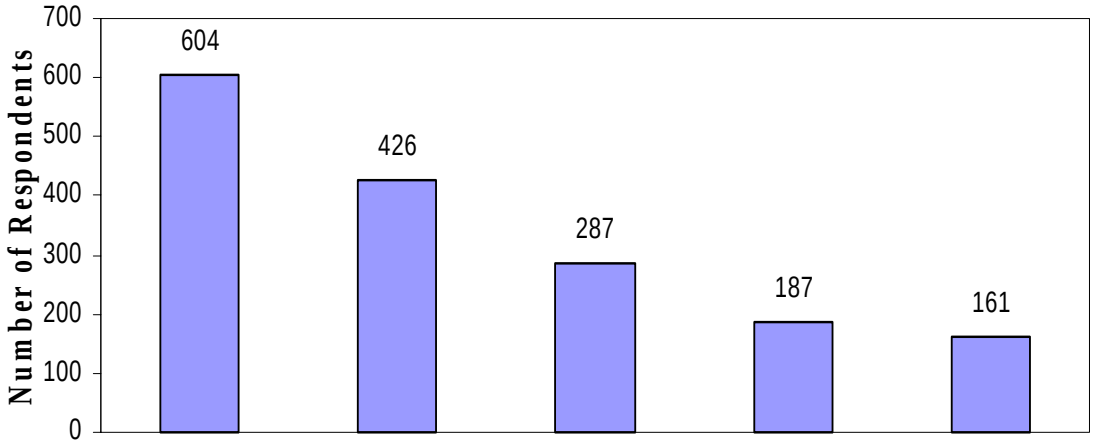


Figure 2.6: Production Risk

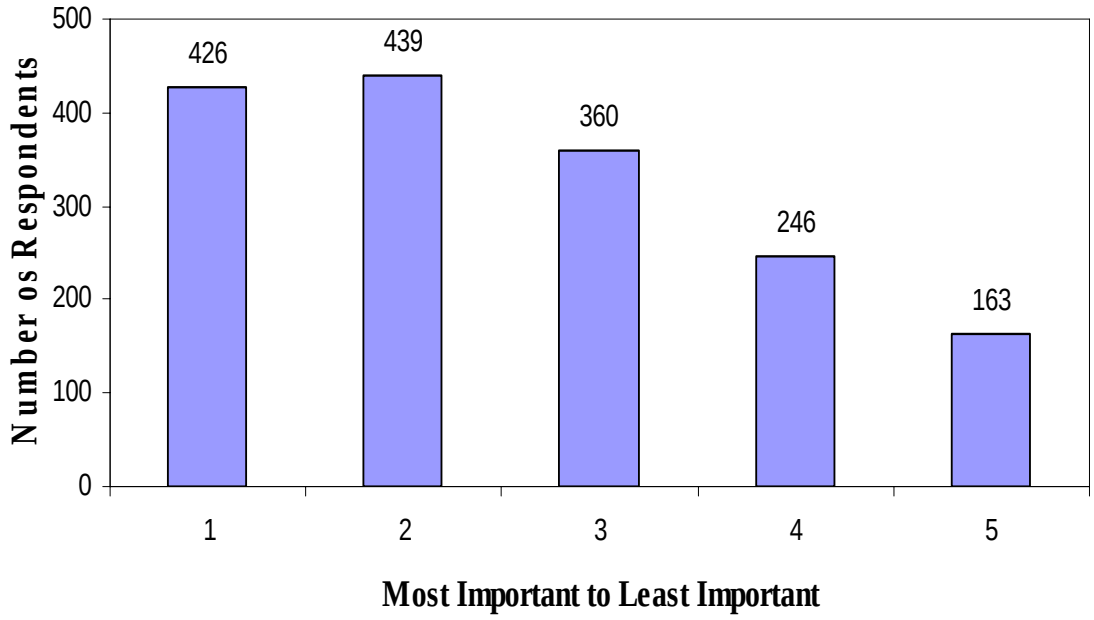


Figure 2.7: Financial Risk

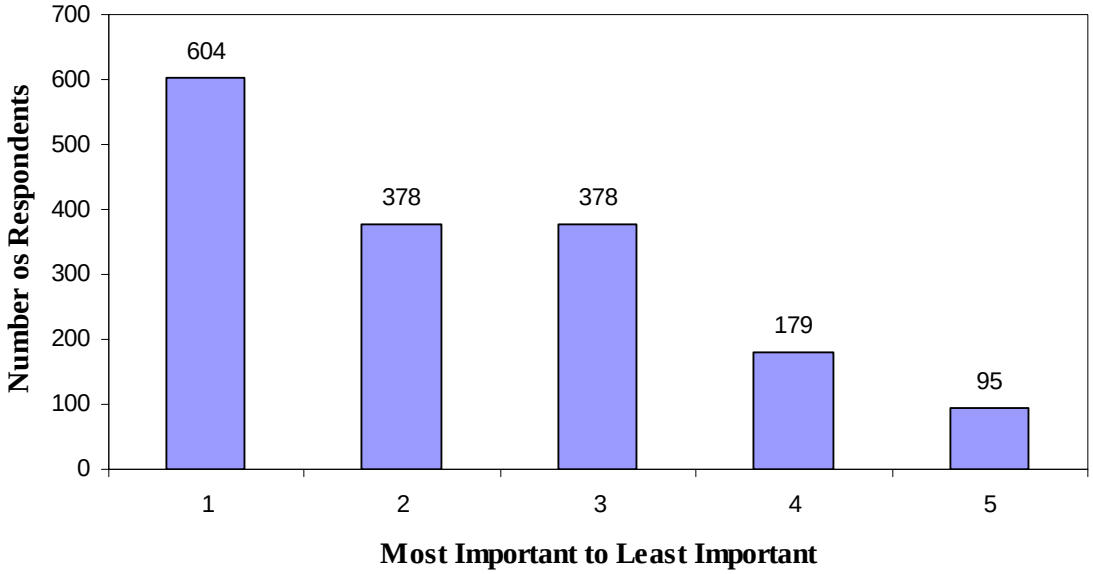


Figure 2.8: Marketing Risk

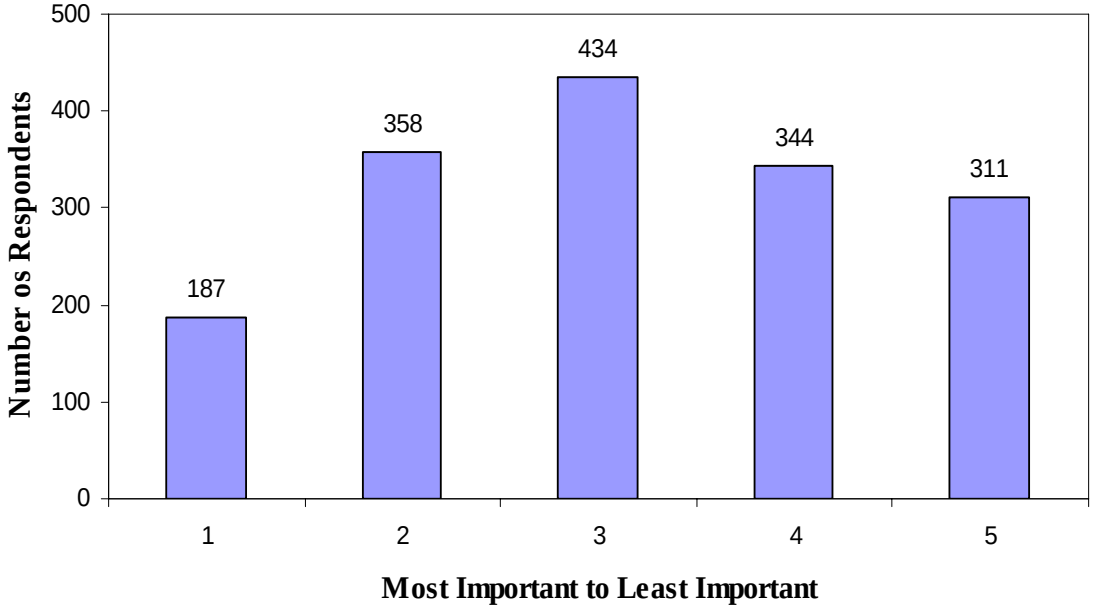


Figure 2.9: Human Risk

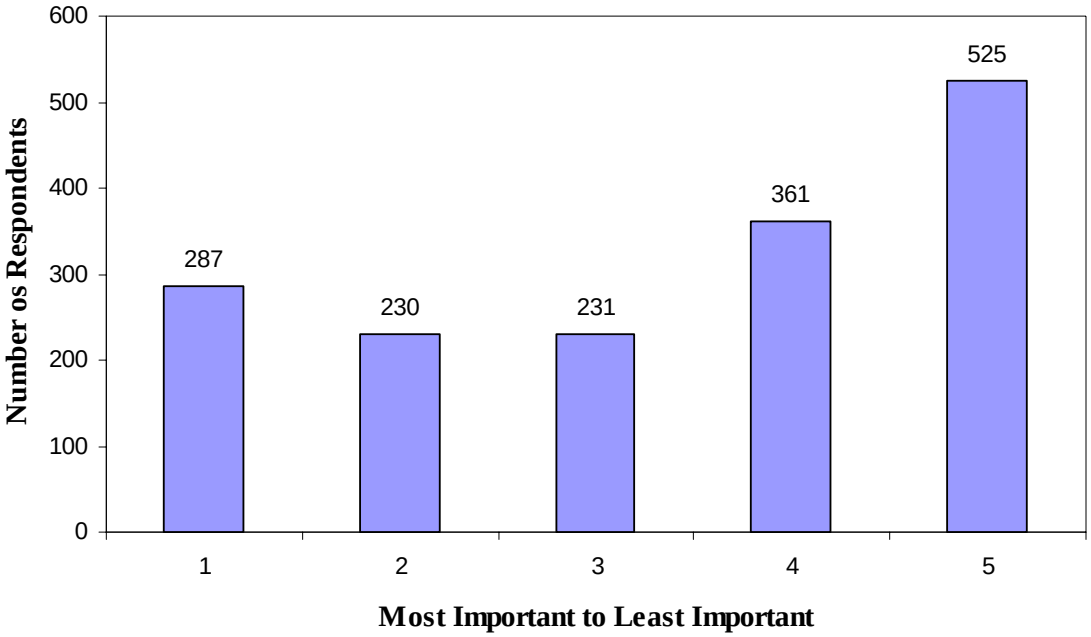
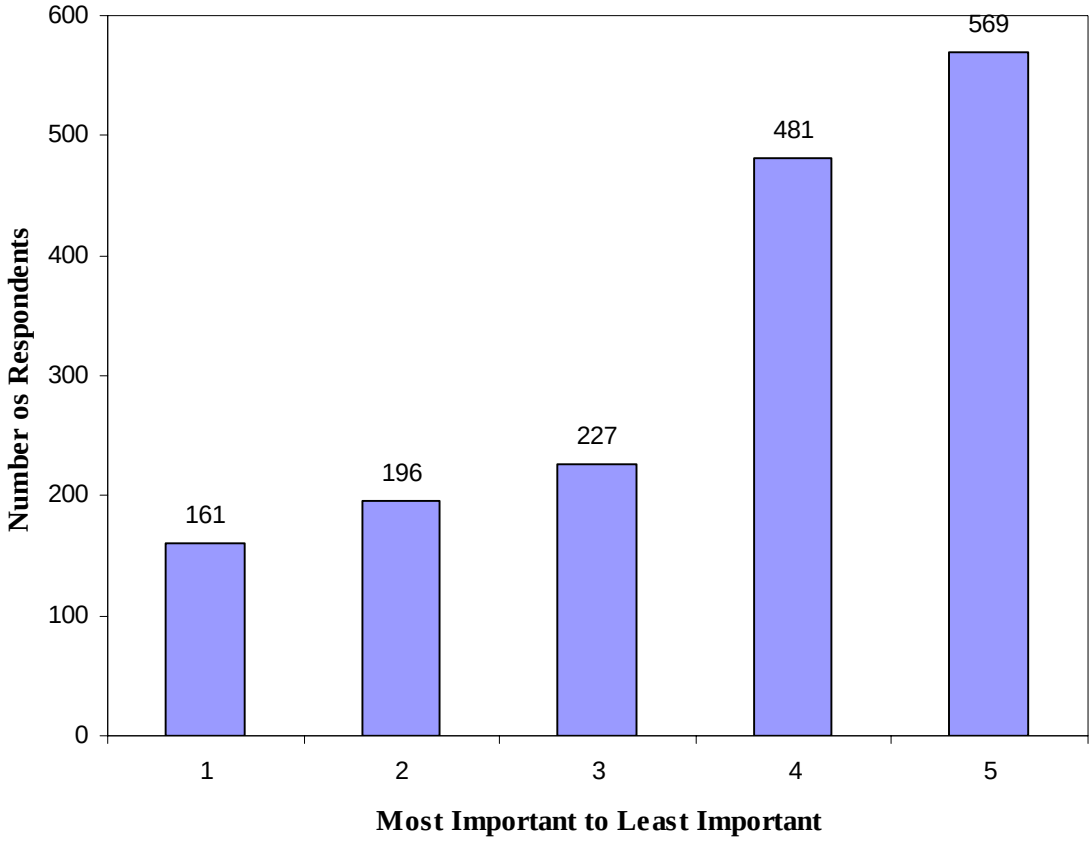


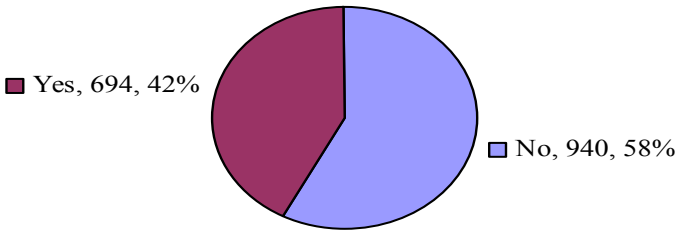
Figure 2.10: Legal Risk



There are several types for financing the farm operation such as personal savings, cash flows from product sales, retirement accounts, and loans from relatives. One of them is the financing source of off-farm income. Respondents were asked whether their operation was financed by off-farm income in 2005 or not. 42% of the small farm holders reported that they provided their financing from off-farm jobs (Figure 2.11). Type of financing is one of the major determinants of demand for extension education and it is

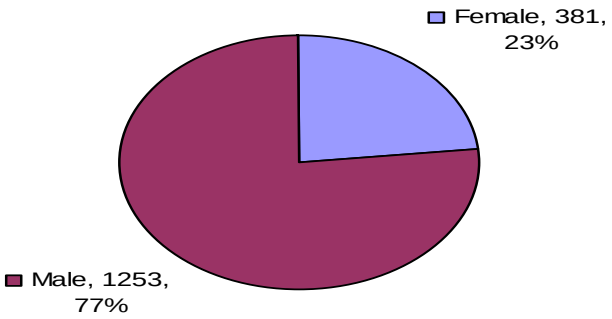
important to examine off-farm job effects on the demand side of extension education in order to provide more information to educators.

Figure 2.11: Source of Financing



The variable *gender* is a dummy variable which indicates the farm operator's gender; taking value 1 if the operator is male and 0 if the operator is female. As depicted in the Figure 2.12, 77% of the operators are male, and the remaining 23% are female according to the study data. This suggests that small-scale farming in the West is male dominated agricultural business.

Figure 2.12: Gender of the Operator



Age is an ordered variable that can take a value between 1 and 6 depending on the age range of the farm operator.

$$Age = \begin{cases} 1 & if & under & 25 & \\ 2 & if & 25 & - & 34 \\ 3 & if & 34 & - & 44 \\ 4 & if & 45 & - & 54 \\ 5 & if & 55 & - & 64 \\ 6 & if & 65 & \& & Over \end{cases}$$

Figure 2.13 shows the distribution of operators by their age range. As survey results show, most of the operators are in the age group 45-54 (523) years and 55-64 (499) years which is given by Figure 2.13. This observation is important since an older group of farmers are less likely to be open to new technologies and risk management strategies. Moreover, it is uncertain that farms will be still used for farming other than non-farm uses after these older operators retire. This variable is a good indicator not only for demand for extension education but also perception of farm holders.

Figure 2.13: Distribution of Operator Age

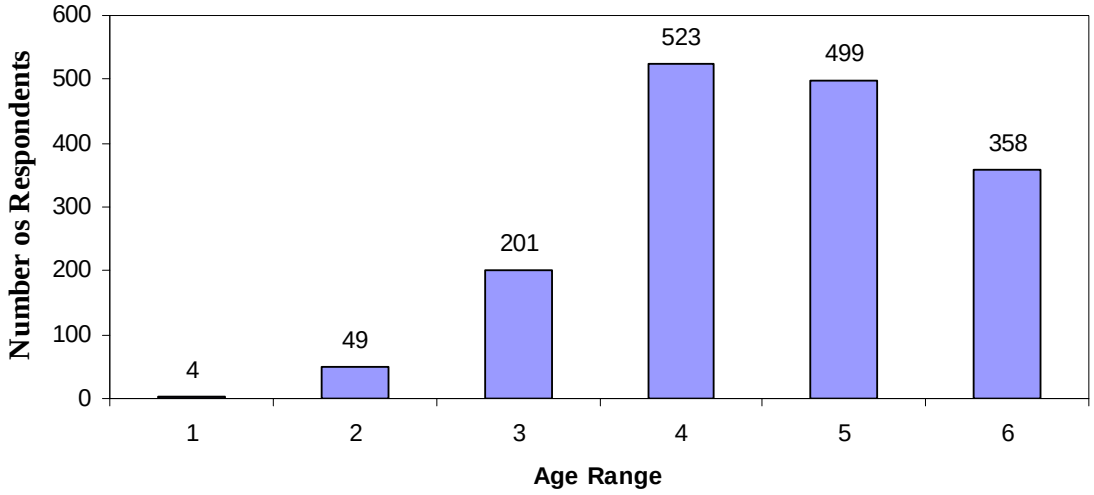


Table 2.1 lists the variables and their definitions. Summary statistics of the variables (mean, standard deviation, minimum and maximum calues) are given by Table 2.2.

Table 2.1: Variables and Definitions

VARIABLE NAME	***VARIABLE DEFINITION***	***TYPE***
Primary Sources of Risk		
Production	Order of production risk in terms of its' importance to operation	Ordered
Marketing	Order of marketing risk in terms of its' importance to operation	Ordered
Financial	Order of financial risk in terms of its' importance to operation	Ordered
Legal	Order of legal risk in terms of its' importance to operation	Ordered
Human	Order of human risk in terms of its' importance to operation	Ordered
Reasons for Involvement		
Profit	={1, if engaged in rural family agricultural operation to make profit; 0, if not}	Binary
Family Income	={1, if engaged in rural family agricultural operation to supplement family income; 0, if not}	Binary
Information Preferences		
Internet	={1, if Internet web sites are used to seek information; 0, if not}	Binary
Trade Magazine	={1, if Trade magazine is used to seek information; 0, if not}	Binary

Extension Education	={1, if received information from Cooperative Extension; 0, if not}	Binary
Resource Management		
TotalLand	Total acres of land managed (owned + leased) in thousands	Continuous
Specialty Market	={1, if produce any commodities indicating a specialty market; 0, if not}	Binary
CRP	={1, if any land enrolled in Conservation Reserve Program; 0, if not}	Binary
Sources of Water		
Wells	={1, if source of water on the land are wells; 0, if not}	Binary
RuralWaterSystem	={1, if source of water on the land is rural water system; 0, if not}	Binary
Income Issues		
Sole Proprietorship	={1, if business type in 2005 is sole proprietorship; 0, if not}	Binary
Agricultural Income	Percent of income comes from the agricultural operation	Continuous
Paid Employee	={1, if they have paid employees in 2005; 0, if not}	Binary
Offfarmy	={1, if the operation was financed in 2005 by off-farm income; 0, if not}	Binary
Demographics		

Az	={1, if the primary residence is Arizona; 0, if not}	Binary
Wy	={1, if the primary residence is Wyoming; 0, if not}	Binary
Rural	={1, if most of the property managed by the operation is completely rural; 0, if not}	Binary
Distance	The distance of the property from the nearest 'metro area' in miles	Continuous
Offproperty	={1, if they currently hold an off-property job; 0, if not}	Binary
Gender	={1, if the operator is male; 0, if the operator is female}	Binary
Age	Age of the respondent	Ordered
Educ_high	={1, if the highest level of education is high school; 0, if not}	Binary
Educ_trade	={1, if the highest level of education is trade school; 0, if not}	Binary
Educ_col2	={1, if the highest level of education is college degree, 2 yr; 0, if not}	Binary
Educ_col4	={1, if the highest level of education is college degree, 4 yr; 0, if not}	Binary
Educ_grad	={1, if the highest level of education is graduate degree; 0, if not}	Binary

Table 2.2: Summary Statistics

Explanatory Variables	Mean	Std. Dev	Min	Max
Production	2.560	1.292	1	5
Financial	2.255	1.224	1	5
Marketing	3.143	1.276	1	5
Human	3.371	1.488	1	5
Legal	3.674	1.322	1	5
Profit	0.414	0.493	0	1
Family Income	0.422	0.494	0	1
Internet	0.452	0.498	0	1
Trade Magazine	0.420	0.494	0	1
TotalLand	0.648	2.973	0	50.08
Specialty Market	0.129	0.335	0	1
CRP	0.084	0.277	0	1
Wells	0.535	0.499	0	1
RuralWaterSystem	0.201	0.401	0	1
Sole Proprietorship	0.808	0.394	0	1
Agricultural Income	14.687	23.377	0	100
Paid Employee	0.154	0.361	0	1
Offfarmy	0.425	0.494	0	1
Az	0.124	0.329	0	1
Wy	0.189	0.392	0	1
Distance	25.391	37.586	1	350
Rural	0.622	0.485	0	1
offproperty	0.736	0.441	0	1
Gender	0.767	0.423	0	1
Age	4.553	1.068	1	6
Educ_high	0.312	0.463	0	1
Educ_trade	0.069	0.254	0	1
Educ_col2	0.183	0.387	0	1
Educ_col4	0.237	0.425	0	1
Educ_grad	0.145	0.352	0	1

2.4 Econometric Model and Estimation

Our dependent variables of main interest are the measures of perceived farm risks of production, marketing, financial, human, and legal. Since the measures of each perceived farm risks are ordinal in nature, we estimate the appropriate model of Ordered Probit Model for corresponding farm risks. The order of the values conveys information for ordinal variables as opposed to ordinary regression analysis in which the magnitude of the variables conveys information. It can be illustrated by the difference between a 1 and a 2 as not being the same with the difference between a 2 and a 3, whereas they are only showing a ranking.

In order to examine the determinants of perceived farm risks and evaluate the role of Extension Education, data on measures of perceived farm risks and two social groups who have ever received extension information and who have not are considered as the basic components. The dependent variables are measured by using a Likert scale of 1 to 5, where 1 being the most important to the operation, and 5 being the least important. Lets assume that Y_i, i=1,2,…,5 denotes the dependent variables corresponding to each farm risk and z, the binary variable denotes whether a farm operator has ever received extension education and x denotes other explanatory variables such as gender, education levels, sources of income. We can start by conceptualizing the perceived farm risks as function of a vector of x and a scalar z, as $Y_i = f_i (x,z,u_i)$ where u_i are stochastic discrepancies.

Assuming that stochastic errors across equations are uncorrelated, we can estimate each equation separately as ordered probit model which gives unbiased, efficient,

and consistent parameter estimates. Since there are 5 types of risks, the proposed models are applications of ordered probit model for each farm risk.

As in the case of probit model, we can model the observed response around a latent variable Y_i^* which is linearly dependent on the explanatory variables X_i and errors follow a normal distribution as well:

$$Y_i^* = X_i\beta + \varepsilon_i$$

$$\varepsilon_i \sim N(0,1)$$

What we observe is y_i which can take 5 values in this study:

$$y_i = \begin{cases} 1 \quad if \quad y_i^* \leq \mu_1 \\ 2 \quad if \quad \mu_1 \leq y_i^* \prec \mu_2 \\ 3 \quad if \quad \mu_2 \leq y_i^* \prec \mu_3 \\ 4 \quad if \quad \mu_3 \leq y_i^* \prec \mu_4 \\ 5 \quad if \quad \mu_4 \leq y_i^* \end{cases}$$

where μ_i's are cut points to be estimated with the unknown parameter vector β.

The probabilities for each of the observed response are given as follows:

$$\Pr ob(y_i = 1) = \Phi(\mu_1 - X_i\beta)$$
$$\Pr ob(y_i = 2) = \Phi(\mu_2 - X_i\beta) - \Phi(\mu_1 - X_i\beta)$$
$$\Pr ob(y_i = 3) = \Phi(\mu_3 - X_i\beta) - \Phi(\mu_2 - X_i\beta)$$
$$\Pr ob(y_i = 4) = \Phi(\mu_4 - X_i\beta) - \Phi(\mu_3 - X_i\beta)$$
$$\Pr ob(y_i = 5) = 1 - \Phi(\mu_4 - X_i\beta)$$

where Φ represents the cumulative normal distribution function.

The marginal effects are not equal to the slope coefficients (β's) as in ordinary least square. The marginal effects of changes in the regressors are calculated as follows:

$$\frac{\partial \Pr ob(y_i = 1)}{\partial X_i} = -\phi(\mu_1 - X_i\beta)\beta$$

$$\frac{\partial \Pr ob(y_i = 2)}{\partial X_i} = \beta[\phi(\mu_1 - X_i\beta) - \phi(\mu_2 - X_i\beta]$$

$$\frac{\partial \Pr ob(y_i = 3)}{\partial X_i} = \beta[\phi(\mu_2 - X_i\beta) - \phi(\mu_3 - X_i\beta]$$

$$\frac{\partial \Pr ob(y_i = 4)}{\partial X_i} = \beta[\phi(\mu_3 - X_i\beta) - \phi(\mu_4 - X_i\beta]$$

$$\frac{\partial \Pr ob(y_i = 5)}{\partial X_i} = \phi(\mu_4 - X_i\beta)\beta$$

where ϕ represents the probability density function (pdf) of normal distribution.

However, this approach is not appropriate for evaluating the effect of a dummy variable (Greene, 2000). The marginal effect of a dummy variable can be calculated by the difference in the probabilities when the variable takes 1 and 0 with the other explanatory variables held at their sample means.

The ordered probit models to be estimated with respect to five types of farm risks are given below:

$$\textit{Farm risk (i)} = \beta_0 + \beta_1\, profit + \beta_2 familyIncome + \beta_3 internet + \beta_4 tradeMagazine + \beta_5 ExtensionEducation + \beta_6 totalLand + \beta_7 specialtyMarket + \beta_8 CRP + \beta_9 wells + \beta_{10} RuralWaterSystem + \beta_{11} SoleProprietorship + \beta_{12} AgriculturalIncome + \beta_{13} PaidEmployee + \beta_{14} offfarmy + \beta_{15} az + \beta_{16} wy + \beta_{17} Rural + \beta_{18} offproperty + \beta_{19} gender + \beta_{20} age + \beta_{21} educ\_high + \beta_{22} educ\_trade + \beta_{23} educ\_col2 + \beta_{24} educ\_col4 + \beta_{25} educ\_grad \qquad (1)$$

i = production, financial, marketing, human, legal

Model (1) is estimated by a maximum likelihood procedure which is a statistical method that uses the cumulative density function of the normal distribution.

2.4.1 Endogeneity of Extension Education

In the preceding section, participation in extension education programs is not considered as endogenous. However, it is suspected that extension education is potentially endogenous due to various reasons. Extension education might be correlated on the error term of the ordered probit equations due to omitted variable bias. In other words, explanatory variable *extension education* is not exogenous. The participation in extension education programs can affect the perceived farm risks, whereas the possibility of farm holders attending these programs may be affected by their perception of farm risks. Thus, there is a simultaneous feedback between perceived farm risk and participation in extension education.

In the following, I test the endogeneity of extension education. In order to do so, I estimate a probit model where extension education is dependent variable and perceived farm risks of production, financial, marketing, human, and legal are explanatory variables respectively.

Corresponding to each farm risk, a probit model is estimated by a Maximum Likelihood Procedure.

Table 2.3: Endogeneity of Extension Education in Production Farm Risk: Extension Education as Dependent Variable

	COEFFICIENT	STD. ERROR
Production	-0.059**	0.0274
Reasons For Involvement		
Profit	0.064	0.0795
Family Income	0.242**	0.0780
Information Preferences		
Internet	-0.1589**	0.0764
Trade Magazine	-0.0541	0.0740
Resource Management		
TotalLand	-0.02*	0.0113
Specialty Market	0.138	0.1117
CRP	0.1686	0.1443
Sources of Water		
Wells	-0.0342	0.0789
RuralWaterSystem	-0.0742	0.0950
Income Issues		
Sole Proprietorship	-0.0792	0.0960
Agricultural Income	0.0029*	0.0017
Paid Employee	0.0895	0.1051
Offfarmy	0.1721**	0.0776
Demographics		
Az	-0.3865**	0.1075
Wy	0.086	0.0969
Rural	0.1281*	0.0756
Offproperty	0.0137	0.0925
Gender	0.1823**	0.0840
Age	0.004	0.0374
Educ_high	-0.1633	0.1627
Educ_trade	-0.0911	0.2013
Educ_col2	0.0708	0.1729
Educ_col4	0.2822*	0.1710
Educ_grad	0.1012	0.1784
Probit Threshold		
μ1	0.6867**	0.2981

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.4: Endogeneity of Extension Education in Financial Farm Risk: Extension Education as Dependent Variable

	COEFFICIENT	STD. ERROR
Financial	0.0154	0.0295
Reasons For Involvement		
Profit	0.076	0.0795
Family Income	0.2331**	0.0778
Information Preferences		
Internet	-0.172**	0.0761
Trade Magazine	-0.0593	0.0743
Resource Management		
TotalLand	-0.02*	0.0113
Specialty Market	0.1326	0.1115
CRP	0.2169	0.1464
Sources of Water		
Wells	-0.061	0.0789
RuralWaterSystem	-0.0979	0.0949
Income Issues		
Sole Proprietorship	-0.0806	0.0960
Agricultural Income	0.003*	0.0017
Paid Employee	0.0648	0.1050
Offfarmy	0.1672**	0.0775
Demographics		
Az	-0.3786**	0.1074
Wy	0.1094	0.0972
Rural	0.1401*	0.0755
Offproperty	-0.0024	0.0928
Gender	0.1924**	0.0837
Age	0.0072	0.0375
Educ_high	-0.1595	0.1628
Educ_trade	-0.0709	0.2011
Educ_col2	0.0687	0.1730
Educ_col4	0.2762	0.1711
Educ_grad	0.1065	0.1785
Probit Threshold		
μ1	0.5042*	0.2960

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.5: Endogeneity of Extension Education in Marketing Farm Risk: Extension Education as Dependent Variable

	COEFFICIENT	STD. ERROR
Marketing	-0.0188	0.0286
Reasons For Involvement		
Profit	0.0637	0.0796
Family Income	0.2446**	0.0781
Information Preferences		
Internet	-0.1679**	0.0766
Trade Magazine	-0.0664	0.0741
Resource Management		
TotalLand	-0.0907	-0.0201*
Specialty Market	-0.0749**	0.1290
CRP	-0.0689**	0.2156
Sources of Water		
Wells	-0.0483	0.0789
RuralWaterSystem	-0.0915	0.0947
Income Issues		
Sole Proprietorship	-0.0792	0.0960
Agricultural Income	0.003*	0.0017
Paid Employee	0.0699	0.1050
Offfarmy	0.1584**	0.0778
Demographics		
Az	-0.3858**	0.1075
Wy	0.1002	0.0974
Rural	-0.0004	0.1297*
Offproperty	-0.1359*	0.0194
Gender	-0.2674**	0.1863**
Age	0.0047	0.0375
Educ_high	-0.1751	0.1626
Educ_trade	-0.0642	0.2020
Educ_col2	0.0607	0.1728
Educ_col4	0.2687	0.1707
Educ_grad	0.0944	0.1784
Probit Threshold		
μ1	0.6114**	0.3062

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.6: Endogeneity of Extension Education in Human Farm Risk: Extension Education as Dependent Variable

	COEFFICIENT	STD. ERROR
Human	0.0298	0.0242
Reasons For Involvement		
Profit	0.0648	0.0798
Family Income	0.2315**	0.0779
Information Preferences		
Internet	-0.1706**	0.0763
Trade Magazine	-0.0762	0.0741
Resource Management		
TotalLand	-0.0199*	0.0113
Specialty Market	0.146	0.1118
CRP	0.2188	0.1462
Sources of Water		
Wells	-0.0649	0.0790
RuralWaterSystem	-0.096	0.0951
Income Issues		
Sole Proprietorship	-0.0672	0.0956
Agricultural Income	0.0027	0.0017
Paid Employee	0.0801	0.1050
Offfarmy	0.1612**	0.0778
Demographics		
Az	-0.3845**	0.1078
Wy	0.1035	0.0975
Rural	0.1371*	0.0756
Offproperty	-0.0021	0.0927
Gender	0.1916**	0.0837
Age	0.0031	0.0374
Educ_high	-0.1636	0.1633
Educ_trade	-0.0672	0.2029
Educ_col2	0.0646	0.1732
Educ_col4	0.2764	0.1714
Educ_grad	0.0899	0.1785
Probit Threshold		
μ1	0.4667	0.3017

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.7: Endogeneity of Extension Education in Legal Farm Risk: Extension Education as Dependent Variable

	COEFFICIENT	STD. ERROR
Legal	0.0449*	0.0273
Reasons For Involvement		
Profit	0.0696	0.0799
Family Income	0.231**	0.0782
Information Preferences		
Internet	-0.1615**	0.0766
Trade Magazine	-0.0651	0.0743
Resource Management		
TotalLand	-0.0187*	0.0113
Specialty Market	0.1262	0.1120
CRP	0.1967	0.1464
Sources of Water		
Wells	-0.06	0.0792
RuralWaterSystem	-0.1057	0.0952
Income Issues		
Sole Proprietorship	-0.0822	0.0958
Agricultural Income	0.0029*	0.0017
Paid Employee	0.067	0.1052
Offfarmy	0.1635**	0.0780
Demographics		
Az	-0.3895**	0.1079
Wy	0.0953	0.0976
Rural	0.1448*	0.0758
Offproperty	-0.0116	0.0929
Gender	0.1852**	0.0840
Age	0.0042	0.0376
Educ_high	-0.1635	0.1634
Educ_trade	-0.0529	0.2028
Educ_col2	0.0881	0.1738
Educ_col4	0.3086*	0.1718
Educ_grad	0.1	0.1786
Probit Threshold		
μ1	0.4005	0.3024

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

From Tables 2.3, 2.5, 2.5, 2.6, and 2.7, it can be observed that production and legal farm risks are statistically significant at 5% and 10% respectively.

These statistical results indicate that extension education is endogenous in the determination of production and legal farm risks.

2.4.2 Instrument for Extension Education

From preceding section, it is clear that extension education is endogenous. Instrumental variables techniques are used to overcome endogeneity problems in econometrics and other literature in order to obtain a consistent estimator when there is a correlation between the disturbance term and the explanatory variable of interest which is extension education in this case. There are 2 conditions that an instrument must satisfy to provide consistent and unbiased estimates. These requirements for good instruments are as below:

1) The instrument variable should be highly correlated with the endogenous variable. Therefore, it should be clear that the instrument is not a direct determinant of the dependent variable of the equation intuitively. It should be statistically significant in the first stage regression.

2) The instrument should be uncorrelated with the error term in the main equation.

We consider distance of farm operation from the nearest metro areas as the instrument for participation into extension education to purge endogeneity problem. Summary statistics of the instrument is given in Table 2.8 for each farm risk data set. The distance of the property from the nearest ‘metro area’ in miles is correlated with the

decision to go to the extension education workshops whereas it is uncorrelated with the perceptions of farm risks which makes this variable a very good instrument for our estimations. To check the statistical significance of distance, a probit model regression is used for each farm risk data set in which the participation in extension education is the dependent variable and the distance is the explanatory variable. As shown in Table 2.9, distance is statistically significant at 10% level for all the data except for legal farm risk data. Actually, the distance coefficient is significant at around a 10.5% level for the legal farm risk data. From these results, we can conclude that our instrument variable decision is appropriate because it satisfies the first condition of being a good instrument. Distance is uncorrelated with the error term in the main equation intuitively which satisfies the second condition.

After we decided on the instrument variable, we implemented a two-stage estimation to obtain more accurate estimates. We run the probit model (2) where extension education is the dependent variable and the distance variable in addition to the explanatory variables used in the previous estimations (1) are independent variables as the first stage estimation. First stage regression is given by:

$$Extension\ Education(y=1) = \beta_0 + \beta_1\ profit + \beta_2 familyIncome + \beta_3 internet + \beta_4 tradeMagazine + \beta_5 totalLand + \beta_6 specialtyMarket + \beta_7 CRP + \beta_8 wells + \beta_9 RuralWaterSystem + \beta_{10} SoleProprietorship + \beta_{11} AgriculturalIncome + \beta_{12} PaidEmployee + \beta_{13} offfarmy + \beta_{14} az + \beta_{15} wy + \beta_{16} Rural + \beta_{17} offproperty + \beta_{18} gender + \beta_{19} age + \beta_{20} educ\_high + \beta_{21} educ\_trade + \beta_{22} educ\_col2 + \beta_{23} educ\_col4 + \beta_{24} educ\_grad + \beta_{25} Distance \quad (2)$$

From the probit model estimation (2), predictions for *extension education* are obtained to examine the determinants of small farm holders risk perceptions in the West and analyze the role of *extension education*. The predicted value of extension education has been substituted in place of *extension education* in Model (1). Second-stage estimations are the re-estimations of Model (1) with the predicted *extension education* instead of *extension education* from the data set.

Table 2.8: Summary Statistics of Distance (Instrument)

Data Set	***N***	***Mean***	***Std. Dev.***	***Min***	***Max***
Production	1656	25.3381643	37.6224737	1	350
Financial	1652	25.4067797	37.6820246	1	350
Marketing	1647	25.4104432	37.7076957	1	350
Human	1645	25.3866261	37.6038392	1	350
Legal	1642	25.3964677	37.5266137	1	350

Table 2.9: Probit Model Estimation for Instrument: Extension Education as Dependent Variable

DATA SET	**INTERCEPT**	**DISTANCE**	**Prob > chi2**	**Log Likelihood**
Production	0.7848**	0.0017*	0.0768	-836.4408
Financial	0.7858**	0.0017*	0.0815	-834.2145
Marketing	0.7856**	0.0017*	0.0805	-831.7028
Human	0.7807**	0.0018*	0.0683	-832.4698
Legal	0.7876	0.0016	0.0986	-829.3630

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Thus, distance of farm operation from the nearest metro areas is a good instrument for extension education.

2.5 Empirical Results

2.5.1 Determinants of Perceived Production Farm Risk

In this section results are discussed for determinants of perceived production farm risk for both models in which extension education is endogenous and exogenous. Table 10 gives descriptive statistics for variables that are used in these estimations.

Table 2.10: Summary Statistics

Number of Observation=1656	***Mean***	***Std. Dev.***	***Min***	***Max***
Primary Source of Risk				
Production	2.553	1.296	1	5
Reasons For Involvement				
Profit	0.415	0.493	0	1
Family Income	0.420	0.494	0	1
Information Preferences				
Internet	0.449	0.498	0	1
Trade Magazine	0.418	0.493	0	1
Extension Education	0.796	0.403	0	1
Resource Management				
TotalLand	0.646	2.955	0	50.08
Specialty Market	0.130	0.337	0	1
CRP	0.084	0.277	0	1
Sources of Water				
Wells	0.534	0.499	0	1
RuralWaterSystem	0.201	0.401	0	1
Income Issues				
Sole Proprietorship	0.809	0.393	0	1
Agricultural Income	14.682	23.382	0	100
Paid Employee	0.155	0.362	0	1
Offfarmy	0.425	0.495	0	1
Demographics				
Az	0.124	0.330	0	1
Wy	0.189	0.392	0	1
Rural	0.623	0.485	0	1
Offproperty	0.735	0.442	0	1
Gender	0.769	0.422	0	1
Age	4.559	1.069	1	6

Educ_high	0.312	0.464	0	1
Educ_trade	0.069	0.253	0	1
Educ_col2	0.183	0.387	0	1
Educ_col4	0.236	0.425	0	1
Educ_grad	0.145	0.352	0	1

Table 2.11 represents the estimated results of the ordered probit model by assuming the *extension education* is exogenous in the MLE estimation and endogenous in the IV estimation. Column 1 of the table gives the explanatory variables, while their corresponding parameter estimates and standard errors for MLE estimation are given in columns 2 and 3 respectively. Parameter estimates and their standard errors for IV estimation are given by column 4 and 5 respectively.

Table 2.12 shows the marginal effects of the variables with their standard errors at P(Y=1), P(Y=2), P(Y=3), P(Y=4) and P(Y=5) by assuming *extension education* is exogenous.

Table 2.13 shows the marginal effects of the variables with their standard errors at P(Y=1), P(Y=2), P(Y=3), P(Y=4) and P(Y=5) by assuming *extension education* is endogenous.

Table 2.11: Determinants of Perceived Production Farm Risk (Ordered Probit Model)

Determinants of Perceived Production Farm Risk				
	MLE Estimation		**IV Estimation**	
Explanatory Variables	**COEFFICIENT**	**S.E.**	**COEFFICIENT**	**S.E.**
Reasons For Involvement				
Profit	-0.1015*	0.0572	-0.1043	0.0645
Family Income	-0.0849	0.0557	-0.0931	0.1093
Information Preferences				
Internet	0.1664**	0.0555	0.1724**	0.0833
Trade Magazine	0.043	0.0538	0.045	0.0587

Extension Education	-0.1366**	0.0664		
Predicted Extension Education			-0.0049	1.4425
Resource Management				
TotalLand	0.0055	0.0089	0.0064	0.0126
Specialty Market	0.0905	0.0782	0.0858	0.0944
CRP	-0.2157**	0.0974	-0.2214*	0.1207
Sources of Water				
Wells	0.1635**	0.0574	0.1648**	0.0612
RuralWaterSystem	0.1234*	0.0691	0.126	0.0769
Income Issues				
Sole Proprietorship	-0.0561	0.068	-0.0533	0.0749
Agricultural Income	-0.0022*	0.0013	-0.0023	0.0017
Paid Employee	0.0765	0.0741	0.074	0.0782
Offfarmy	0.0475	0.0562	0.0411	0.0873
Demographics				
Az	-0.0325	0.0844	-0.0165	0.1962
Wy	-0.1218*	0.0692	-0.125	0.0789
Rural	-0.0715	0.0557	-0.0762	0.0766
Offproperty	0.0386	0.0681	0.0391	0.0681
Gender	-0.0693	0.0632	-0.0759	0.0967
Age	-0.005	0.0274	-0.0053	0.0274
Educ_high	0.1001	0.1213	0.1039	0.1331
Educ_trade	0.0647	0.1507	0.0663	0.1546
Educ_col2	0.0042	0.1277	-0.00002	0.1311
Educ_col4	0.1122	0.1245	0.1014	0.1599
Educ_grad	0.0835	0.1313	0.079	0.1372
Ordered Probit Thresholds				
μ1	-0.7128	0.2193	-0.62	1.0493
μ2	0.0052	0.2188	0.0974	1.0493
μ3	0.6133	0.219	0.7044	1.0491
μ4	1.2344	0.2207	1.3237	1.0493
LR chi2(25)	62.11		57.88	
Prob >chi2	0.0001		0.0002	
PseudoR2	0.0121		0.0113	

Note: ** significant at 5% level of significance, * significant at 10% level of significance

Table 2.12: Marginal Effects of Perceived Production Farm Risk (Ordered Probit Model): Extension Education as Exogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	0.0261	0.0135	-0.0019	-0.0132	-0.0244
	(0.0192)	(0.0109)	(0.0118)	(0.0091)	(0.0184)
Family Income	0.0219	0.0111	-0.0018	-0.0111	-0.0202

	(0.0172)	(0.0103)	(0.0098)	(0.0082)	(0.0174)
Information Preferences					
Internet	-0.0480*	-0.0181	0.0081	0.0233**	0.0346
	(0.0249)	(0.0177)	(0.0183)	(0.0091)	(0.0232)
Trade Magazine	-0.0118	-0.0052	0.0015	0.0059	0.0096
	(0.0155)	(0.0077)	(0.0052)	(0.0075)	(0.0132)
Extension Education	0.0345	0.0185	-0.0020	-0.0175	-0.0334
	(0.0230)	(0.0140)	(0.0159)	(0.0109)	(0.0239)
Resource Management					
TotalLand	-0.0015	-0.0007	0.0002	0.0007	0.0013
	(0.0025)	(0.0012)	(0.0007)	(0.0012)	(0.0021)
Specialty Market	-0.0253	-0.0105	0.0037	0.0125	0.0196
	(0.0239)	(0.0127)	(0.0104)	(0.0111)	(0.0206)
CRP	0.0524	0.0303	-0.0013	-0.0266	-0.0548
	(0.0368)	(0.0188)	(0.0248)	(0.0182)	(0.0339)
Sources of Water					
Wells	-0.0471*	-0.0178	0.0079	0.0229**	0.0341
	(0.0258)	(0.0172)	(0.0182)	(0.0096)	(0.0226)
RuralWaterSystem	-0.0350	-0.0139	0.0055	0.0172*	0.0263
	(0.0240)	(0.0144)	(0.0138)	(0.0103)	(0.0212)
Income Issues					
Sole Proprietorship	0.0147	0.0072	-0.0014	-0.0074	-0.0132
	(0.0189)	(0.0100)	(0.0066)	(0.0093)	(0.0175)
Agricultural Income	0.0006	0.0003	-0.0001	-0.0003	-0.0005
	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0004)
Paid Employee	-0.0213	-0.0090	0.0030	0.0105	0.0167
	(0.0222)	(0.0114)	(0.0089)	(0.0105)	(0.0190)
Offfarmy	-0.0130	-0.0057	0.0017	0.0065	0.0105
	(0.0166)	(0.0079)	(0.0058)	(0.0080)	(0.0136)
Demographics					
Az	0.0086	0.0041	-0.0009	-0.0043	-0.0075
	(0.0230)	(0.0109)	(0.0045)	(0.0115)	(0.0197)
Wy	0.0309	0.0163	-0.0020	-0.0157	-0.0295
	(0.0237)	(0.0126)	(0.0142)	(0.0113)	(0.0215)
Rural	0.0186	0.0093	-0.0016	-0.0094	-0.0169
	(0.0166)	(0.0095)	(0.0083)	(0.0080)	(0.0161)
Offproperty	-0.0106	-0.0047	0.0013	0.0053	0.0086
	(0.0196)	(0.0087)	(0.0052)	(0.0095)	(0.0155)

Gender	0.0180	0.0090	-0.0016	-0.0091	-0.0164
	(0.0182)	(0.0101)	(0.0081)	(0.0088)	(0.0174)
Age	0.0013	0.0006	-0.0002	-0.0007	-0.0011
	(0.0074)	(0.0034)	(0.0010)	(0.0037)	(0.0063)
Educ_high	-0.0281	-0.0115	0.0042	0.0138	0.0216
	(0.0260)	(0.0215)	(0.0066)	(0.0144)	(0.0357)
Educ_trade	-0.0179	-0.0077	0.0024	0.0089	0.0142
	(0.0371)	(0.0220)	(0.0047)	(0.0192)	(0.0385)
Educ_col2	-0.0011	-0.0005	0.0001	0.0006	0.0010
	(0.0340)	(0.0161)	(0.0036)	(0.0171)	(0.0294)
Educ_col4	-0.0317	-0.0128	0.0048	0.0156	0.0241
	(0.0266)	(0.0226)	(0.0077)	(0.0148)	(0.0371)
Educ_grad	-0.0233	-0.0098	0.0033	0.0115	0.0182
	(0.0305)	(0.0211)	(0.0057)	(0.0162)	(0.0359)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.13: Marginal Effects of Perceived Production Farm Risk (Ordered Probit Model): Extension Education as Endogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	0.0265	0.0140	-0.0017	-0.0134	-0.0254
	(0.0220)	(0.0112)	(0.0125)	(0.0105)	(0.0193)
Family Income	0.0238	0.0124	-0.0016	-0.0120	-0.0226
	(0.0313)	(0.0156)	(0.0113)	(0.0154)	(0.0278)
Information Preferences					
Internet	-0.0494	-0.0190	0.0081	0.0240*	0.0363
	(0.0352)	(0.0182)	(0.0209)	(0.0138)	(0.0248)
Trade Magazine	-0.0122	-0.0055	0.0015	0.0061	0.0102
	(0.0173)	(0.0080)	(0.0058)	(0.0083)	(0.0140)
Extension Education	0.0013	0.0006	-0.0001	-0.0007	-0.0011
	(0.3841)	(0.1819)	(0.0403)	(0.1922)	(0.3335)
Resource Management					
TotalLand	-0.0017	-0.0008	0.0002	0.0009	0.0015
	(0.0036)	(0.0016)	(0.0009)	(0.0018)	(0.0028)
Specialty Market	-0.0237	-0.0102	0.0032	0.0117	0.0189
	(0.0266)	(0.0147)	(0.0099)	(0.0128)	(0.0248)
CRP	0.0531	0.0314	-0.0006	-0.0268	-0.0571
	(0.0432)	(0.0202)	(0.0258)	(0.0217)	(0.0370)

Sources of Water					
Wells	-0.0471*	-0.0183	0.0076	0.0229**	0.0348
	(0.0283)	(0.0172)	(0.0193)	(0.0106)	(0.0228)
RuralWaterSystem	-0.0354	-0.0144	0.0053	0.0174	0.0272
	(0.0278)	(0.0145)	(0.0151)	(0.0119)	(0.0218)
Income Issues					
Sole Proprietorship	0.0139	0.0069	-0.0012	-0.0070	-0.0127
	(0.0197)	(0.0113)	(0.0064)	(0.0098)	(0.0199)
Agricultural Income	0.0006	0.0003	-0.0001	-0.0003	-0.0005
	(0.0006)	(0.0003)	(0.0003)	(0.0003)	(0.0005)
Paid Employee	-0.0204	-0.0088	0.0027	0.0101	0.0165
	(0.0224)	(0.0122)	(0.0087)	(0.0107)	(0.0205)
offfarmy	-0.0111	-0.0050	0.0013	0.0055	0.0093
	(0.0236)	(0.0117)	(0.0052)	(0.0117)	(0.0210)
Demographics					
Az	0.0044	0.0021	-0.0004	-0.0022	-0.0039
	(0.0512)	(0.0255)	(0.0049)	(0.0258)	(0.0465)
Wy	0.0314	0.0170	-0.0017	-0.0159	-0.0308
	(0.0271)	(0.0130)	(0.0150)	(0.0130)	(0.0227)
Rural	0.0196	0.0101	-0.0015	-0.0099	-0.0183
	(0.0228)	(0.0112)	(0.0093)	(0.0111)	(0.0198)
offproperty	-0.0106	-0.0048	0.0013	0.0053	0.0088
	(0.0195)	(0.0088)	(0.0053)	(0.0095)	(0.0158)
Gender	0.0195	0.0100	-0.0015	-0.0098	-0.0182
	(0.0276)	(0.0135)	(0.0093)	(0.0135)	(0.0241)
Age	0.0014	0.0007	-0.0001	-0.0007	-0.0012
	(0.0073)	(0.0035)	(0.0010)	(0.0037)	(0.0064)
Educ_high	-0.0290	-0.0121	0.0041	0.0143	0.0227
	(0.0319)	(0.0221)	(0.0091)	(0.0165)	(0.0373)
Educ_trade	-0.0182	-0.0080	0.0024	0.0090	0.0148
	(0.0385)	(0.0223)	(0.0058)	(0.0197)	(0.0394)
Educ_col2	0.000004	0.000002	-0.0000004	-0.000002	-0.000004
	(0.0349)	(0.0165)	(0.0037)	(0.0175)	(0.0303)
Educ_col4	-0.0282	-0.0119	0.0040	0.0139	0.0222
	(0.0374)	(0.0255)	(0.0073)	(0.0197)	(0.0437)
Educ_grad	-0.0218	-0.0094	0.0029	0.0108	0.0175
	(0.0317)	(0.0218)	(0.0054)	(0.0167)	(0.0376)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Empirical results suggest that strong predictor variables influencing perceived production farm risks in the rural West are *profit, internet, extension education, CRP, RuralWaterSystem, agricultural Income* and *wy* which are all significant at 5 and 10% level as given in Table 2.11 for MLE estimation**.** All the results for the parameter estimates and their corresponding standard errors calculated for each one are given in column 2 and 3 of Table 2.11. *Internet, extension education and RuralWaterSystem* are relatively more significant parameter estimates compared to the other parameters. Marginal effects of the parameters at P(Y=1), P(Y=2), P(Y=3), P(Y=4) and P(Y=5) are given in Table 2.12. At P(Y=1), marginal effects have the opposite sign with the parameter estimates, whereas they have the same sign with the parameter estimate at P(Y=5). From marginal effects table, we can see that the probability of perceiving production farm risk as being the most important risk is decreasing for the small farm holders who get information from internet. When the small farm holders' water source is wells, the probability of perceiving production farm risk as the most important risk to the operating is decreasing which is similar to the internet variable effect. Marginal effects of the other explanatory variables are insignificant which is showing that they are not affecting the perceptions as much as we expected.

What we can infer from IV estimation results of Table 2.11 is that *internet* and *CRP* are the determinants of perceived production farm risk at 5 and 10% significance levels respectively. On comparing the results of MLE and IV estimations of Table 2.11, we note that the explanatory variables *profit, extension education, RuralWaterSystem, agricultural income, and wy* were significant when *extension education* is exogenous,

while they are insignificant when it is assumed to be endogenous. From the Marginal Effects Table 2.13, we can reveal that the only variable that changes the probability of perceiving production farm risk as the most important is *wells* with an opposite direction.

We look at differences (or variations) between perceived farm risks of two social groups (one group that received Extension Education, and second that did not receive extension education). The role of Extension education can be evaluated or tested by including Extension education as an Independent Explanatory variable, where it is defined by a binary dummy variable as done in the ordered probit estimation. The estimated coefficient for extension education was negative and significant at 5% level in the estimation where *extension education* is exogenous; whereas it is insignificant after we used the predicted extension education from the probit model as the explanatory variable in which we overcome the endogeneity problem. Thus, we conclude that the differences between production farm risks of two social groups can not be evaluated by only extension education.

2.5.2 Determinants of Perceived Financial Farm Risk

In this section, estimation results of ordered probit model for perceived farm risk of financial with extension education as endogenous and exogenous are discussed. Explanatory variables and their means, standard deviations, minimum and maximum values are given in Table 2.14.

Table 2.14: Summary Statistics

Number of Observation = 1652	***Mean***	***Std. Dev.***	***Min***	***Max***
Primary Source of Risk				
Financial	2.2536	1.2233	1	5
Reasons For Involvement				

Profit	0.4134	0.4926	0	1
Family Income	0.4213	0.4939	0	1
Information Preferences				
Internet	0.4516	0.4978	0	1
Trade Magazine	0.4177	0.4933	0	1
Extension Education	0.7960	0.4031	0	1
Resource Management				
TotalLand	0.6435	2.9572	0	50.08
Specialty Market	0.1301	0.3366	0	1
CRP	0.0835	0.2768	0	1
Sources of Water				
Wells	0.5369	0.4988	0	1
RuralWaterSystem	0.1998	0.3999	0	1
Income Issues				
Sole Proprietorship	0.8087	0.3934	0	1
Agricultural Income	14.6132	23.3227	0	100
Paid Employee	0.1531	0.3602	0	1
Offfarmy	0.4237	0.4943	0	1
Demographics				
Az	0.1247	0.3305	0	1
Wy	0.1889	0.3915	0	1
Rural	0.6223	0.4850	0	1
Offproperty	0.7343	0.4419	0	1
Gender	0.7676	0.4225	0	1
Age	4.5551	1.0699	1	6
Educ_high	0.3117	0.4633	0	1
Educ_trade	0.0696	0.2546	0	1
Educ_col2	0.1816	0.3856	0	1
Educ_col4	0.2361	0.4248	0	1
Educ_grad	0.1465	0.3537	0	1

Determinants of perceived farm risk of financial are given in Table 2.15. As observed from the table, the significant parameter estimates at 10% level are *family Income, CRP and offfarmy* for MLE estimation. The parameters *trade magazine, offproperty, and age* are significant at 5% level which means that they have relatively

more importance to the operation at the perceived financial farm risk when *extension education* is exogenous.

In comparison to MLE estimation, the estimated coefficients of IV estimation for *family income and offfarmy* are not significant any more. Similar results are observed for the estimated coefficients of *trade magazine, CRP, agricultural income, offproperty, and age* in both estimations. We can conclude that these are the main determinants of perceived financial farm risks for small farm holders.

Marginal effects of the parameters due to the financial risk are given in Table 2.16 at P(Y=1), P(Y=2), P(Y=3), P(Y=4) and P(Y=5) respectively when *extension education* is exogenous. We can reveal from the table that the probability of perceiving financial risk as the most important risk is increasing as the percentage of income coming from agriculture increases. Small farm holders who have any land enrolled in Conservation Reserve Program have the same positive relation of their perception of financial risk with CRP as agricultural income variable does. What is interesting is that the probability of perceiving financial risk as the most important risk is decreasing as the small farm holders get older. This might happen because they already had their financial resources when they get old as an accumulation of their past works so they do not worry about their financial status as they did when they are younger and started working. Small farm holders who involve in agriculture operations to supplement family income see the financial risk as the most important risk in the operation as well as the ones who have off farm income and off property jobs.

Marginal effects of *trade magazine, CRP, offproperty, and age* have the same signs and significance level at P(Y=1) as in the marginal effect Table 2.16 for the ordered probit model estimation with *extension education* as endogenous (Table 2.17).

Table 2.15: Determinants of Perceived Financial Farm Risk (Ordered Probit Model)

Determinants of Perceived Financial Farm Risk				
	MLE Estimation		IV Estimation	
Explanatory Variables	**COEFFICIENT**	**S.E.**	**COEFFICIENT**	**S.E.**
Reasons For Involvement				
Profit	-0.0262	0.0585	-0.0406	0.067
Family Income	-0.0996*	0.057	-0.1397	0.1071
Information Preferences				
Internet	0.0151	0.0566	0.0436	0.0857
Trade Magazine	-0.2405**	0.0553	-0.2286**	0.0616
Extension Education	0.0424	0.0681		
Predicted Extension Education			0.7068	1.5022
Resource Management				
TotalLand	-0.0017	0.0093	0.0021	0.0128
Specialty Market	0.0209	0.0808	-0.004	0.0981
CRP	-0.1828*	0.1009	-0.2186*	0.1294
Sources of Water				
Wells	-0.0808	0.0584	-0.0676	0.0654
RuralWaterSystem	-0.0568	0.0709	-0.0389	0.0814
Income Issues				
Sole Proprietorship	0.0514	0.07	0.0655	0.077
Agricultural Income	-0.0037**	0.0013	-0.0042**	0.0017
Paid Employee	0.0564	0.0758	0.0469	0.0788
Offfarmy	-0.106*	0.0574	-0.1365	0.0895
Demographics				
Az	0.0907	0.0856	0.1713	0.201
Wy	0.0618	0.071	0.0416	0.0843
Rural	-0.0148	0.0568	-0.0402	0.0808
Offproperty	-0.138**	0.0689	-0.1334*	0.0696
Gender	0.081	0.065	0.0459	0.1023
Age	0.0716**	0.0283	0.0702**	0.0284
Educ_high	-0.0582	0.1237	-0.0345	0.1347
Educ_trade	-0.0264	0.153	-0.0145	0.1552
Educ_col2	-0.035	0.1299	-0.0489	0.1336
Educ_col4	0.0666	0.1265	0.0188	0.1659
Educ_grad	0.0928	0.1336	0.0726	0.1415
Ordered Probit Thresholds			0.0021	0.0128
μ1	-0.2676	0.2238	0.2053	1.0917
μ2	0.3398	0.2241	0.8125	1.092

μ3	1.0663	0.2252	1.5388	1.0923
μ4	1.686	0.2273	2.159	1.0927
LR chi2(25)	78.16		77.99	
Prob >chi2	0		0	
PseudoR2	0.016		0.0163	

Note: ** significant at 5% level of significance, * significant at 10% level of significance

Table 2.16: Marginal Effects of Perceived Financial Farm Risk (Ordered Probit Model): Extension Education as Exogenous

Variable	Y=1	Y=2	Y=3	Y=4	Y=5
Reasons For Involvement					
Profit	0.0103	-0.0016	-0.0044	-0.0028	-0.0016
	(0.0230)	(0.0046)	(0.0098)	(0.0065)	(0.0040)
Family Income	0.0393*	-0.0054	-0.0165*	-0.0111	-0.0067
	(0.0228)	(0.0112)	(0.0096)	(0.0084)	(0.0077)
Information Preferences					
Internet	-0.0059	0.0010	0.0025	0.0016	0.0009
	(0.0221)	(0.0040)	(0.0095)	(0.0060)	(0.0035)
Trade Magazine	0.0954**	-0.0093	-0.0389**	-0.0283**	-0.0184
	(0.0221)	(0.0274)	(0.0123)	(0.0131)	(0.0175)
Extension Education	-0.0165	0.0029	0.0071	0.0044	0.0025
	(0.0265)	(0.0066)	(0.0115)	(0.0073)	(0.0046)
Resource Management					
TotalLand	0.0007	-0.0001	-0.0003	-0.0002	-0.0001
	(0.0036)	(0.0006)	(0.0016)	(0.0010)	(0.0006)
Specialty Market	-0.0082	0.0014	0.0035	0.0022	0.0012
	(0.0316)	(0.0057)	(0.0136)	(0.0086)	(0.0050)
CRP	0.0724*	-0.0083	-0.0299*	-0.0210	-0.0132
	(0.0396)	(0.0211)	(0.0177)	(0.0140)	(0.0138)
Sources of Water					
Wells	0.0318	-0.0045	-0.0134	-0.0089	-0.0053
	(0.0233)	(0.0093)	(0.0098)	(0.0078)	(0.0066)
RuralWaterSystem	0.0223	-0.0033	-0.0095	-0.0062	-0.0036
	(0.0278)	(0.0075)	(0.0119)	(0.0081)	(0.0057)
Income Issues					
Sole Proprietorship	-0.0200	0.0036	0.0086	0.0053	0.0030
	(0.0273)	(0.0073)	(0.0118)	(0.0077)	(0.0050)
Agricultural Income	0.0015**	-0.0002	-0.0006**	-0.0004	-0.0002

	(0.0005)	(0.0004)	(0.0002)	(0.0002)	(0.0002)
Paid Employee	-0.0219	0.0040	0.0095	0.0058	0.0032
	(0.0297)	(0.0077)	(0.0127)	(0.0085)	(0.0056)
Offfarmy	0.0418*	-0.0057	-0.0176*	-0.0118	-0.0071
	(0.0230)	(0.0119)	(0.0097)	(0.0085)	(0.0081)
Demographics					
Az	-0.0351	0.0067	0.0152	0.0092	0.0050
	(0.0338)	(0.0107)	(0.0144)	(0.0102)	(0.0072)
Wy	-0.0240	0.0044	0.0104	0.0064	0.0035
	(0.0279)	(0.0077)	(0.0119)	(0.0082)	(0.0056)
Rural	0.0058	-0.0009	-0.0025	-0.0016	-0.0009
	(0.0223)	(0.0039)	(0.0095)	(0.0062)	(0.0037)
Offproperty	0.0545*	-0.0069	-0.0228**	-0.0156	-0.0096
	(0.0280)	(0.0154)	(0.0116)	(0.0109)	(0.0108)
Gender	-0.0314	0.0059	0.0136	0.0082	0.0045
	(0.0254)	(0.0096)	(0.0110)	(0.0078)	(0.0058)
Age	-0.0280*	0.0046	0.0120**	0.0076	0.0043
	(0.0110)	(0.0078)	(0.0049)	(0.0048)	(0.0047)
Educ_high	0.0229	-0.0034	-0.0097	-0.0063	-0.0037
	(0.0471)	(0.0123)	(0.0213)	(0.0114)	(0.0056)
Educ_trade	0.0103	-0.0016	-0.0044	-0.0028	-0.0016
	(0.0593)	(0.0114)	(0.0258)	(0.0156)	(0.0086)
Educ_col2	0.0137	-0.0021	-0.0059	-0.0038	-0.0022
	(0.0500)	(0.0108)	(0.0221)	(0.0128)	(0.0067)
Educ_col4	-0.0258	0.0047	0.0112	0.0068	0.0038
	(0.0513)	(0.0056)	(0.0210)	(0.0156)	(0.0102)
Educ_grad	-0.0359	0.0069	0.0156	0.0094	0.0051
	(0.0548)	(0.0066)	(0.0223)	(0.0171)	(0.0114)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.17: Marginal Effects of Perceived Financial Farm Risk (Ordered Probit Model): Extension Education as Endogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	0.0162	-0.0031	-0.0068	-0.0041	-0.0022
	(0.0267)	(0.0069)	(0.0113)	(0.0069)	(0.0041)
Family Income	0.0557	-0.0091	-0.0234	-0.0148	-0.0084
	(0.0426)	(0.0173)	(0.0182)	(0.0127)	(0.0101)
Information Preferences					

Internet	-0.0174	0.0036	0.0073	0.0042	0.0022
	(0.0339)	(0.0092)	(0.0144)	(0.0080)	(0.0044)
Trade Magazine	0.0909**	-0.0128	-0.0379**	-0.0252*	-0.0151
	(0.0243)	(0.0257)	(0.0108)	(0.0147)	(0.0163)
Extension Education	-0.2814	0.0560	0.1189	0.0696	0.0370
	(0.5956)	(0.1550)	(0.2525)	(0.1420)	(0.0778)
Resource Management					
TotalLand	-0.0009	0.0002	0.0004	0.0002	0.0001
	(0.0051)	(0.0011)	(0.0022)	(0.0012)	(0.0007)
Specialty Market	0.0016	-0.0003	-0.0007	-0.0004	-0.0002
	(0.0391)	(0.0078)	(0.0165)	(0.0096)	(0.0051)
CRP	0.0870*	-0.0125	-0.0363	-0.0240	-0.0143
	(0.0518)	(0.0262)	(0.0225)	(0.0162)	(0.0149)
Sources of Water					
Wells	0.0270	-0.0049	-0.0114	-0.0069	-0.0038
	(0.0262)	(0.0079)	(0.0110)	(0.0082)	(0.0059)
RuralWaterSystem	0.0155	-0.0029	-0.0065	-0.0039	-0.0021
	(0.0325)	(0.0070)	(0.0137)	(0.0087)	(0.0052)
Income Issues					
Sole Proprietorship	-0.0260	0.0056	0.0110	0.0062	0.0032
	(0.0304)	(0.0098)	(0.0129)	(0.0077)	(0.0048)
Agricultural Income	0.0017**	-0.0003	-0.0007**	-0.0004	-0.0002
	(0.0007)	(0.0005)	(0.0003)	(0.0003)	(0.0002)
Paid Employee	-0.0187	0.0039	0.0079	0.0045	0.0023
	(0.0314)	(0.0076)	(0.0133)	(0.0083)	(0.0049)
offfarmy	0.0544	-0.0090	-0.0228	-0.0144	-0.0082
	(0.0357)	(0.0165)	(0.0153)	(0.0111)	(0.0093)
Demographics					
Az	-0.0675	0.0161	0.0285	0.0153	0.0075
	(0.0772)	(0.0289)	(0.0325)	(0.0172)	(0.0101)
Wy	-0.0165	0.0035	0.0070	0.0040	0.0021
	(0.0337)	(0.0074)	(0.0142)	(0.0089)	(0.0052)
Rural	0.0160	-0.0030	-0.0068	-0.0040	-0.0022
	(0.0322)	(0.0078)	(0.0136)	(0.0081)	(0.0047)
offproperty	0.0532*	-0.0088	-0.0223*	-0.0140	-0.0080
	(0.0277)	(0.0147)	(0.0116)	(0.0111)	(0.0099)
Gender	-0.0182	0.0038	0.0077	0.0044	0.0023
	(0.0408)	(0.0091)	(0.0172)	(0.0105)	(0.0060)

Age	-0.0280**	0.0056	0.0118**	0.0069	0.0037
	(0.0114)	(0.0074)	(0.0048)	(0.0049)	(0.0043)
Educ_high	0.0137	-0.0026	-0.0058	-0.0035	-0.0019
	(0.0535)	(0.0124)	(0.0227)	(0.0126)	(0.0065)
Educ_trade	0.0058	-0.0011	-0.0024	-0.0014	-0.0008
	(0.0617)	(0.0129)	(0.0261)	(0.0150)	(0.0078)
Educ_col2	0.0195	-0.0036	-0.0082	-0.0049	-0.0027
	(0.0530)	(0.0139)	(0.0226)	(0.0116)	(0.0055)
Educ_col4	-0.0075	0.0015	0.0032	0.0018	0.0010
	(0.0662)	(0.0123)	(0.0280)	(0.0169)	(0.0092)
Educ_grad	-0.0288	0.0062	0.0122	0.0069	0.0035
	(0.0572)	(0.0083)	(0.0241)	(0.0164)	(0.0098)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

The variable *extension education* indicating information is received from Cooperative Extension or not is statistically insignificant in both cases. This implies that extension education is not indicative of the differences of perceived financial farm risk between two social groups who received extension education and who did not receive it on its own given our data sample.

2.5.3 Determinants of Perceived Marketing Farm Risk

In this section, estimation results for perceived marketing farm risk with explanatory variable extension education as endogenous and exogenous are presented. Table 2.18 lists the summary statistics of the data variables for perceived marketing farm risk (mean, standard deviation, minimum and maximum values).

Table 2.18: Summary Statistics

Number of Observation=1647	***Mean***	***Std. Dev.***	***Min***	***Max***
Primary Source of Risk				
Marketing	3.1378	1.2778	1	5
Reasons For Involvement				
Profit	0.4153	0.4929	0	1
Family Income	0.4214	0.4939	0	1
Information Preferences				

Internet	0.4511	0.4978	0	1
Trade Magazine	0.4177	0.4933	0	1
Extension Education	0.7960	0.4031	0	1
Resource Management				
TotalLand	0.6482	2.9621	0	50.08
Specialty Market	0.1299	0.3363	0	1
CRP	0.0838	0.2772	0	1
Sources of Water				
Wells	0.5355	0.4989	0	1
RuralWaterSystem	0.2016	0.4013	0	1
Income Issues				
Sole Proprietorship	0.8081	0.3939	0	1
Agricultural Income	14.6758	23.3379	0	100
Paid Employee	0.1536	0.3607	0	1
Offfarmy	0.4232	0.4942	0	1
Demographics				
Az	0.1245	0.3302	0	1
Wy	0.1882	0.3910	0	1
Rural	0.6236	0.4846	0	1
Offproperty	0.7335	0.4423	0	1
Gender	0.7675	0.4226	0	1
Age	4.5562	1.0706	1	6
Educ_high	0.3109	0.4630	0	1
Educ_trade	0.0692	0.2539	0	1
Educ_col2	0.1821	0.3861	0	1
Educ_col4	0.2368	0.4252	0	1
Educ_grad	0.1457	0.3529	0	1

Table 2.19 represents the parameter estimates with their corresponding standard variations in both cases where *extension education* is assumed to be exogenous and endogenous.

Table 2.19: Determinants of Perceived Marketing Farm Risk (Ordered Probit Model)

Determinants of Perceived Marketing Farm Risk				
	MLE Estimation		**IV Estimation**	
Explanatory Variables	**COEFFICIENT**	**S.E.**	**COEFFICIENT**	**S.E.**
Reasons For Involvement				

Profit	-0.0831	0.0567	-0.0859	0.0635
Family Income	-0.1508**	0.0554	-0.1598	0.1098
Information Preferences				
Internet	0.2048**	0.0553	0.211**	0.0837
Trade Magazine	-0.0137	0.0535	-0.0111	0.06
Extension Education	-0.0353	0.066		
Predicted Extension Education			0.1053	1.4633
Resource Management				
TotalLand	0.0199**	0.0095	0.0207	0.0132
Specialty Market	-0.0338	0.0784	-0.0388	0.0946
CRP	0.071	0.0963	0.0634	0.1256
Sources of Water				
Wells	0.0248	0.0569	0.0271	0.0618
RuralWaterSystem	-0.0264	0.0686	-0.023	0.0775
Income Issues				
Sole Proprietorship	0.0162	0.0675	0.0189	0.0743
Agricultural Income	-0.0031**	0.0012	-0.0032*	0.0017
Paid Employee	0.0592	0.0739	0.0571	0.077
Offfarmy	-0.087	0.0559	-0.0932	0.0856
Demographics				
Az	-0.0361	0.0843	-0.0183	0.1999
Wy	-0.0862	0.0686	-0.0901	0.0798
Rural			-0.0846	0.0764
Offproperty	-0.0795	0.0555	0.117*	0.0675
Gender	0.1169*	0.0675	0.047	0.0966
Age	-0.0731**	0.0273	-0.0732**	0.0273
Educ_high	-0.0987	0.1196	-0.0932	0.1326
Educ_trade	-0.1473	0.1483	-0.1455	0.1498
Educ_col2	0.0496	0.1261	0.0469	0.1289
Educ_col4	-0.0596	0.1227	-0.0692	0.1584
Educ_grad	-0.0936	0.1298	-0.0975	0.1359
Ordered Probit Thresholds				
μ1	-1.6379	0.2189	-1.5374	1.0669
μ2	-0.8512	0.2171	-0.7506	1.0668
μ3	-0.1516	0.2166	-0.0511	1.0666
μ4	0.4915	0.2167	0.5918	1.0666
LR chi2(25)	75.88		75.6	
Prob >chi2	0		0	
PseudoR2	0.015		0.0145	

Note: ** significant at 5% level of significance, * significant at 10% level of significance

Results suggest that strong predictor variables for the perceived marketing farm risk in the rural West are *family income, internet, totalLand, agricultural income, gender,*

and age. They are significant variables at 5% level except *gende*r which is significant at 10% level as given in Table 2.19 for MLE estimation. We can infer from column 4 of Table 2.19 the following: *offproperty, internet, agricultural income, and age* are the significant determinants of perceived marketing farm risk for the small farm holders in the West. In the MLE estimation, the variables *family income, totalLand, and gender* were also statistically significant explanatory variables while they are not significant any more with the endogeneity of *extension education*.

The results from the marginal effects given in Table 20 show that there is a negative relation with the variable internet and the marketing risk's being the most important to the small farm holder as in the case of production farm risk perceptions. As the income percentage coming from agriculture increases, the probability of perceiving the marketing farm risk as the most important risk is increasing. When the small farm holder gets older, he perceives marketing risk as the most important risk too. The farm holders whose objective is to supplement family income have the perception of marketing risk as being the most important risk.

When we look at the marginal effects (Table 2.21), we can see that *age* has significant effects on the perception of marketing farm risk at P(Y=1) at 10% level. As the small farm holder gets older, his probability of perceiving the marketing risk as the most important risk is increasing.

The estimated coefficient for extension education is statistically insignificant with and without endogeneity. This finding suggests that the differences in perceptions for

marketing risk between the small farm holders who has received extension education and who has not can not be explained by only extension education.

Table 2.20: Marginal Effects of Perceived Marketing Farm Risk (Ordered Probit Model): Extension Education as Exogenous

Variable	Y=1	Y=2	Y=3	Y=4	Y=5
Reasons For Involvement					
Profit	0.0217	0.0111	-0.0046	-0.0123	-0.0160
	(0.0178)	(0.0109)	(0.0106)	(0.0085)	(0.0146)
Family Income	0.0381*	0.0211	-0.0071	-0.0220**	-0.0302
	(0.0222)	(0.0158)	(0.0188)	(0.0088)	(0.0215)
Information Preferences					
Internet	-0.0604**	-0.0212	0.0181	0.0307**	0.0328
	(0.0282)	(0.0245)	(0.0224)	(0.0084)	(0.0238)
Trade Magazine	0.0037	0.0018	-0.0009	-0.0020	-0.0025
	(0.0146)	(0.0069)	(0.0038)	(0.0080)	(0.0099)
Extension Education	0.0094	0.0046	-0.0022	-0.0053	-0.0066
	(0.0179)	(0.0094)	(0.0057)	(0.0098)	(0.0132)
Resource Management					
TotalLand	-0.0054	-0.0025	0.0013	0.0030**	0.0036
	(0.0036)	(0.0023)	(0.0025)	(0.0015)	(0.0028)
Specialty Market	0.0090	0.0044	-0.0021	-0.0050	-0.0063
	(0.0215)	(0.0105)	(0.0064)	(0.0117)	(0.0149)
CRP	-0.0199	-0.0084	0.0052	0.0106	0.0124
	(0.0273)	(0.0143)	(0.0102)	(0.0144)	(0.0193)
Sources of Water					
Wells	-0.0068	-0.0031	0.0017	0.0037	0.0045
	(0.0160)	(0.0074)	(0.0050)	(0.0085)	(0.0105)
RuralWaterSystem	0.0071	0.0034	-0.0016	-0.0039	-0.0049
	(0.0188)	(0.0091)	(0.0054)	(0.0102)	(0.0130)
Income Issues					
Sole Proprietorship	-0.0044	-0.0020	0.0011	0.0024	0.0029
	(0.0186)	(0.0085)	(0.0050)	(0.0101)	(0.0123)
Agricultural Income	0.0008*	0.0004	-0.0002	-0.0005**	-0.0006
	(0.0005)	(0.0004)	(0.0004)	(0.0002)	(0.0004)
Paid Employee	-0.0165	-0.0071	0.0043	0.0089	0.0104
	(0.0215)	(0.0110)	(0.0085)	(0.0111)	(0.0148)

Offfarmy	0.0227	0.0117	-0.0048	-0.0128	-0.0168
	(0.0176)	(0.0113)	(0.0110)	(0.0084)	(0.0150)
Demographics					
Az	0.0096	0.0047	-0.0022	-0.0054	-0.0067
	(0.0232)	(0.0112)	(0.0070)	(0.0126)	(0.0160)
Wy	0.0225	0.0116	-0.0047	-0.0127	-0.0166
	(0.0213)	(0.0117)	(0.0114)	(0.0104)	(0.0159)
Rural	0.0208	0.0106	-0.0044	-0.0118	-0.0152
	(0.0171)	(0.0107)	(0.0101)	(0.0083)	(0.0143)
Offproperty	-0.0333	-0.0133	0.0092	0.0175*	0.0198
	(0.0245)	(0.0144)	(0.0147)	(0.0102)	(0.0166)
Gender	-0.0150	-0.0065	0.0039	0.0081	0.0095
	(0.0188)	(0.0093)	(0.0079)	(0.0095)	(0.0125)
Age	0.0198*	0.0092	-0.0048	-0.0109**	-0.0133
	(0.0114)	(0.0082)	(0.0089)	(0.0042)	(0.0097)
Educ_high	0.0256	0.0134	-0.0053	-0.0145	-0.0191
	(0.0402)	(0.0107)	(0.0165)	(0.0192)	(0.0160)
Educ_trade	0.0373	0.0206	-0.0070	-0.0215	-0.0294
	(0.0500)	(0.0149)	(0.0218)	(0.0241)	(0.0216)
Educ_col2	-0.0137	-0.0060	0.0035	0.0074	0.0088
	(0.0310)	(0.0191)	(0.0059)	(0.0186)	(0.0264)
Educ_col4	0.0157	0.0079	-0.0035	-0.0088	-0.0113
	(0.0377)	(0.0126)	(0.0129)	(0.0190)	(0.0188)
Educ_grad	0.0243	0.0127	-0.0051	-0.0138	-0.0181
	(0.0418)	(0.0128)	(0.0163)	(0.0205)	(0.0190)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.21: Marginal Effects of Perceived Marketing Farm Risk (Ordered Probit Model): Extension Education as Endogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	0.0225	0.0115	-0.0048	-0.0127	-0.0164
	(0.0206)	(0.0113)	(0.0117)	(0.0097)	(0.0151)
Family Income	0.0405	0.0223	-0.0075	-0.0233	-0.0319
	(0.0358)	(0.0197)	(0.0215)	(0.0170)	(0.0273)
Information Preferences					
Internet	-0.0626	-0.0214	0.0190	0.0316**	0.0334

	(0.0392)	(0.0254)	(0.0264)	(0.0124)	(0.0244)
Trade Magazine	0.0030	0.0014	-0.0007	-0.0016	-0.0020
	(0.0162)	(0.0078)	(0.0040)	(0.0089)	(0.0112)
Extension Education	-0.0287	-0.0132	0.0070	0.0157	0.0191
	(0.4022)	(0.1804)	(0.1019)	(0.2188)	(0.2624)
Resource Management					
TotalLand	-0.0056	-0.0026	0.0014	0.0031	0.0038
	(0.0048)	(0.0024)	(0.0029)	(0.0021)	(0.0030)
Specialty Market	0.0104	0.0050	-0.0024	-0.0058	-0.0072
	(0.0265)	(0.0122)	(0.0081)	(0.0142)	(0.0175)
CRP	-0.0177	-0.0075	0.0047	0.0095	0.0110
	(0.0345)	(0.0175)	(0.0106)	(0.0187)	(0.0243)
Sources of Water					
Wells	-0.0075	-0.0033	0.0019	0.0041	0.0048
	(0.0178)	(0.0077)	(0.0058)	(0.0093)	(0.0110)
RuralWaterSystem	0.0062	0.0029	-0.0015	-0.0034	-0.0042
	(0.0208)	(0.0104)	(0.0055)	(0.0115)	(0.0148)
Income Issues					
Sole Proprietorship	-0.0052	-0.0023	0.0013	0.0028	0.0034
	(0.0209)	(0.0091)	(0.0059)	(0.0112)	(0.0132)
Agricultural Income	0.0009	0.0004	-0.0002	-0.0005*	-0.0006
	(0.0007)	(0.0004)	(0.0004)	(0.0003)	(0.0004)
Paid Employee	-0.0159	-0.0068	0.0042	0.0086	0.0100
	(0.0219)	(0.0116)	(0.0084)	(0.0115)	(0.0156)
offfarmy	0.0244	0.0125	-0.0052	-0.0138	-0.0179
	(0.0264)	(0.0136)	(0.0131)	(0.0130)	(0.0186)
Demographics					
Az	0.0050	0.0023	-0.0012	-0.0027	-0.0034
	(0.0532)	(0.0261)	(0.0123)	(0.0297)	(0.0375)
Wy	0.0236	0.0120	-0.0050	-0.0133	-0.0173
	(0.0253)	(0.0125)	(0.0128)	(0.0123)	(0.0170)
Rural	0.0222	0.0113	-0.0048	-0.0125	-0.0162
	(0.0237)	(0.0123)	(0.0119)	(0.0116)	(0.0167)
offproperty	-0.0335	-0.0132	0.0094	0.0176*	0.0197
	(0.0249)	(0.0149)	(0.0151)	(0.0102)	(0.0168)
Gender	-0.0131	-0.0056	0.0034	0.0070	0.0083
	(0.0268)	(0.0132)	(0.0084)	(0.0144)	(0.0185)
Age	0.0200*	0.0092	-0.0049	-0.0109**	-0.0133

	(0.0118)	(0.0084)	(0.0092)	(0.0043)	(0.0099)
Educ_high	0.0244	0.0125	-0.0052	-0.0138	-0.0179
	(0.0415)	(0.0150)	(0.0161)	(0.0206)	(0.0217)
Educ_trade	0.0371	0.0202	-0.0071	-0.0213	-0.0288
	(0.0501)	(0.0162)	(0.0222)	(0.0241)	(0.0233)
Educ_col2	-0.0131	-0.0056	0.0034	0.0070	0.0083
	(0.0319)	(0.0193)	(0.0062)	(0.0190)	(0.0268)
Educ_col4	0.0183	0.0091	-0.0040	-0.0103	-0.0131
	(0.0476)	(0.0170)	(0.0157)	(0.0243)	(0.0253)
Educ_grad	0.0254	0.0131	-0.0054	-0.0144	-0.0188
	(0.0443)	(0.0130)	(0.0174)	(0.0215)	(0.0194)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

2.5.4 Determinants of Perceived Human Farm Risk

In this section, estimation results for perceived human farm risk with explanatory variable extension education as endogenous and exogenous are presented. Table 2.22 lists the summary statistics of the data variables for perceived human farm risk (mean, standard deviation, minimum and maximum values).

Table 2.22: Summary Statistics

Number of Observation=1645	***Mean***	***Std. Dev.***	***Min***	***Max***
Primary Source of Risk				
Human	3.3678	1.4893	1	5
Reasons For Involvement				
Profit	0.4146	0.4928	0	1
Family Income	0.4219	0.4940	0	1
Information Preferences				
Internet	0.4505	0.4977	0	1
Trade Magazine	0.4207	0.4938	0	1
Extension Education	0.7951	0.4037	0	1
Resource Management				
TotalLand	0.6462	2.9632	0	50.08
Specialty Market	0.1307	0.3372	0	1
CRP	0.0839	0.2773	0	1
Sources of Water				
Wells	0.5362	0.4988	0	1
RuralWaterSystem	0.1994	0.3997	0	1

Income Issues				
Sole Proprietorship	0.8067	0.3950	0	1
Agricultural Income	14.7198	23.4441	0	100
Paid Employee	0.1544	0.3614	0	1
Offfarmy	0.4243	0.4944	0	1
Demographics				
Az	0.1234	0.3290	0	1
Wy	0.1878	0.3907	0	1
Rural	0.6219	0.4851	0	1
Offproperty	0.7350	0.4415	0	1
Gender	0.7666	0.4231	0	1
Age	4.5562	1.0677	1	6
Educ_high	0.3106	0.4629	0	1
Educ_trade	0.0687	0.2530	0	1
Educ_col2	0.1836	0.3873	0	1
Educ_col4	0.2365	0.4250	0	1
Educ_grad	0.1459	0.3531	0	1

In Table 2.23, the results of estimated ordered probit model for determinants of perceived human farm risk are presented. In the case when *extension education* is exogenous, we can see that *profit, internet*, *trade magazine, specialty market and wy* play important roles on the perceptions of human risk of small farm holders. What is revealing from the marginal effects in Table 2.24 is that none of the variables are significant at P(Y=1); whereas *internet, trade magazine, and specialty market* are significant at P(Y=5). At P(Y=5), there is a positive relation between internet and probability of perception of human farm risk. As opposed to this, the relation is negative for *trade magazine and specialty market*. The small farm holders who produce any commodities indicating a specialty market see the human risk more important compared to the others. People who seek information from internet has a positive relation with the probability of perceiving human farm risk as the most important opposed to the production, financial, and marketing farm risk

perceptions cases. Probability of perceiving human farm risk as the most important risk is decreasing for the small farm holders who are engaged in rural family agricultural operation to make profit and for the small farm holders whose highest level of education is trade school.

Engaged in rural agricultural operation to make profit and produce any commodities indicating a specialty market are the significant determinants of perceived human farm risk with the IV estimation. The other explanatory variables which were significant in the ordered probit estimation without endogeneity are not significant for the estimation using instrument variable technique. From marginal effects (Table 2.25), the predicted probabilities of perceiving human farm risk as the least important risk are significant for *profit* at 10% level of significance and for *specialty Market* at 5% level of significance. Human farm risk is becoming less important for the small farm holders in the West as they engage in rural agricultural operation to make profit. The probability of perceiving human farm risk as the least important is decreasing for the small farm holders who produce commodities indicating a specialty market according to the marginal effects table.

Table 2.23: Determinants of Perceived Human Farm Risk (Ordered Probit Model)

Determinants of Perceived Human Farm Risk				
	MLE Estimation		IV Estimation	
Explanatory Variables	**COEFFICIENT**	**S.E.**	**COEFFICIENT**	**S.E.**
Reasons For Involvement				
Profit	0.1632**	0.0584	0.158**	0.0662
Family Income	0.0903	0.0569	0.0728	0.1097
Information Preferences				
Internet	-0.1139**	0.0566	-0.1019	0.0877
Trade Magazine	0.0961*	0.0549	0.1021	0.0638
Extension Education	0.0732	0.0675		

Predicted Extension Education			0.3502	1.4974
Resource Management				
TotalLand	0.0058	0.0095	0.0073	0.0129
Specialty Market	-0.1564**	0.0797	-0.1673*	0.0992
CRP	0.0827	0.0989	0.0678	0.1305
Sources of Water				
Wells	-0.048	0.0585	-0.0422	0.0666
RuralWaterSystem	-0.0761	0.0708	-0.0689	0.0809
Income Issues				
Sole Proprietorship	-0.1108	0.0688	-0.1054	0.0753
Agricultural Income	0.0019	0.0013	0.0017	0.0016
Paid Employee	-0.0489	0.0757	-0.054	0.0804
Offfarmy	0.0922	0.0574	0.0797	0.0891
Demographics				
Az	0.0562	0.0866	0.0908	0.2056
Wy	0.1403**	0.0713	0.1324	0.0833
Rural	0.0513	0.0569	0.0408	0.0809
Offproperty	-0.0839	0.0692	-0.0816	0.0698
Gender	-0.0287	0.0642	-0.0431	0.0999
Age	0.0019	0.0278	0.0022	0.0279
Educ_high	0.0512	0.1237	0.0808	0.184
Educ_trade	0.1889	0.1547	0.2131	0.1879
Educ_col2	-0.0851	0.1299	-0.0706	0.1414
Educ_col4	0.0109	0.1267	0.0153	0.1266
Educ_grad	-0.0131	0.1337	-0.0005	0.1409
Ordered Probit Thresholds				
μ1	-0.8705	0.2242	-0.6488	1.1899
μ2	-0.4084	0.2233	-0.1868	1.1897
μ3	-0.0256	0.2232	0.1958	1.1898
μ4	0.5545	0.2237	0.7756	1.19
LR chi2(25)	55.87		54.75	
Prob >chi2	0.0004		0.0005	
PseudoR2	0.0109		0.0107	

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.24: Marginal Effects of Perceived Human Farm Risk (Ordered Probit Model): Extension Education as Exogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	-0.0332	-0.0178**	-0.0109	-0.0009	0.0628**
	(0.0231)	(0.0066)	(0.0092)	(0.0186)	(0.0240)
Family Income	-0.0176	-0.0099	-0.0064	-0.0012	0.0351
	(0.0161)	(0.0062)	(0.0057)	(0.0103)	(0.0222)
Information Preferences					
Internet	0.0196	0.0125**	0.0090	0.0041	-0.0451**

	(0.0164)	(0.0063)	(0.0061)	(0.0126)	(0.0225)
Trade Magazine	-0.0188	-0.0105*	-0.0067	-0.0013	0.0373*
	(0.0154)	(0.0061)	(0.0061)	(0.0109)	(0.0219)
Extension Education	-0.0141	-0.0080	-0.0052	-0.0011	0.0285
	(0.0161)	(0.0074)	(0.0058)	(0.0083)	(0.0263)
Resource Management					
TotalLand	-0.0011	-0.0006	-0.0004	-0.0001	0.0023
	(0.0019)	(0.0010)	(0.0007)	(0.0007)	(0.0037)
Specialty Market	0.0261	0.0170*	0.0125	0.0063	-0.0620**
	(0.0226)	(0.0089)	(0.0082)	(0.0170)	(0.0316)
CRP	-0.0161	-0.0091	-0.0058	-0.0012	0.0322
	(0.0207)	(0.0109)	(0.0083)	(0.0095)	(0.0390)
Sources of Water					
Wells	0.0086	0.0053	0.0037	0.0014	-0.0189
	(0.0117)	(0.0064)	(0.0049)	(0.0057)	(0.0231)
RuralWaterSystem	0.0134	0.0083	0.0059	0.0024	-0.0301
	(0.0155)	(0.0078)	(0.0061)	(0.0086)	(0.0279)
Income Issues					
Sole Proprietorship	0.0191	0.0121	0.0087	0.0039	-0.0438
	(0.0172)	(0.0076)	(0.0069)	(0.0125)	(0.0274)
Agricultural Income	-0.0004	-0.0002	-0.0001	0.0000	0.0008
	(0.0003)	(0.0001)	(0.0001)	(0.0002)	(0.0005)
Paid Employee	0.0088	0.0054	0.0037	0.0014	-0.0193
	(0.0148)	(0.0083)	(0.0061)	(0.0058)	(0.0298)
Offfarmy	-0.0180	-0.0101	-0.0065	-0.0012	0.0358
	(0.0160)	(0.0063)	(0.0059)	(0.0105)	(0.0226)
Demographics					
Az	-0.0107	-0.0062	-0.0040	-0.0010	0.0219
	(0.0174)	(0.0095)	(0.0069)	(0.0066)	(0.0341)
Wy	-0.0282	-0.0153*	-0.0095	-0.0011	0.0542*
	(0.0213)	(0.0080)	(0.0088)	(0.0159)	(0.0289)
Rural	-0.0098	-0.0056	-0.0037	-0.0009	0.0200
	(0.0126)	(0.0063)	(0.0047)	(0.0059)	(0.0222)
Offproperty	0.0147	0.0092	0.0065	0.0027	-0.0331
	(0.0150)	(0.0076)	(0.0065)	(0.0097)	(0.0276)
Gender	0.0052	0.0031	0.0022	0.0008	-0.0113
	(0.0120)	(0.0071)	(0.0050)	(0.0037)	(0.0253)
Age	-0.0004	-0.0002	-0.0001	0.0000	0.0008

	(0.0051)	(0.0031)	(0.0021)	(0.0007)	(0.0109)
Educ_high	-0.0097	-0.0056	-0.0037	-0.0009	0.0200
	(0.0193)	(0.0137)	(0.0107)	(0.0072)	(0.0499)
Educ_trade	-0.0390*	-0.0205	-0.0124	-0.0005	0.0724
	(0.0227)	(0.0181)	(0.0174)	(0.0194)	(0.0660)
Educ_col2	0.0149	0.0093	0.0066	0.0028	-0.0336
	(0.0302)	(0.0145)	(0.0080)	(0.0058)	(0.0496)
Educ_col4	-0.0020	-0.0012	-0.0008	-0.0002	0.0043
	(0.0226)	(0.0139)	(0.0097)	(0.0038)	(0.0500)
Educ_grad	0.0024	0.0014	0.0010	0.0003	-0.0051
	(0.0255)	(0.0147)	(0.0097)	(0.0025)	(0.0522)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.25: Marginal Effects of Perceived Human Farm Risk (Ordered Probit Model): Extension Education as Endogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	-0.0305	-0.0173**	-0.0112	-0.0025	0.0615**
	(0.0262)	(0.0072)	(0.0085)	(0.0193)	(0.0254)
Family Income	-0.0133	-0.0080	-0.0054	-0.0018	0.0286
	(0.0256)	(0.0121)	(0.0075)	(0.0084)	(0.0420)
Information Preferences					
Internet	0.0167	0.0111	0.0083	0.0044	-0.0405
	(0.0210)	(0.0099)	(0.0071)	(0.0112)	(0.0344)
Trade Magazine	-0.0190	-0.0112	-0.0075	-0.0022	0.0400
	(0.0156)	(0.0070)	(0.0074)	(0.0126)	(0.0262)
Extension Education	-0.0612	-0.0384	-0.0272	-0.0115	0.1384
	(0.2487)	(0.1635)	(0.1226)	(0.0757)	(0.5957)
Resource Management					
TotalLand	-0.0013	-0.0008	-0.0006	-0.0002	0.0029
	(0.0022)	(0.0014)	(0.0011)	(0.0011)	(0.0051)
Specialty Market	0.0262	0.0181*	0.0139	0.0084	-0.0666*
	(0.0227)	(0.0105)	(0.0108)	(0.0210)	(0.0398)
CRP	-0.0124	-0.0074	-0.0051	-0.0017	0.0266
	(0.0272)	(0.0143)	(0.0096)	(0.0083)	(0.0507)
Sources of Water					
Wells	0.0072	0.0046	0.0033	0.0016	-0.0167

	(0.0131)	(0.0073)	(0.0053)	(0.0052)	(0.0263)
RuralWaterSystem	0.0115	0.0075	0.0055	0.0028	-0.0273
	(0.0172)	(0.0090)	(0.0065)	(0.0080)	(0.0318)
Income Issues					
Sole Proprietorship	0.0172	0.0115	0.0086	0.0046	-0.0419
	(0.0187)	(0.0084)	(0.0068)	(0.0122)	(0.0297)
Agricultural Income	-0.0003	-0.0002	-0.0001	-0.0001	0.0007
	(0.0004)	(0.0002)	(0.0001)	(0.0002)	(0.0006)
Paid Employee	0.0091	0.0059	0.0043	0.0021	-0.0214
	(0.0145)	(0.0088)	(0.0070)	(0.0074)	(0.0320)
offfarmy	-0.0146	-0.0087	-0.0059	-0.0019	0.0313
	(0.0222)	(0.0098)	(0.0064)	(0.0094)	(0.0340)
Demographics					
Az	-0.0168	-0.0100	-0.0067	-0.0021	0.0356
	(0.0371)	(0.0226)	(0.0166)	(0.0124)	(0.0814)
Wy	-0.0251	-0.0145	-0.0096	-0.0024	0.0517
	(0.0251)	(0.0091)	(0.0082)	(0.0161)	(0.0321)
Rural	-0.0073	-0.0045	-0.0031	-0.0012	0.0161
	(0.0170)	(0.0089)	(0.0058)	(0.0048)	(0.0314)
offproperty	0.0135	0.0089	0.0066	0.0034	-0.0324
	(0.0151)	(0.0077)	(0.0064)	(0.0100)	(0.0278)
Gender	0.0073	0.0047	0.0034	0.0016	-0.0171
	(0.0159)	(0.0108)	(0.0087)	(0.0074)	(0.0400)
Age	-0.0004	-0.0002	-0.0002	-0.0001	0.0009
	(0.0049)	(0.0031)	(0.0022)	(0.0010)	(0.0110)
Educ_high	-0.0149	-0.0089	-0.0060	-0.0019	0.0317
	(0.0279)	(0.0202)	(0.0162)	(0.0122)	(0.0743)
Educ_trade	-0.0425	-0.0232	-0.0145	-0.0020	0.0823
	(0.0257)	(0.0215)	(0.0210)	(0.0240)	(0.0798)
Educ_col2	0.0118	0.0077	0.0057	0.0029	-0.0280
	(0.0303)	(0.0159)	(0.0095)	(0.0043)	(0.0549)
Educ_col4	-0.0027	-0.0017	-0.0012	-0.0005	0.0061
	(0.0211)	(0.0139)	(0.0102)	(0.0053)	(0.0503)
Educ_grad	0.0001	0.0001	0.00004	0.00002	-0.0002
	(0.0247)	(0.0154)	(0.0109)	(0.0046)	(0.0556)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Extension education is a statistically insignificant explanatory variable which indicates that the role of extension education is not enough on its own to analyze the differences of perceived human farm risk between the two social groups who received extension education and who did not.

2.5.5 Determinants of Perceived Legal Farm Risk

In this section, estimation results for perceived legal farm risk with explanatory variable *extension education* as endogenous and exogenous are presented. Table 2.26 lists the summary statistics of the data variables for perceived legal farm risk (mean, standard deviation, minimum and maximum values).

Table 2.26: Summary Statistics

Number of Observation=1642	***Mean***	***Std. Dev.***	***Min***	***Max***
Primary Source of Risk				
Legal	3.6693	1.3251	1	5
Reasons For Involvement				
Profit	0.4129	0.4925	0	1
Family Income	0.4220	0.4940	0	1
Information Preferences				
Internet	0.4513	0.4978	0	1
Trade Magazine	0.4190	0.4935	0	1
Extension Education	0.7960	0.4031	0	1
Resource Management				
TotalLand	0.6463	2.9656	0	50.08
Specialty Market	0.1297	0.3361	0	1
CRP	0.0847	0.2784	0	1
Sources of Water				
Wells	0.5353	0.4989	0	1
RuralWaterSystem	0.1998	0.3999	0	1
Income Issues				
Sole Proprietorship	0.8057	0.3958	0	1
Agricultural Income	14.6249	23.3376	0	100
Paid Employee	0.1535	0.3606	0	1
Offfarmy	0.4233	0.4942	0	1

Demographics				
Az	0.1242	0.3300	0	1
Wy	0.1888	0.3915	0	1
Rural	0.6224	0.4849	0	1
Offproperty	0.7345	0.4417	0	1
Gender	0.7674	0.4226	0	1
Age	4.5566	1.0678	1	6
Educ_high	0.3106	0.4629	0	1
Educ_trade	0.0688	0.2532	0	1
Educ_col2	0.1821	0.3860	0	1
Educ_col4	0.2369	0.4253	0	1
Educ_grad	0.1474	0.3546	0	1

The findings from Table 2.27 suggest that *family income, internet, extension education, totalLand, CRP, sole proprietorship and agricultural income* are main determinants of perceived legal farm risk when *extension education* is assumed exogenous. In the case where *extension education* is endogenous, *Internet, totalLand, CRP, sole proprietorship, and agricultural income* determine the perceived legal farm risk for small farm holders in the West as given in the forth column of Table 2.27.

Table 2.27: Determinants of Perceived Legal Farm Risk (Ordered Probit Model)

Determinants of Perceived Legal Farm Risk				
	MLE Estimation		**IV Estimation**	
Explanatory Variables	**COEFFICIENT**	**S.E.**	**COEFFICIENT**	**S.E.**
Reasons For Involvement				
Profit	0.0943	0.0585	0.1088	0.0675
Family Income	0.1313**	0.057	0.1715	0.1108
Information Preferences				
Internet	-0.1902**	0.0565	-0.2179**	0.0867
Trade Magazine	-0.011	0.0551	-0.0231	0.0621
Extension Education	0.129*	0.0675		
Predicted Extension Education			-0.5218	1.52
Resource Management				
TotalLand	-0.0250**	0.0094	-0.0288**	0.0131
Specialty Market	0.0237	0.0812	0.0465	0.0973
CRP	0.2863**	0.1021	0.3212**	0.1317

Sources of Water				
Wells	0.0224	0.0583	0.0103	0.0648
RuralWaterSystem	0.067	0.071	0.0493	0.0824
Income Issues				
Sole Proprietorship	0.1959**	0.0687	0.1826**	0.075
Agricultural Income	0.0031**	0.0013	0.0036**	0.0017
Paid Employee	-0.0978	0.0756	-0.0894	0.0782
Offfarmy	0.0271	0.0578	0.0578	0.0903
Demographics				
Az	0.032	0.0865	-0.0502	0.2099
Wy	0.0763	0.0707	0.0941	0.082
Rural	0.0883	0.0569	0.1136	0.0837
Offproperty	0.0141	0.0697	0.0089	0.071
Gender	0.0051	0.0647	0.0392	0.1005
Age	0.0104	0.0283	0.0113	0.0283
Educ_high	0.0238	0.1261	-0.001	0.1379
Educ_trade	-0.0402	0.1549	-0.048	0.1559
Educ_col2	-0.0053	0.132	0.0107	0.1378
Educ_col4	-0.1878	0.1287	-0.1394	0.1726
Educ_grad	0.03	0.1359	0.0486	0.143
Ordered Probit Thresholds				
μ1	-0.8789	0.226	-1.341	1.1087
μ2	-0.3553	0.2252	-0.8184	1.1081
μ3	0.0672	0.2249	-0.3964	1.108
μ4	0.8482	0.2253	0.3838	1.1082
LR chi2(25)	83.66		80.13	
Prob >chi2	0		0	
PseudoR2	0.017		0.0164	

Note: ** significant at 5% level of significance, * significant at 10% level of significance

As shown in Table 2.28, the marginal effects of *family income, internet, extension education, totalLand, CRP, sole proprietorship and agricultural income* are significant at P(Y=5). Small farm holders' probabilities of seeing legal farm risk as the most important risk is decreasing as they are engaged in rural family agricultural operation to supplement family income, have any land enrolled in Conservation Reserve Program, or operate in a sole proprietorship business type. As the total acres of land they manage plus lease is increasing, the probability of perceiving legal farm risk as the most important risk is

increasing which is intuitive. As in the case of human farm risk, *internet* has a positive relation with the probability of legal farm risk perception at P(Y=1). People who get information from internet have higher perception of legal farm risk compared to the people who do not. The probability of perceiving legal farm risk as the least important risk to the operation is increasing for the small farm holders who has received Extension Education compared to the small farm holders who has not.

Compared to the marginal effects table of coefficient estimates from the ordered probit model where *extension education* is exogenous, *family income* has no significant effect on the perception of legal farm risk anymore as shown in the marginal effects Table 2.29 of the ordered probit model with the predicted extension education from probit model at P(Y=5).

Table 2.28: Marginal Effects of Perceived Legal Farm Risk (Ordered Probit Model): Extension Education as Exogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	-0.0102	-0.0105	-0.0093	-0.0074	0.0374
	(0.0107)	(0.0073)	(0.0060)	(0.0135)	(0.0233)
Family Income	-0.0146	-0.0148*	-0.0129**	-0.0096	0.0519**
	(0.0141)	(0.0080)	(0.0059)	(0.0182)	(0.0226)
Information Preferences					
Internet	0.0162	0.0192*	0.0191**	0.0212	-0.0757**
	(0.0158)	(0.0099)	(0.0058)	(0.0226)	(0.0225)
Trade Magazine	0.0011	0.0012	0.0011	0.0010	-0.0044
	(0.0056)	(0.0060)	(0.0055)	(0.0052)	(0.0219)
Extension Education	-0.0143	-0.0145	-0.0127*	-0.0095	0.0510*
	(0.0145)	(0.0089)	(0.0069)	(0.0181)	(0.0267)
Resource Management					
TotalLand	0.0025	0.0027**	0.0025**	0.0023	-0.0100**
	(0.0023)	(0.0014)	(0.0010)	(0.0034)	(0.0038)

Specialty Market	-0.0024	-0.0026	-0.0024	-0.0021	0.0094
	(0.0085)	(0.0089)	(0.0081)	(0.0078)	(0.0323)
CRP	-0.0361	-0.0334**	-0.0271**	-0.0149	0.1115**
	(0.0299)	(0.0134)	(0.0125)	(0.0411)	(0.0423)
Sources of Water					
Wells	-0.0023	-0.0024	-0.0022	-0.0020	0.0089
	(0.0063)	(0.0064)	(0.0058)	(0.0058)	(0.0232)
RuralWaterSystem	-0.0071	-0.0074	-0.0067	-0.0055	0.0266
	(0.0095)	(0.0081)	(0.0071)	(0.0108)	(0.0283)
Income Issues					
Sole Proprietorship	-0.0230	-0.0224**	-0.0190**	-0.0126	0.0770**
	(0.0206)	(0.0100)	(0.0077)	(0.0276)	(0.0276)
Agricultural Income	-0.0003	-0.0003*	-0.0003*	-0.0003	0.0012**
	(0.0003)	(0.0002)	(0.0001)	(0.0004)	(0.0005)
Paid Employee	0.0090	0.0102	0.0098	0.0099	-0.0390
	(0.0108)	(0.0089)	(0.0076)	(0.0140)	(0.0301)
Offfarmy	-0.0028	-0.0030	-0.0027	-0.0023	0.0108
	(0.0064)	(0.0064)	(0.0058)	(0.0060)	(0.0230)
Demographics					
Az	-0.0033	-0.0035	-0.0032	-0.0027	0.0127
	(0.0091)	(0.0094)	(0.0087)	(0.0088)	(0.0344)
Wy	-0.0081	-0.0085	-0.0076	-0.0061	0.0303
	(0.0098)	(0.0081)	(0.0072)	(0.0120)	(0.0282)
Rural	-0.0095	-0.0098	-0.0087	-0.0070	0.0350
	(0.0103)	(0.0072)	(0.0057)	(0.0125)	(0.0225)
Offproperty	-0.0014	-0.0015	-0.0014	-0.0012	0.0056
	(0.0073)	(0.0077)	(0.0070)	(0.0063)	(0.0277)
Gender	-0.0005	-0.0006	-0.0005	-0.0005	0.0020
	(0.0065)	(0.0070)	(0.0065)	(0.0058)	(0.0258)
Age	-0.0010	-0.0011	-0.0010	-0.0009	0.0042
	(0.0030)	(0.0031)	(0.0028)	(0.0029)	(0.0113)
Educ_high	-0.0024	-0.0026	-0.0024	-0.0021	0.0095
	(0.0113)	(0.0131)	(0.0128)	(0.0134)	(0.0504)
Educ_trade	0.0039	0.0043	0.0040	0.0038	-0.0160
	(0.0173)	(0.0176)	(0.0154)	(0.0119)	(0.0615)
Educ_col2	0.0005	0.0006	0.0005	0.0005	-0.0021
	(0.0135)	(0.0144)	(0.0132)	(0.0115)	(0.0525)
Educ_col4	0.0160	0.0190	0.0189	0.0209*	-0.0748

	(0.0231)	(0.0191)	(0.0131)	(0.0119)	(0.0520)
Educ_grad	-0.0031	-0.0033	-0.0030	-0.0026	0.0119
	(0.0122)	(0.0141)	(0.0138)	(0.0146)	(0.0544)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

Table 2.29: Marginal Effects of Perceived Legal Farm Risk (Ordered Probit Model): Extension Education as Endogenous

Variable	**Y=1**	**Y=2**	**Y=3**	**Y=4**	**Y=5**
Reasons For Involvement					
Profit	-0.0112	-0.0119	-0.0108	-0.0093	0.0433
	(0.0115)	(0.0080)	(0.0070)	(0.0165)	(0.0271)
Family Income	-0.0186	-0.0191	-0.0169	-0.0133	0.0679
	(0.0187)	(0.0129)	(0.0115)	(0.0262)	(0.0445)
Information Preferences					
Internet	0.0170	0.0211	0.0217**	0.0266	-0.0864**
	(0.0168)	(0.0115)	(0.0085)	(0.0290)	(0.0335)
Trade Magazine	0.0021	0.0024	0.0023	0.0023	-0.0092
	(0.0058)	(0.0065)	(0.0063)	(0.0073)	(0.0248)
Extension Education	0.0491	0.0550	0.0524	0.0516	-0.2081
	(0.1372)	(0.1557)	(0.1534)	(0.1814)	(0.6070)
Resource Management					
TotalLand	0.0027	0.0030*	0.0029**	0.0028	-0.0115**
	(0.0025)	(0.0016)	(0.0014)	(0.0042)	(0.0053)
Specialty Market	-0.0046	-0.0050	-0.0047	-0.0043	0.0185
	(0.0097)	(0.0103)	(0.0098)	(0.0117)	(0.0389)
CRP	-0.0394	-0.0370**	-0.0306*	-0.0183	0.1254**
	(0.0326)	(0.0159)	(0.0158)	(0.0477)	(0.0549)
Sources of Water					
Wells	-0.0010	-0.0011	-0.0010	-0.0010	0.0041
	(0.0064)	(0.0069)	(0.0065)	(0.0057)	(0.0258)
RuralWaterSystem	-0.0048	-0.0053	-0.0049	-0.0046	0.0196
	(0.0098)	(0.0093)	(0.0082)	(0.0094)	(0.0327)
Income Issues					
Sole Proprietorship	-0.0200	-0.0204*	-0.0180**	-0.0139	0.0723**
	(0.0206)	(0.0113)	(0.0076)	(0.0257)	(0.0293)
Agricultural Income	-0.0003	-0.0004*	-0.0004**	-0.0004	0.0014**
	(0.0003)	(0.0002)	(0.0002)	(0.0005)	(0.0007)

Paid Employee	0.0078	0.0091	0.0090	0.0097	-0.0356
	(0.0105)	(0.0092)	(0.0079)	(0.0131)	(0.0312)
offfarmy	-0.0057	-0.0062	-0.0058	-0.0053	0.0230
	(0.0096)	(0.0096)	(0.0091)	(0.0121)	(0.0361)
Demographics					
Az	0.0045	0.0052	0.0050	0.0053	-0.0200
	(0.0178)	(0.0210)	(0.0212)	(0.0252)	(0.0837)
Wy	-0.0096	-0.0102	-0.0094	-0.0082	0.0374
	(0.0108)	(0.0090)	(0.0084)	(0.0156)	(0.0329)
Rural	-0.0118	-0.0124	-0.0113	-0.0096	0.0451
	(0.0126)	(0.0095)	(0.0086)	(0.0178)	(0.0336)
offproperty	-0.0008	-0.0009	-0.0009	-0.0009	0.0035
	(0.0069)	(0.0076)	(0.0071)	(0.0069)	(0.0283)
Gender	-0.0038	-0.0042	-0.0039	-0.0037	0.0156
	(0.0099)	(0.0106)	(0.0101)	(0.0114)	(0.0401)
Age	-0.0011	-0.0012	-0.0011	-0.0011	0.0045
	(0.0028)	(0.0030)	(0.0029)	(0.0032)	(0.0113)
Educ_high	0.0001	0.0001	0.0001	0.0001	-0.0004
	(0.0130)	(0.0146)	(0.0138)	(0.0136)	(0.0550)
Educ_trade	0.0043	0.0050	0.0048	0.0050	-0.0191
	(0.0167)	(0.0174)	(0.0156)	(0.0135)	(0.0622)
Educ_col2	-0.0010	-0.0011	-0.0011	-0.0010	0.0043
	(0.0124)	(0.0143)	(0.0139)	(0.0145)	(0.0550)
Educ_col4	0.0116	0.0139	0.0140	0.0159	-0.0555
	(0.0227)	(0.0215)	(0.0176)	(0.0137)	(0.0694)
Educ_grad	-0.0048	-0.0052	-0.0049	-0.0045	0.0193
	(0.0113)	(0.0141)	(0.0146)	(0.0181)	(0.0572)

Note: ** significant at 5% level of significance, * significant at 10% level of significance.

The empirical results show that *extension education* is statistically insignificant when we deal with the endogeneity bias with using distance as the instrument variable; whereas it was significant at 10% level when we got the estimated coefficient by not including any instrument. The implication for the results regarding the endogeneity is that the difference between two social groups can not be explained by just looking at

extension education for the perceived human farm risk as well as for the other primary sources of risks.

2.6 Concluding Remarks

In this chapter determinants of perceived farm risks of small farm holders in Arizona, Wyoming and Colorado are examined. One of the determinants is the extension education and one of the objectives of this research is to see the differences in risk perceptions of small farm holders between two social groups: who has received extension education and who has not.

In order to investigate main factors that affect the risk perceptions, we estimated ordered probit models in which the dependent variables are the measures of perceived farm risks of production, financial, marketing, human, and legal. Since each farm risk is ordered data which is measured in a 1-5 Likert scale; 1 being the most important to the operation and 5 being the least important to the operation, ordered probit models are used.

The findings of determinants of perceived farm risks indicate that strong predictor variables for all 5 types of risk perceptions are internet as a source of information, income percentage coming from agriculture, age of the operator, gender of the operator and the reason for being involved in agricultural operation to make profit. The results also demonstrate that extension education has played statistically significant role in the risk perceptions of production and legal for small farm holders in the Western United States.

As discussed in details in the previous sections, extension education and the perceived farm risks have reciprocal effects which cause endogeneity. We have used

instrumental variable method to purge endogeneity where we have used the distance of the property from the nearest ‘metro area’ in miles as instrument variable. The findings of the instrument two stage estimation show that the differences in risk perceptions of small farm holders in the Western United States can not be explained by only extension education.

Results from this study provide policy implications for improvements through changes in extension education program delivery. It identifies the strong predictors of determinants of perceived farm risks of production, financial, marketing, human, and legal, and it shows how the small farm holder in rural West perceive source of risks. It will help to improve the risk management strategies by targeting the main factors that affect the risk perception of small farm holders in the rural West.

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CHAPTER 3

Thesis Concluding Remarks

In this thesis, I examined the determinants of both the demand for extension education and perceived farm risks, using representation survey data of small farms in Arizona, Colorado, and Wyoming. I find that supplementing family income, demographic variables such as gender, education and the residency, internet, income percentage coming form agriculture, total acres of land, and off-farm income are the main determinants among many other factors that affect the demand for extension education in the rural West. Furthermore, male farmers have higher demand for extension information than female farmers in Western United States. I also find that the farmers in Arizona have less demand for receiving extension information compared to the farmers in Colorado and Wyoming**.** Findings from the estimated models also suggest that education level is an important determinant of demand for extension education. Farm operators who have higher education are more likely to participate in extension programs.

In order to investigate main factors that affect the risk perceptions of small farms, I estimated ordered probit models in which the dependent variables were the measures of perceived farm risks of production, financial, marketing, human, and legal. Since each farm risk is ordered data which is measured in a 1-5 Likert scale; 1 being the most important to the operation and 5 being the least important to the operation, ordered probit models are used.

The findings of determinants of perceived farm risks indicate that strong predictor variables for all 5 types of risk perceptions are internet as a source of information, income

percentage coming from agriculture, age of the operator, gender of the operator and the reason for being involved in agricultural operation to make profit. The results also demonstrate that extension education has played statistically significant role in the risk perceptions of production and legal for small farm holders in the Western United States.

Results from this study provide policy implications for improvements through changes in extension education program delivery. It identifies the strong predictors of determinants of perceived farm risks of production, financial, marketing, human, and legal, and it shows how the small farm holder in rural West perceive source of risks. It will help to improve the risk management strategies by targeting the main factors that affect the risk perception of small farm holders in the rural West.

APPENDIX

Defining New Rural Clientele for Extension in the West

The Cooperative Extension Services of Arizona, Colorado, and Wyoming are conducting this survey to identify alternative enterprises in the West and to provide better educational offerings. Please complete the survey if you operate rural land in one of these states. Thank you**.**

SECTION I - Reasons for Involvement

1. Why are you engaged in your particular rural family agricultural operation (mark all that apply):	
a. To make a profit **VN1100_a**	1101
b. To supplement family income **VN1100_b**	1102
c. I had limited alternatives for employment and business opportunities **VN1100_c**	1103
d. Working close to nature is rewarding **VN1100_d**	1104
e. I inherited the operation **VN1100_e**	1105
f. My operation keeps me closer to my family **VN1100_f**	1106
g. I wanted a change in career direction **VN1100_g**	1107
h. I like to be involved in unique and challenging work **VN1100_h**	1108
I. My "hobby" expanded into a business **VN1100_i**	1109
j. Other (specify) Engage - other (100) **VN1100_j**	1110

2. How long do you expect to manage your property? (mark only one)	
a. Until children graduate high school **VN1201**	1201
b. Until children graduate college	1202
c. Until one of my children "takes over" the business	1203
d. Until a landlord dies or sells the land	1204
e. Until I retire	1205
f. Until my spouse retires	1206
g. Until I can no longer do the work	1207
h. Other (specify) Manage - other (100)	1208

3. The United States Department of Agriculture has identified five primary sources of risk for agricultural operations: production, marketing, legal or institutional, finance, and human. Please rank the five risks in terms of their importance to your operation (1 being the most important or critical to your operation and 5 being the least important)	
a) Production Risk **VN1301**	130
b) Marketing Risk **VN1302**	130
c) Financial Risk **VN1303**	130
d) Legal or Institutional Risk **VN1304**	130
e) Human Risk **VN1305**	130

4. Please circle the answer that best indicates your agreement/disagreement with each statement about rural family businesses. (1 meaning greatest disagreement and 5 meaning greatest agreement)

	Disagree				Agree	
a) ..... I am comfortable with the way I handle uncertainty in my business environment **VN1401**	1	2	3	4	5	1401
b) ..... Success in my business is driven by my own abilities as an individual rather than relying on others to help me succeed **VN1402**	1	2	3	4	5	1402
c) ..... I have little time for myself or any leisure activities **VN1403**	1	2	3	4	5	1403
d) ..... I am optimistic about the future of my business **VN1404**	1	2	3	4	5	1404
e) ..... I consider myself successful **VN1405**	1	2	3	4	5	1405
..... f) ..... I am achieving most of my goals **VN1406**	1	2	3	4	5	1406
e) ..... I am always one of the first in my industry to try new technologies or production strategies **VN1407**	1	2	3	4	5	1407
f) .I am confident in my ability to deal with the changes that are taking place in the business environment **VN1408**	1	2	3	4	5	1408
g) ..... The work of the business needs to be done but there's no great joy in it **VN1409**	1	2	3	4	5	1409
h) ..... Business tasks must come before family/personal time **VN1410**	1	2	3	4	5	1410
I) ..... This business will fail if I am not able to do the work **VN1411**	1	2	3	4	5	1411
j)Today's ranchers and farmers are at the mercy of outside forces so the best you can do is to adjust to the situation **VN1412**	1	2	3	4	5	1412
k) ..... Ranchers and farmers today must be sensitive to the environment by reducing the use of agricultural chemicals on their land **VN1413**	1	2	3	4	5	1413

SECTION II - Information Preferences

1. When seeking information relevant to your agricultural operation, what are your most preferred sources? (mark 3 choices)

.....a) .....Trade organization ..... **VN2100_a**	2101	h)..... Television ..... **VN2100_h**	2108
..... b) ..... Commodity group ..... **VN2100_b**	2102	I) ..... Trade magazine ..... **VN2100_i**	2109
.....c) ..... Radio ..... **VN2100_c**	2103	j) ..... Salesperson ..... **VN2100_j**	2110
..... d) .....Internet web sites ..... **VN2100_d**	2104	k)..... Local community college ..... **VN2100_k**	2111
.....e) ..... Peer/support group or network ..... **VN2100_e**	2105	l) .....University (other than Extension) ..... **VN2100_l**	2112
.....f) .....Library ..... **VN2100_f**	2106	m) .....Cooperative Extension ..... **VN2100_m**	2113
..... g) ..... Paid consultant ..... **VN2100_g**	2107	n).....Other (specify) ..... **VN2100_n** **Source_other** (80)	2114

2. Of the information sources you use, please indicate how they could be improved. (mark all that apply)

.....a) .....Easier access ..... **VN2200_a**	2201	e).....Improved content ..... **VN2200_e**	2205
..... b) ..... Improved timeliness ..... **VN2200_b**	2202	f) .....Content applicability ..... **VN2200_f**	2206
.....c) .....Lower cost ..... **VN2200_c**	2203	g)..... More understandable ..... **VN2200_g**	2207
..... d) .....Faster internet ..... **VN2200_d**	2204	h).....Other (specify) ..... **VN2200_h** **Improve_other** (100)	2208

3. In what form do you prefer to receive information? (mark top 3 choices)

.....a) .....Print ..... **VN2300_a**	2301	f) ..... Workshop/meeting/field day ..... **VN2300_f**	2306
..... b) ..... Video/DVD ..... **VN2300_b**	2302	g).....One on one ..... **VN2300_g**	2307
.....c) ..... Internet ..... **VN2300_c**	2303	h).....Direct mailing ..... **VN2300_h**	2308
..... d) ..... Newsletter ..... **VN2300_d**	2304	I) Other (specify) Form _other1 (100) **VN2300_i**	2309
.....e) ..... e-Mail ..... **VN2300_e**	2305	j) Other (specify) Form _ other2 (100) **VN2300_j**	2310

4. Have you ever received information from Cooperative Extension? **VN2401**	❑ Yes	❑ No	2401
5. Has anyone from the operation participated in a Cooperative Extension program (except 4-H) in the last 12 months?..... **VN2501**	❑ Yes	❑ No	2501
6. Have any immediate family members participated in 4-H in the last two years?... **VN2601**	❑ Yes	❑ No	2601
7. Have any operators used any University services besides Cooperative Extension? **VN2701**	❑ Yes	❑ No	2701

8. If you indicated Yes on question 7, please list those University services you have used.		
VN2801 (100) 2801	**VN2802** (100) 2802	**VN2803** (100) 2803

SECTION III – Resource Management

1. How many acres of owned land do you manage? **VN3101**	3101
2. ..... How many acres of leased land do you manage? **VN3201**	3201

3. What are the sources of water on the land (owned + leased) you manage? (mark all that apply)

.....a) .....Surface water ..... **VN3300_a**	3301	e).....Municipal ..... **VN3300_e**	3304
..... b) ..... Wells ..... **VN3300_b**	3302	f) ..... Rural water system ..... **VN3300_f**	3305
.....c) .....Developed springs ..... **VN3300_c**	3303	g) Other (specify) **Water_other** (80) **VN3300_g**	3306

4. Is there a river, stream, pond, or other surface waterway on/bordering the property you manage? **VN3401**	❑ Yes	❑ No	3401
5. Do you use chemicals to control weeds on your property?.....**VN3501**	❑ Yes	❑ No	3501
6. Do you have a current chemical applicators license? **VN3601**	❑ Yes	❑ No	3601
7. Do you produce any commodities sold as organic, certified organic, all natural, chemical free, free range, or some other term indicating a specialty market?.....**VN3701**	❑ Yes	❑ No	3701

8. Do you have any land enrolled in the Conservation Reserve Program? ..... ❑ Yes ..... ❑ No .... If yes, how many acres ..... **VN3801** **CRP_Screen**	3801
9. Do you irrigate any pasture on your property? ..... ❑ Yes ..... ❑ No .... If yes, how many acres ..... **VN3901** **IRR_Pasture**	3901

If you grew any crops or cut hay on your land in 2005, complete Section IV.
Please skip to Section V if you do not have were not involved in crop and hay production.

Section IV. Complete this section if you grew any crops or cut hay on your land in 2005. Please skip this section if you do not have crops.

1. What crops do you grow annually? (Enter acres for all applicable crops)

	Acres		Acres
a) Alfalfa & alfalfa mixtures Hay **VN4101**	4101	g) Soybeans **VN4107**	4107
b) Mixed/other Hay **VN4102**	4102	h) Dry Beans **VN4108**	4108
c) Corn **VN4103**	4103	I) Fruits **VN4109**	4109
d) Sorghum (grain) **VN4104**	4104	j) Vegetables **VN4110**	4110
e) Small Grains **VN4105**	4105	k) Other Crop_other1 **VN4111**	4111
f) Sunflowers **VN4106**	4106	l) Other Crop_other2 **VN4112**	4112

2. Do you irrigate any of your crops?

❑ Yes 4201

❑ No 4202

If yes, how many acres **VN4203** 4203

VN4201

Section V. Complete this section if you had any animals on your land in 2005. Please skip this section if you do not have animals.

1. How many head of livestock do you currently raise/own each year (annual peak numbers)? **Livestock_screen**

	Number		Number
.....a) Beef cattle	5101	f) Swine..... **VN5106**	5106
.....b) Dairy cattle	5102	g) Horses (for sale)..... **VN5107**	5107
.....c) Sheep	5103	h) Llamas/Alpacas..... **VN5108**	5108
.....d) Goats (meat)	5104	I) Poultry **VN5109**	5109
.....e) Sheep and Goats (milking)	5105	j)Other **Livestock_other** (80) **VN5110**	5110

2. How many months per year do you usually graze animals on your pasture? **VN5201**	5201
3. Do you use a grazing management system to rotate animals through two or more pastures? .....❑ Yes 5301 .....❑ No 5302 .... If yes, how many pastures **VN5303** **VN5301**	5303
4. Do you have any grazing rights for public lands, such as BLM, forest service, etc? .....❑ Yes 5401 .....❑ No 5402 ....If yes, how many animal unit months (aums) **VN5403** **VN5401**	5403

5. How much of your annual pasture production do your grazing animals typically eat? (mark one)

a) All of it or as much as they can get **VN5501**	5501
b) Most of it (some left standing but pretty short)	5502
c) About half	5503
d) A little bit (most of what grew in a given year remains standing after grazing)	5504
e) None	5505
f) Other (specify) **Pasture_other** (100) _____	5506

6. Do you purchase or raise most of the feed for the animals on your property?

❑ Purchase, where do your purchase your feed (mark all that apply) 5601

❑ Raise 5609

VN5601 (1 or 2)

❑ Local grower 5602 **VN5602**
❑ Feed store 5603 **VN5603**
❑ Bulk delivery 5604 **VN5604**
❑ Other (specify)_____ 5605
Purchase_other (80) **VN5605**

SECTION VI – Income Issues

1. What business type best describes your operation in 2005? (mark one) **VN6101**

.....a)	6101	e) .....S Corporation	6106
..... b)	6102	f) ..... Regular Corporation	6107
	..... c) .....Limited Liability Entity – LLC, LLP,... .LLLP, other	6103	g) Other (trust, grazing association, ... etc.) .....
..... d)	6104		

2. Did you file a I.R.S. Form 1040 Schedule F in 2005? .....**VN6201** ❑ Yes ❑ No 6201

3. What size was your farm/ranch based on gross farm income in 2005, according to the schedule F? (mark one) **VN6301**

.....a)	6301	g) ..... $25,000 to $39,999	6307
..... b)	6302	h) ..... $40,000 to $49,999	6308
.....c)	6303	I)..... $50,000 to $99,999	6309
..... d)	6304	j) ..... $100,000 to $249,999	6310
.....e)	6305	k) ..... $250,000 to $499,999	6311
..... f)	6306	l) .....$500,000 or more	6312

4. What percent of your household income comes from the agricultural operation? **VN6401**	6401

5. Did you have paid employees (including family members) in 2005? ❑ Yes 6501 ❑ No 6502 If yes, how many employees **VN6503** **VN6501**	6503

6. What was your primary source of income for this operation in 2005? (mark one) **VN6601**

a)	6601	I) Beef cattle	6608
b)	6602	j) Cattle feedlots	6609
c)	6603	k) Dairy cattle & milk production	6610
d)	6604	l) Hog & pig production	6611
e)	6605	m) Sheep & goat production	6612
f)	6606	n) Aquaculture & other animal production	6613
g)	6607	o) Specialty products	6614
h) Other (specify) **Income_other** (80) _____			6815

7. How was this operation financed in 2005? (mark all that apply)

a)	6701	e) Retirement accounts **VN6700_e**	6704
b)	6702	f) Operating loan from bank **VN6700_f**	6705
c)	6703	g) Loans from relatives **VN6700_g**	6706
d) Other (specify) **Finance_other** (100) _____ **VN6700_d**			6707

8. How do you market your commodities, products, and services? (mark all that apply)			
.....a)	6801	~~e) ..... Other direct sales~~	6805
..... b)	6802	f).....Auctions ..... **VN6800_f**	6806
	..... c) . Other direct sales ... **VN6800_c**	6803	g) Brokers/traders. **VN6800_g**
..... d)	6804	h) Other (specify) **Market_other** (80) **VN6800_h**	6808

SECTION VII – Demographics

1. How rural is most of the property managed by this operation? (mark only one) **VN7101**					
	Completely Rural	Mostly Rural	Mix of Rural & Urban	Mostly Urban	Completely Urban
	7101	7102	7103	7104	7105

2. What is the zip code of the primary residence **VN7201**	7201
3. Is the primary residence located on the property? ..... ❑ Yes 7301 ..... ❑ No 7302 ....If no, how far apart are they? (miles) **VN7303** **VN7301**	7303
4. How far is the property (headquarters) from the nearest "metro area?" (miles) **VN7401**	7401
5. If you or members of your family currently hold an off-property job, how far does the individual who travels farthest commute to work? (miles) off_property_job..... **VN7501**	7501
6. Operators are those persons responsible for the day-to-day management decisions for "this operation." How many operators are associated with this "operation?"..... **VN7601**	7601

7. Please complete the following questions for up to two primary operators associated with this operation.

	Operator 1		Operator 2 Screen_operator2	
.....a) .....Gender	**VN7701** ❑ Male [7701]	❑ Female [7702]	**VN7703** ❑ Male [7703]	❑ Female [7704]
..... b) ..... Age as of January 1, 2006	**VN7710** ❑ Under 25[1] ❑ 25 - 34[2] ❑ 35 - 44[3]	❑ 45 - 54[4] [7710] ❑ 55 - 64[5] ❑ 65 & Over[6]	**VN7720** ❑ Under 25[1] ❑ 25 - 34[2] ❑ 35 - 44[3]	❑ 45 - 54[4] [7720] ❑ 55 - 64[5] ❑ 65 & Over[6]
c) Of Spanish, Hispanic, or Latino origin or background.....	**VN7731** ❑ Yes [7731]	❑ No [7732]	**VN7733** ❑ Yes [7733]	❑ No [7734]
..... d) ..... Race (mark all that apply)	❑ American Indian or Alaskan Native [1] **VN7740** [7740] ❑ Caucasian [2] **VN7741** ❑ Black or African-American [3] **VN7742** ❑ Asian [4] **VN7743** ❑ Native Hawaiian or Other Pacific Islander [5] **VN7744**		❑ American Indian or Alaskan Native [1] **VN7750** [7750] ❑ Caucasian [2] **VN7751** ❑ Black or African-American [3] **VN7752** ❑ Asian [4] **VN7753** ❑ Native Hawaiian or Other Pacific Islander [5] **VN7754**	
e) .....Highest level of education	❑ No Formal Schooling[1] [7760] ❑ High School [2] **VN7760** ❑ Trade School [3] ❑ College Degree, 2 yr [4] ❑ College Degree, 4 yr [5] ❑ Graduate Degree [6] ❑ Other **school_other** (80)[7]		❑ No Formal Schooling[1] [7770] ❑ High School [2] **VN7771** ❑ Trade School [3] ❑ College Degree, 2 yr [4] ❑ College Degree, 4 yr [5] ❑ Graduate Degree [6] ❑ Other **school_other2** (80)[7]	
f) How long have you lived on the property (years)?.....	[7781] **VN7781**		[7782] **VN7782**	

8. Please indicate the previous work experiences for up to two primary operators associated with this operation? (mark all that apply)

	Operator 1	Operator 2
	❑ Farm/Ranch Employee [7801] **VN781_01** ❑ Farm/Ranch Owner [7802] **VN781_02** ❑ Small Business Owner [7803] **VN781_03** ❑ Large Company Owner [7804] **VN781_04** ❑ Large Company Employee [7805] **VN781_05** ❑ Financial /Accounting [7806] **VN781_06** ❑ Management [7807] **VN781_07** ❑ K-12 Education [7808] **VN781_08** ❑ Higher Education [7809] **VN781_09** ❑ Government [7810] **VN781_10** ❑ Legal [7811] **VN781_11** ❑ Doctor/Nurse [7812] **VN781_12** ❑ Other Health Care [7813] **VN781_13** ❑ Airline/Travel [7814] **VN781_14** ❑ Fine Arts [7815] **VN781_15** ❑ Other **work_other1** (80) [7816] **VN781_16**	❑ Farm/Ranch Employee [7821] **VN781_21** ❑ Farm/Ranch Owner [7822] **VN781_22** ❑ Small Business Owner [7823] **VN781_23** ❑ Large Company Owner [7824] **VN781_24** ❑ Large Company Employee [7825] **VN781_25** ❑ Financial /Accounting [7826] **VN781_26** ❑ Management [7827] **VN781_27** ❑ K-12 Education [7828] **VN781_28** ❑ Higher Education [7829] **VN781_29** ❑ Government [7830] **VN781_30** ❑ Legal [7831] **VN781_31** ❑ Doctor/Nurse [7832] **VN781_32** ❑ Other Health Care [7833] **VN781_33** ❑ Airline/Travel [7834] **VN781_34** ❑ Fine Arts [7835] **VN781_35** ❑ Other **work_other2** (80) [7836] **VN781_36**

Thank you *for completing this survey.*
Your answers are confidential.

Producer input is crucial to interpreting the data from this survey. Would you be willing to be contacted by the principal investigator from the land grant university in your state to verify the findings of the survey?

If yes, please sign and date below. Thank you. **VN9999**

Signature **contact_person** [9999] (0)_____ Date_____