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Risk Perceptions, Attitudes, and Influential Factors of Rainfed Lowland Rice Farmers in Ilocos Norte, Philippines

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ABSTRACT

This study analyzes the risk perceptions and risk attitudes of farmers practicing different rice-based cropping patterns in the rainfed lowland ecosystems of Ilocos Norte, Philippines. The Likert scale and Kruskal-Wallis test were employed to assess the farmers' risk perceptions while the experimental method was applied to determine the farmers' risk attitudes (i.e., risk averse, risk neutral, or risk taker). Regression analysis highlights the significant factors affecting perceptions and attitudes.

Resource-endowed and resource-poor farmers generally perceived various risk sources as moderately low regardless of crops planted. However, on the average, resource-poor farmers were more likely to consider farming as not risky possibly because they had little to lose or gain compared to their resource-endowed counterparts. By source of risk, both farmer groups perceived that farming is relatively risky considering the increasing price of fertilizer and environmental factors (e.g., weather), which are beyond their control. By crop, the farmers considered rice and corn as relatively risky compared to other crops. The major crops are rice during the wet season and corn in the dry season.

High fertilizer costs and erratic climatic conditions usually burden the farmers during the wet season. Similarly, corn output is badly affected by adverse weather circumstances. Farm size and wealth are the variables that affect the farmers' risk perceptions. The farmers in Ilocos Norte were found to be generally risk averse. Wealth, age, and availability of credit are important determinants of the farmers' risk attitudes, but their impacts vary across cropping patterns.

INTRODUCTION

The risk and uncertainty associated with rainfed farming make the latter a complex process. Farmers are exposed to the possibilities of losses in production and uncertainty of return on their investment. Risk, which is regarded in this study as the chance of falling below a critical (i.e., minimum or subsistence) income level, plays a vital role in the farmers' production decisions related to choices and levels of inputs and outputs. Empirically, how farmers decide under risky conditions is best analyzed by taking into account their risk perceptions and risk attitudes or preferences (i.e., risk-averse, risk-taker, or risk-neutral). Farmers whose survival hinges on production may be more sensitive to income variability than to average income and often exhibit high aversion to risk (Belaid and Miller 1987).

Risk aversion is the willingness to accept a lower expected return to obtain lower risk (Roumasset 1979). Prediction of behavior in risky situations depends on how much is known of the individual's willingness to take risks (Patindol 2001). For instance, farmers could be risk-averse yet willing to take risks (Manlangit 1993). Risk behavior of agents is determined not only by preferences but also by availability of institutions that facilitate the risk bearing (Roumasset 1976). Farmers may perceive farming as risky, not risky, or neutral considering the various sources of risk. Risk aversion is a source of inefficiency, which may lead to misallocation of resources.

The Psychometric Theory, which uses the characteristics of risk itself to explain the individual's perception of risk (Starbird and Baker 2004), was the basis in determining the farmers' risk perceptions in this study.

Farmers maximize the expected value of some utility function and choose among alternatives solely on the basis of expected

return and expected loss. Unlike in the econometric estimation of a utility function to determine farmers' risk preferences, this study employed the experimental approach using a set of decision choices. The use of experimental economics to estimate risk attitudes is relatively advantageous because of the researcher's ability to control the decision environment, which is more difficult with either time series data or surveys (Lusk and Coble 2005).

The farming system in Ilocos Norte is highly intensive and diversified with majority of the farm lands under rainfed conditions. The International Rice Research Institute (IRRI) has defined the rainfed ecosystem as a fragile environment; hence, farmers are continuously challenged to choose efficient management practices in the face of uncertain outcomes. Though there are several sources of risk in agricultural production, the risk perceptions and risk attitudes that affect farmers' choice of cropping pattern are still unknown. A better understanding of farmers' behavior toward risk is essential in designing improved risk management strategies—for different cropping patterns under an uncertain environment—that will offer farmers maximum benefits (e.g., which technology option is best for risk-averse farmers). Identifying the sources of risk aversion is crucial in policy making since well-designed public policies could prevent new degrees of risk for farmers. Therefore, policies to improve not only agricultural production but also farmers' ability to manage risk must take into account farmers' perceptions on and attitudes toward risk.

This paper investigates the risk perceptions and risk attitudes or preferences of rice-based farmers in rainfed lowlands as well as how they are influenced by various socioeconomic factors. It also illustrates the use of the experimental method in assessing the farmers' risk attitudes. The impact of risks associated

with different cropping patterns and the farmers' risk aversion have important economic and policy implications.

Study Area

Ilocos Norte, a major crop-producing area in northwestern Philippines, represents a rainfed ecosystem where the farming system is highly intensive, diversified, commercialized, and dominantly rice-based during the wet season. The province is located geographically between N 17°48' and N 18°29' latitude and E 120°5' and E 120°58' longitude, occupying a coastal plain in the northwest corner of the island of Luzon. It has a total land area of 362,291 hectares (ha), more than one-third (129,650 ha) of which is devoted to agriculture and forestry. There are 39,000 ha of rainfed areas, of which 66 percent constitute rainfed lowlands (Provincial Planning and Development Office [PPDO] 1995). Agriculture and forestry employ a significant labor force of 47 percent.

Majority of the farm lands are rainfed conditions and rice farming activity is highly dependent on rainfall during the wet season. When water is limited, the farmers use groundwater for supplemental irrigation. After rice is harvested, farmers cultivate various dry-season cash crops including corn (*Zea mays*), garlic (*Allium sativum*), mungbean (*Vigna radiate*), onion (*Allium sepa*), tomato (*Lycopersicon esculentum*), sweet pepper (*Capsicum annum* var. *annum*), and tobacco (*Nicotiana tabacum*). A well-developed marketing system has facilitated the evolution of the highly intensified rice-cash crop production system in the area (Lucas et al. 1999).

The study covered 10 municipalities, namely, Bacarra, Badoc, Batac, Currimao, Dingras, Laoag City, Paoay, Pinili, San Nicolas, and Sarrat. These municipalities are located in

the central rainfed lowlands of the province (Figure 1).

The climate is classified as Type I and is characterized by a distinct dry and wet season—predominantly dry from November to April and wet from May to October. For 29 years (1976-2005), the mean annual rainfall was about 2,000 millimeters (mm) with most of the rain received during heavy typhoons (Figure 2). The province experiences frequent strong typhoons and interspersed dry spells during the wet season.

METHODOLOGY

To determine the farmers' perceptions and attitudes toward risk, 100 farmers were consulted using an interview schedule. The respondents were visited twice during the 2005-2006 cropping season—after crop establishment and after the harvest period. The farmers' risk perceptions and risk attitudes were elicited during the first visit while their risk attitudes were again drawn during the second visit. Purposive sampling was employed to ensure that each farmer-respondent had at least 0.5 ha of rainfed landholding and had been practicing the following major cropping patterns for the last two years: rice-corn, rice-garlic, rice-mungbean, rice-tomato, and rice-sweet pepper. The data collection instrument was pre-tested to assess its validity. Rainfall data were secured from the Mariano Marcos State University Agro-Met Station covering the period 1976-2005.

The farmers were then classified as resource-endowed or resource-poor based on farm size and value of livestock and machinery. In this study, a resource-endowed farmer had a farm size of more than one hectare while a resource-poor farmer had one hectare or less. Prices, yields, and net revenue were assumed stochastic variables and were normally distributed.

Figure 1. Study areas in the rainfed lowlands of Ilocos Norte, Philippines

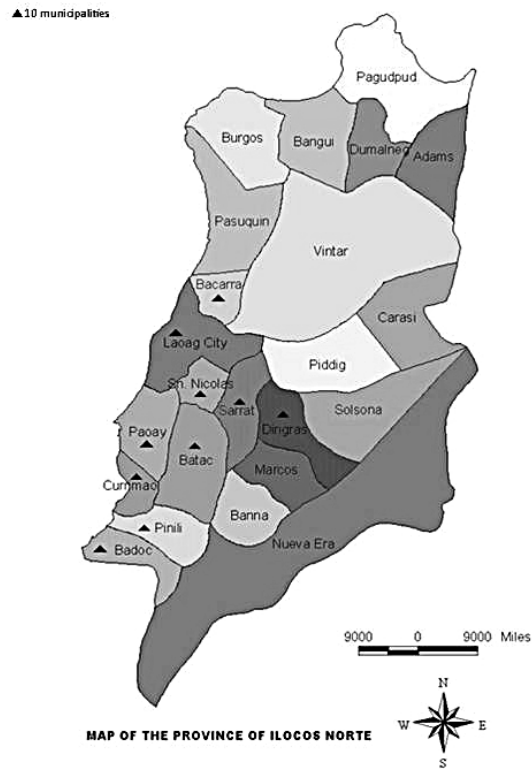
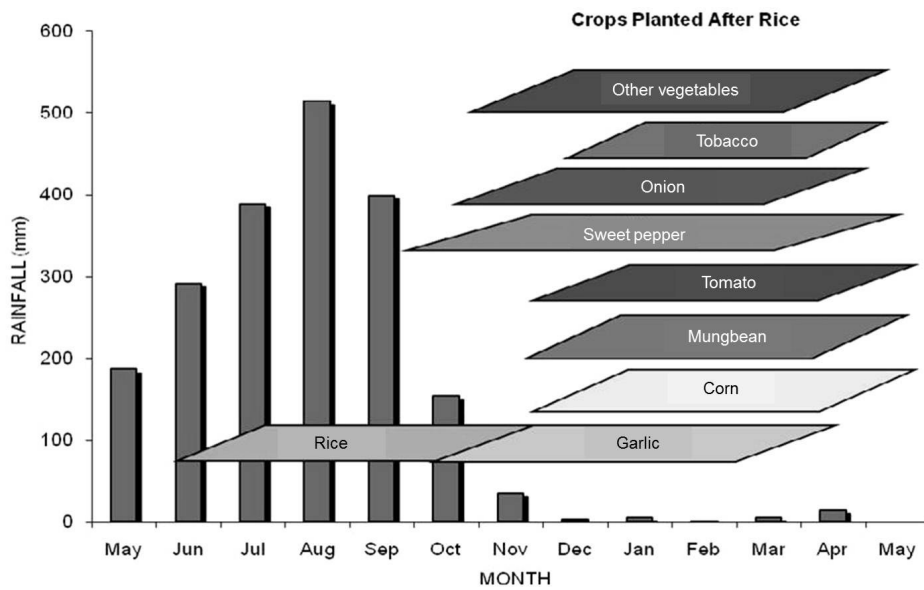


Figure 2. Average monthly rainfall and crops planted in Ilocos Norte, Philippines



Source: MMSU Agromet Station, Batac, Ilocos Norte, 1976-2005

Analytical Tools

Eliciting Farmers' Risk Perceptions

The farmers' risk perceptions, which were categorized based on the sources of risk considered (i.e., financial, production, and environmental), were determined through questions answered using a five-point Likert scale. The respondents were presented with several statements regarding the risks associated with their existing cropping patterns (Table 1), with which they had to agree or disagree and check the appropriate scale or numerical category as perceived. The descriptive categories used were *strongly agree* = 5, *moderately agree* = 4, *agree* (neutral) = 3, *moderately disagree* = 2, and *strongly disagree* = 1. It was assumed that the perceptions of resource-endowed and resource-poor farmers were the same.

The farmers' risk perceptions on financial, production, and environmental sources of risk were analyzed by taking the weighted mean of each item and the mean score. The frequencies of responses for the farmers' risk perceptions were multiplied by the scores on the Likert scale. The notations used for the weighted frequencies were *Fsa* (*strongly agree*), *Fma* (*moderately agree*), *Fa* (*agree*), *Fmd* (*moderately disagree*), and *Fsd* (*strongly disagree*), respectively.

$$\bar{X} = \frac{[(Fsa * 5 + Fma * 4) + (Fa * 3) + (Fmd * 2) + (Fsd * 1)]}{N} \quad (1)$$

where \bar{X} is the weighted mean of responses of each farmer; F is the frequency of responses for each risk perception category; and N is the number of observations.

To test the hypothesis that the mean scores¹ of the resource-endowed and resource-poor

Table 1. Statements used to determine the farmers' risk perceptions

Statements	
1	Producing rice, corn, garlic, mungbean, sweet pepper, and tomato is risky.
2	Rice-corn, rice-garlic, rice-mungbean, rice-sweet pepper, and rice-tomato cropping patterns are risky.
3	Price of fertilizer affects your crop production.
4	Price of pesticide affects your crop production.
5	Price of fungicide affects your crop production.
6	The market (selling) prices affect your crop production.
7	Unstable farm income affects your crop production.
8	Availability of credit affects your crop production.
9	Pest and disease infestation are common problems in crop production.
10	There is high variability in crop yield.
11	Availability of water affects your crop production.
12	Unpredictable weather condition affects your crop production.
13	Availability of inputs affects your crop production.
14	The risk of typhoon affects your crop production.
15	The risk of heavy rainfall affects your crop production.

¹ Mean scores are calculated by getting the ratio of \bar{X} and the total number of items of risk perceptions

farmers' risk perceptions are the same, the mean scores of risk perceptions under each cropping pattern were ranked from lowest to highest. The Kruskal-Wallis (K-W) test, a non-parametric statistic test that resembles the ANOVA except that the group means are based on ranks rather than on the raw measures, was used to check the hypothesis.

Risk Aversion Derivation

Eliciting Farmers' Risk Attitudes

Analysis of risk attitudes involved an experimental approach, which elicited farmers' attitudes toward risks using a set of lottery choices. Originally developed by Binswanger (1980) and used by Holt and Laury (2002) and Lusk and Coble (2005), among others, this technique involves individuals making a series of repeated decisions among risky prospects. It also provides some incentives to the farmer-respondents, which could be monetary or otherwise. According to Fishbein and Aizen (1975), risk attitudes or preferences are good predictors of behavior if the two are measured at the same level of specificity.

All farmer-respondents were visited twice during the conduct of the study. The farmers' risk perceptions and risk attitudes were elicited during the first visit while their risk attitudes were again drawn during the second visit. For each respondent, the incentives were PHP 50.00² and 15 kilograms (kg) of rice seed (PSB Rc 14) worth PHP 75.00 for the first and second visits, respectively. These motivated the farmers to cooperate fully. The amount of the incentives was small considering the inflation rate; however, at the time of the study, PHP 50.00 was enough to buy 2 kg of rice. Many

of the farmers lacked access to high-quality seeds, which was why the seed material was an important element.

In each visit, farmers were oriented about the procedure before their responses were gathered. When asked if they had any experience in gambling, any betting game, or lottery, all farmer-respondents revealed that they had tried gambling where there is uncertainty. This strengthened the researcher's confidence to conduct the experiment using hypothetical payoffs and it helped establish a good researcher-respondent relationship over time, both being cooperators of a long-term research project on rice-based farming. During data gathering, it was emphasized that there was no correct or wrong answer to each decision choice. The farmers were asked to take their time in answering and to reveal truthful choices. In this experiment, the farmers decided individually, unlike in Binswanger's (1980) study where farmers were allowed to discuss and consult with one another.

The decision choices and options are presented in Table 2. The monetary value (e.g., PHP 9.00, PHP 8.00, PHP 4.00, and PHP 3.00) represents the hypothetical amount used in determining the payoff given the probability p of getting the payoff under each decision. Though the payoffs were hypothetical, which was a limitation of this study, the farmers fully understood the elicitation process as they were given enough time to ask questions and clarify the procedure. For the first four choices listed in the table, a risk-neutral individual would choose option A (safe option) because its expected value is greater than the expected value of option B (risky option). Moving down the list, the chances of winning the higher payoff increases in both options.

² In 2006, USD 1 = PHP 51.31

Table 2. Decision choices of farmers under two lottery options

Decision	Option A	Option B
1	10% chance of PHP 8.00; 90% chance of PHP 4.00	10% chance of PHP 9.00; 90% chance of PHP 3.00
2	20% chance of PHP 8.00; 80% chance of PHP 4.00	20% chance of PHP 9.00; 80% chance of PHP 3.00
3	30% chance of PHP 8.00; 70% chance of PHP 4.00	30% chance of PHP 9.00; 70% chance of PHP 3.00
4	40% chance of PHP 8.00; 60% chance of PHP 4.00	40% chance of PHP 9.00; 60% chance of PHP 3.00
5	50% chance of PHP 8.00; 50% chance of PHP 4.00	50% chance of PHP 9.00; 50% chance of PHP 3.00
6	60% chance of PHP 8.00; 40% chance of PHP 4.00	60% chance of PHP 9.00; 40% chance of PHP 3.00
7	70% chance of PHP 8.00; 30% chance of PHP 4.00	70% chance of PHP 9.00; 30% chance of PHP 3.00
8	80% chance of PHP 8.00; 20% chance of PHP 4.00	80% chance of PHP 9.00; 20% chance of PHP 3.00
9	90% chance of PHP 8.00; 10% chance of PHP 4.00	90% chance of PHP 9.00; 10% chance of PHP 3.00
10	100% chance of PHP 8.00; 0 chance of PHP 4.00	100% chance of PHP 9.00; 0 chance of PHP 3.00

The expected payoffs were not reflected in the instructions while the farmers' risk attitudes were being drawn. Hence, except for decision 10, the farmers did not know which options would provide the higher expected payoff in each decision choice. Following the work of Lusk and Coble (2005), equivalent values of risk aversion were determined from the respondents' choices. Ranges of the relative risk aversion (r) were derived.

From the range of r , the midpoint of the minimum and maximum was determined. The number of safe choices in each payoff condition was used to obtain risk aversion estimates using the utility function in power form: $U(W)=Wr$, where W is the value of wealth (assumed 0) and r is the risk aversion coefficient between 0 and 1. Subjects do not fully account for their initial wealth when comparing how their wealth is affected by different lotteries (Holt and Laury 2002).

Using the power function, the number of safe choices in each expected payoff in Option A was used to obtain each farmer's risk aversion coefficient. Based on the farmer's chosen option for each of the 10 decisions, the expected payoff of the decision choice was calculated using the probability p . This was done for both low (PHP 50.00) and high (PHP 75.00) payoffs. The expected utility (EU) of the option was calculated by first identifying where the subject chose option B for the first time and chose it continuously thereafter. The option where the farmer made the first switch was used as the point of reference in determining the number of safe choices. The lower and upper limits in the farmer's safe options were determined using the expected payoffs. These values were transformed in natural logarithm to determine the range of the risk aversion r . Based on the range, the midpoint of the lower and upper limits (in log form) was determined,

which represented the farmer's risk aversion coefficient. Equations 2 and 3 illustrate how the lower and upper limits were determined.

For decision 1:

$$EU(A) = p(8.00)^r > p(9.00)^r + 1 - p(3.00)^r = EU(B) \quad (2)$$

For decision 2:

$$EU(B) = p(9.00)^r + 1 - p(3.00)^r > 1 - p(4.00)^r = EU(A) \quad (3)$$

Aside from eliciting the farmers' risk perceptions (Z), this study also determined whether or not the farmers' risk perceptions were influenced by their socioeconomic characteristics. The values of variable Z were derived from the mean scores of the farmers' risk perceptions. The following multiple regression model was estimated in log form.

$$Z = \gamma_0 + \gamma_1 W_i + \gamma_2 A_i + \gamma_3 E_i + \gamma_4 F_i + \gamma_5 T_i + \gamma_6 Y_i + \gamma_7 C_i + \zeta_i \quad (4)$$

for $i = 1, 2, \dots, n$. Where W is wealth, A is age, E is educational attainment, F is farm size, T is tenure status, Y is income, and C is availability of credit. In this study, wealth was measured by the value of livestock and machinery while income covered the farmers' cash income from farm and non-farm sources. Belaid and Miller (1987) used schooling and cropping areas as proxies to wealth. Meanwhile, Rosenzweig and Binswanger (1992) found that wealthier farmers were more willing to absorb significantly higher risk while reaping high returns than less wealthy farmers. The γ_i 's were the parameters to be estimated and ζ_i was the random error. Data were analyzed using the Statistical Analysis System (SAS).

To explain variations in risk attitudes, the log of the coefficient of risk aversion, r , was regressed against the same independent variables in Equation 4. The risk aversion parameter (r) is, to some degree, governed by personal characteristics of the entrepreneur (Freund 1956; Moscardi and de Janvry 1977; Binswanger 1980; Holt and Laury 2002). However, the immediacy of exposure to risk also affects a farmer's risk attitude or preference. Love and Robison (1984) concluded that while risk preferences may not be intertemporally stable over wide ranges of income, they are stable for incomes close to those typically experienced by the individuals.

RESULTS AND DISCUSSION

On the average, the respondents were 52 years old and had attained nine years of education (Table 3). The resource-endowed farmers and their spouses were older and had a higher level of education than their resource-poor counterparts. Both groups had five household members, (60 percent of which were children), and derived their income from farming.

The resource-endowed farmers had lower value of livestock compared to the resource-poor farmers. The latter generally raised small animals (e.g., hogs), ruminants (e.g., goat and sheep), and some native chicken to sell or consume should they experience production shortfall. In contrast, the resource-endowed farmers had higher value of machinery. The farm size of the sampled farmers ranged from 0.58 to 1.46 ha with an average size of 0.83 ha. More than half (56%) of the farms were cultivated by tenants while 44 percent were cultivated by farm owners. Landholdings were highly fragmented with an average of three to four parcels per farm household.

Table 3. Selected characteristics of farm households

Characteristics	Units	Resource-Endowed	Resource-Poor	Overall
Family members	Number	5 (1.6)	5 (2)	5 (1.8)
Dependent children	Number	1.2 (1.2)	1.1 (1.4)	3 (1.2)
Age	Year			
Farmer		52 (9.6)	50 (12)	52 (11)
Spouse		47 (15)	42 (20)	43 (20)
Education	Year			
Farmer		10 (1.6)	9 (2)	9 (2.5)
Spouse		10 (4.4)	8 (4)	8 (4.6)
Members available to work in the farm	Number	3 (1.5)	3 (1.6)	3 (1.5)
Average farm size	Hectare	1.46 (0.85)	0.60 (0.31)	0.83 (0.29)
Value of livestock	Peso	59,433 (37,645)	64,675 (46,559)	59,643 (40,899)
Value of machinery	Peso	68,389 (46,786)	35,526 (28,459)	33,200 (29,272)

Note: Values in parentheses are standard deviations

Farms in Ilocos Norte are mostly rainfed. When surface water is limited during the wet season, the farmers use subsurface water (groundwater) for irrigation. Majority of the farmers own water pumps with 4- to 5-horsepower engines. During the dry season, water pumps are mainly used to draw groundwater to irrigate dry-season crops.

Farmers' Overall Risk Perceptions

Farmers have different perceptions and ways of weighing risks related to their agricultural production activities. For the farmer-provided answers in this study, higher ratings signify that they perceived farming as risky considering the three sources of risks; lower ratings suggest otherwise.

Regardless of crop, the general perceptions of the resource-endowed and resource-poor farmers about the various sources of risk were rated as moderately low (Table 4). The values, which were close to 2.00 (moderately disagree), mean that they disagreed that farming is risky considering the financial, production, and environmental sources of risk. However,

regardless of source of risk, the mean response of the resource-poor farmers was lower than those of the resource-endowed farmers. This indicates that resource-poor farmers are more likely to perceive farming as not risky because, other things equal, they have relatively little to lose or gain compared to farmers with abundant resources. Meanwhile, across the sources of risk, both farmer groups considered farming as relatively risky given the increasing price of fertilizer and environmental factors, which are beyond their control. This is indicated by values exceeding 2.00. Fertilizer cost was the most felt source of risk while weather condition was the most visible source of risk affecting their farming activities.

Farmers usually base their perceptions on their past experiences and the availability of information regarding a particular crop. Results show that the farmers had higher average ratings for corn and rice (Table 5). This implies that farmers perceived these two crops as relatively risky compared to the others. At the time of the study, the major crops for the wet and dry seasons were rice and corn, respectively. Farmers saw rice production as relatively risky.

Table 4. Farmers' ratings of their risk perceptions, by source of risk

Source	Resource-Endowed	Resource-Poor	Overall
Financial			
Income	1.702	1.924	1.800
Price			
Fertilizer	2.077	2.318	2.183
Pesticide	1.824	1.856	1.840
Fungicide	1.708	1.648	1.682
Output	1.845	1.894	1.870
Production			
Pest and diseases	1.661	1.890	1.762
Yield variability	1.622	1.879	1.735
Availability of water	1.914	2.045	1.972
Availability of inputs	1.905	2.064	1.975
Unpredictable weather	1.890	2.000	1.925
Environmental			
Frequency of typhoons	2.050	2.133	2.085
Heavy rainfall	2.107	2.083	2.097
Overall	1.716	1.649	

Table 5. Farmers' ratings of their risk perceptions, by source and by crop

Source	Corn	Garlic	Mungbean	Rice	Sweet Pepper	Tomato	Overall Rating
Financial							
Income	2.290	1.729	1.237	2.727	1.260	1.810	1.800
Price							
Fertilizer	2.810	2.167	1.206	3.520	1.479	2.130	2.183
Pesticide	2.222	1.990	1.113	3.000	1.479	1.420	1.840
Fungicide	1.929	1.844	1.010	2.740	1.189	1.570	1.682
Output	2.707	2.062	1.526	2.810	1.189	1.190	1.890
Production							
Pest and diseases	2.143	1.770	1.112	2.580	1.198	1.950	1.762
Yield variability	2.021	1.625	1.227	2.720	1.239	1.790	1.735
Availability of water	2.485	1.854	1.367	3.210	1.402	1.697	1.972
Availability of inputs	2.455	1.843	1.299	3.190	1.250	1.760	1.975
Unpredictable weather	2.296	1.948	1.367	3.230	1.323	1.810	1.925
Environmental							
Frequency of typhoon	2.636	1.781	1.474	3.510	1.333	1.970	2.085
Heavy rainfall	2.667	1.948	1.776	3.100	1.385	1.919	2.097
Overall	2.406	1.803	1.337	3.308	1.268	1.784	

They added that they are usually burdened by high fertilizer cost in the wet season, during which the climatic condition is also erratic. Typhoons occur frequently in the Ilocos region during the rainy season when the area is mostly planted with rice.

Rice crops are also affected by water stress when there are interspersed dry spells during the wet season. Corn production was also perceived as relatively risky compared to other non-rice crops. When bad weather conditions such as typhoons occur in the area during the dry season, corn production is adversely affected. The farmers' ratings of their risk perceptions by crop could also be related to the proportion of area planted to their major crops.

Ranking of Risk Perceptions by Crop

The ranking of resource-endowed and resource-poor farmers' risk perceptions for corn, mungbean, and sweet pepper production differed significantly based on the K-W test (Table 6). In contrast, both farmer groups ranked their risk perceptions for garlic, rice, and tomato production the same way.

The farmers generally perceived both corn and rice production as relatively risky. However, the two farmer groups ranked their risk perceptions toward the sources of risk for corn production differently. This contrasts with how they ranked their risk perceptions for rice production, which was the same for both groups.

Similarly, the resource-endowed and resource-poor farmers perceived garlic and tomato production as not risky and ranked their perceptions the same way. They also perceived mungbean and sweet pepper production as not risky but ranked their risk perceptions for these crops differently.

Ranking of Risk Perceptions by Source of Risk

Results of the K-W statistical test reveal that the resource-endowed and resource-poor farmers had the same risk perceptions regarding the financial, production, and environmental sources of risk (Table 7). Hence, the null hypothesis that the risk perceptions of both groups are the same was not rejected. This result, which is consistent with the farmers' general perceptions of risk in farming (Table 4), could be attributed to the fact that all farmers face the same environmental and market conditions.

Risk Perceptions and Socioeconomic Characteristics

Only farm size and wealth, which was measured by value of livestock and machinery, emerged as influential factors affecting the farmers' risk perceptions (Table 8). This implies that the farmers' perceptions were directly influenced by the size of landholding and their level of wealth. Risk perception appears higher with a larger landholding since this requires more input use and more time for crop management, other things being equal. Similarly, greater farm wealth implies greater risk as perceived by farmers.

Age and education had negative effects on the farmers' risk perceptions while tenure status, total farm income, and availability of credit had positive association. However, these variables appear to have had insignificant effects. The results agree with some of Binswanger's (1980) findings wherein assets represented by wealth and land rented represented by landholding were significant variables affecting farmers' risk perceptions.

Table 6. Ranking of risk perceptions by crop

Crop/Farm Type	N	Mean Score	Kruskal-Wallis Test
Corn			2.65*
Resource-endowed	55	54	
Resource-poor	44	45	
Garlic			0.13
Resource-endowed	54	48	
Resource-poor	43	50	
Mungbean			5.36**
Resource-endowed	55	56	
Resource-poor	44	43	
Rice			1.70
Resource-endowed	56	54	
Resource-poor	44	46	
Sweet pepper			5.66***
Resource-endowed	54	44	
Resource-poor	43	56	
Tomato			0.005
Resource-endowed	55	50	
Resource-poor	44	50	

Note: ***, ** and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively.

Table 7. Ranking of risk perceptions by source

Sources	Farm Type	N	Mean Score	Kruskal-Wallis Test
Financial				0.65 ^{ns}
Cost of inputs	Resource-endowed	56	49	
Price of outputs	Resource-poor	44	53	
Production				1.68 ^{ns}
Yield	Resource-endowed	56	47	
	Resource-poor	44	55	
Environmental				0.02 ^{ns}
Typhoon	Resource-endowed	56	51	
Heavy rainfall	Resource-poor	44	50	

Note: ns - Not significant

Risk Aversion Coefficients of the Farmers

A larger value of the r implies a stronger aversion to risk. This study found that the farmers in Ilocos Norte are generally risk averse (Table 9). The results are consistent with those of the studies reviewed wherein farmers were also generally risk averse. This conforms with the safety-first rule, which suggests that a

farmer normally seeks to meet the needs of his household before anything else. The proportion of farmers and the risk aversion coefficients show that most farmers exhibited attitudes away from risk or were more concerned about their security rather than gambling in uncertain situations. As expected, the ranges differed from those obtained in the literature reviewed (Holt and Laury 2002; Anderson et

Table 8. Regression estimates of risk perceptions and socioeconomic characteristics

Variable	Coefficient	t-value
Intercept	-4.60	0.96
Age	-0.20	-0.56
Education	-0.39	-1.51
Farm size	0.20*	1.68
Income	0.44	1.65
Tenurial status	0.06	0.96
Availability of credit	0.02	0.12
Wealth	0.20**	2.04
<i>F</i> -value = 1.86*		
<i>R</i> ² = 0.19		

Note: ** and * are statistically significant at probability level of 5 percent and 10 percent, respectively.

Table 9. Risk aversion coefficients and risk attitude classifications

Number of Safe Choice	Range of Relative Risk Aversion for $U(W) = W^r$	Risk Attitude Classifications	Percentage of Farmers
0-1	$r < 1.57$	Highly risk loving	13
2	$1.57 < r < 1.65$	Very risk loving	1
3	$1.65 < r < 1.72$	Risk loving	0
4	$1.72 < r < 1.79$	Risk neutral	2
5	$1.79 < r < 1.86$	Slightly risk averse	31
6	$1.86 < r < 1.92$	Risk averse	4
7	$1.92 < r < 1.95$	Very risk averse	8
8	$1.95 < r < 2.00$	Highly risk averse	5
9-10	$2.00 < r$	Do nothing	36

al. 1992; Binswanger 1980; and Moscardi and de Janvry 1977). Binswanger (1980) reported a remarkable uniformity in risk preferences, which could be attributed to the homogeneity of farmers' socioeconomic characteristics and production technology.

Ilocos Norte farmers are generally homogenous, yet their varying degrees of exposure to training and new production technologies, which they considered during the interview, affect their aversion to risk. There likely exists considerable heterogeneity in risk preferences among individuals with superficially common business and personal characteristics (Young 1979). Differences in risk preferences may also relate to the farmers'

constraint set (i.e., equipment, labor, input, and credit availability) and not to their willingness to take risks (Belaid and Miller 1987; Binswanger 1980). Regardless of how risk aversion is measured, it is a local characteristic; its sign and degree can vary depending on the stakes involved (Young 1979).

It is worth noting that risk-taking farmers were also encountered during the study. This indicates that some farmers are willing to receive greater benefits even if the risk of obtaining them is high. Notably, some of the farmers who were risk-takers were farmer leaders and had actively attended farmer trainings or seminars. This implies that farmers exposed to such activities, which enhance not

only their technical know-how but also their farm management skills, are at an advantage. Though they appeared to represent only a small proportion of the farmers in Ilocos Norte, acknowledging their presence and background is important for policy initiatives.

Risk Attitudes and Socioeconomic Characteristics

In this study, wealth was measured as the gross value of the farmer's physical assets, particularly machinery and livestock. Income and wealth were not correlated as tested. In the rice-corn cropping pattern, the risk aversion of farmers was affected significantly by their wealth (Table 10). The negative coefficient implies that as wealth increased, aversion to risk decreased (i.e., farmers were increasingly becoming risk-takers). The greater evidence of risk aversion in developing countries is consistent with the widely accepted hypothesis of decreasing risk aversion with respect to wealth. Binswanger (1980) found that wealth showed a slight reduction in risk aversion but was not significant. However, for the other

cropping patterns, the results were consistent with those of Holt and Laury's (2002), which showed no evidence to support the "asset integration" hypothesis that wealth affects risk attitudes.

In the rice-garlic and rice-sweet pepper patterns, age affected the farmers' risk aversion significantly. The positive effect of age indicates that the older farmers were more willing to take risks than their younger counterparts. This could be attributed to their being seasoned farmers, having been more exposed to various risky situations. For the rice-tomato cropping pattern, tenure and credit showed significant effects on the farmers' risk aversion. Tenure was associated with risk aversion, which was consistent with the findings of Moscardi and de Janvry (1977). Landowners can decide on their own; hence, they are more determined to take more risks than tenants. Credit was a determinant of the farmers' risk aversion in the rice-tomato pattern. Most of the farmers planting tomato were contract growers of the National Food Corporation. This private company extends credit to farmers in terms of seeds, fertilizer, and chemicals. No socioeconomic variables

Table 10. Regression estimates of risk attitudes and socioeconomic characteristics

Variable	Cropping Pattern				
	Rice-Corn	Rice-Garlic	Rice-Mungbean	Rice-Sweet Pepper	Rice-Tomato
Constant	1.73 (0.97)	-2.50 (-1.53)	1.94 (1.27)	-6.02** (-2.45)	1.23 (1.09)
Age	-0.78 (-1.19)	0.89*** (2.87)	-0.08 (-0.30)	0.95* (1.97)	0.06 (0.19)
Education	0.09 (0.19)	-0.02 (-0.16)	0.16 (0.81)	0.72 (1.47)	-0.05 (-0.35)
Farm size	0.09 (0.24)	0.14 (1.19)	0.04 (0.27)	-0.23 (-1.05)	-0.11 (-0.83)
Tenure	0.03 (0.46)	0.01 (0.22)	-0.04 (-0.78)	-0.02 (-0.29)	-0.07* (-1.74)
Credit	0.32 (1.60)	-0.02 (-0.15)	0.12 (0.95)	0.10 (0.33)	0.24* (1.88)
Income	0.17 (0.88)	-0.01 (-0.08)	-0.10 (-0.75)	0.15 (1.09)	-0.04 (-0.30)
Wealth	-0.02** (-2.58)	-0.003 (0.46)	0.002 (0.27)	-0.01 (-0.74)	0.01 (1.02)
F-value	2.25*	2.07 ^{ns}	0.59 ^{ns}	1.31 ^{ns}	1.10 ^{ns}
R ²	0.57	0.57	0.26	0.43	0.40

Note: Figures in parentheses are *t*-values; ***, **, and * are statistically significant at probability level of 1 percent, 5 percent, and 10 percent, respectively; ^{ns} means not significant.

showed significant effect on risk aversion in the rice-garlic and rice-mungbean cropping patterns.

The evidence did not support the hypothesis that higher level of schooling decreases risk aversion. It was also expected that the availability of credit would decrease farmers' risk aversion. However, the result did not support the hypothesis for all the cropping patterns. This could be attributed to the presence of other coping mechanisms. Other farmers mentioned lack of credit facility and the presence of bureaucracy, which discouraged them from borrowing from formal sources of credit.

The regressions, though showing overall insignificant relationships that are consistent with Binswanger (1980), are important. Following the lines of Binswanger (1980), "It is not the innate or acquired tastes that hold the poor back but external constraints." This study found that the farmers lacked access to training and seminars as well as good credit facilities. Ilocos Norte farmers also deal with erratic weather conditions regularly because of their geographic location.

CONCLUSIONS AND RECOMMENDATIONS

The farmers in Ilocos Norte had similar perceptions about the risks associated with the different cropping patterns (i.e., financial, production, and environmental). They perceived that the price of fertilizer, occurrence of typhoons, and heavy rainfall are the most likely sources of risk. However, they differed significantly in ranking their perceptions in terms of crops, particularly considering corn, mungbean, and sweet pepper production. In general, they considered farming as not risky. However, when various factors were considered, wealth and farm size affected the farmers' perceptions of risks associated with

the different cropping patterns significantly. Farmers with larger farm size and more wealth have wider exposure to risk; hence, they can provide better insights regarding the risks in farming.

Though farmers in Ilocos Norte have low perceptions of the risks associated with the major cropping patterns, many of them appear to be generally risk-averse. More than three-fourths of the farmer-respondents were risk averse and the distribution of risk aversion coefficients was diverse. This means that even if rainfed farmers are assumed to be homogenous in terms of their socioeconomic characteristics, except in the value of livestock and machinery, and their risk perceptions are the same, their attitudes toward risky situations vary. The regression analysis on socioeconomic variables and risk aversion across cropping patterns yielded insignificant results. However, wealth affected the risk attitudes of farmers under the rice-corn cropping pattern significantly. Likewise, credit affected the risk attitudes of rice-tomato farmers significantly. Age affected the risk attitudes of rice-garlic and rice-sweet pepper farmers significantly. This implies that some of the farmers' socioeconomic characteristics influence their risk attitudes. These differential results could be attributed to farm investment, which varies among cropping patterns. For example, farmers practicing rice-corn cropping pattern invest more on hybrid seeds and fertilizer compared to farmers practicing other cropping patterns. Sufficient financial resources or assistance through a viable and accessible credit program will enable the farmers to take more risks, especially for crops that are highly remunerative. In response to input price variability, farming options like organic agriculture, which has favorable cost and environmental impacts, may be considered.

Limitations in interpreting the results of this study hold. The payoffs were hypothetical,

unlike most of the previous studies on measuring farmers' risk aversion. The probabilities that individuals face when making a particular decision are unobservable (Lybbert and Just 2007). There are more complexities in understanding farmers' production decisions in fragile environments, and these complexities can be intertemporal. Interpreting the effect of wealth on risk aversion should be considered based on cropping pattern and not across cropping patterns. Lybbert and Just (2007) presented results of spurious correlation between economic traits, particularly wealth, and risk preferences. They found that spurious correlation is due to the inclusion of wealth correlates in the estimation of the probabilities and vanishes as these correlates are excluded from the estimation of probabilities.

How farmers respond to risks is important in agricultural decisions. Policies to improve farmers' ability to manage risks should be considered. Enhancing farmer education can help minimize the effect of production risk on a farmer's welfare. Moreover, investment in farmer-training to build human capital will enable farmers to manage production risks better. It should not be discounted that the farmers' attitudes toward risk are major determinants of the rate of diffusion of new technologies among them and of the outcome of rural development programs. Moreover, farmer education should focus on adaptation strategies to climate change considering that farmers consider weather variability as a major source of risk in farming.

The findings suggest a greater role for government and research institutions in technology development programs—in communicating potential risks and in providing the farmers with accurate information on benefits and risks from new technologies as well as alternative farming options. If properly informed, farmers would be able to adjust and be willing to take risks to increase their productivity and profitability. For future research, risk perceptions and risk preferences can be integrated in estimating a production and/or function.

REFERENCES

- Anderson, J., J. Dillon, and J. Hardaker. 1992. *Agricultural Decision Analysis*. Ames: Iowa State University Press.
- Belaid, A., and S.F. Miller. 1987. "Measuring Farmers' Risk Attitudes: A Case Study of the Eastern High Plateau Region of Algeria." *Western Journal of Agricultural Economics* 12 (2): 198-206.
- Binswanger, H.P. 1980. "Attitude Toward Risk: Experimental Measurements in Rural India." *American Journal of Agricultural Economics* 62 (3): 395-407.
- Fishbein, M., and I. Ajzen. 1975. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading, Massachusetts: Addison-Wesley Publishing.
- Freund, R.J. 1956. "The Introduction of Risk into a Programming Model." *Econometrica* 24 (3): 253-263.
- Holt, C., and S. Laury. 2002. "Risk Aversion and Incentive Effects." *American Economic Review* 92 (5): 1644-1655.
- Love, R.O., and L.J. Robison. 1984. "An Empirical Analysis of the Intertemporal Stability of Risk Preference." *Southern Journal of Agricultural Economics* 16 (1): 159-165.
- Lucas, M.P., S. Pandey, R.A. Villano, D.A. Culanay, and S.R. Obien. 1999. "Characterization and Economic Analysis of Intensive Cropping Systems in Rainfed Lowlands of Ilocos Norte, Philippines." *Experimental Agriculture* 35: 211-224.
- Lusk, J.L., and K.H. Coble. 2005. "Risk Perceptions, Risk Preference, and Acceptance of Risky Food." *American Journal of Agricultural Economics* 87 (2): 393-405.
- Manlangit, M.D. 1993. "Measurement of Production Risk of Rice Farmers in the Rainfed Areas of Victoria, Tarlac." Unpublished MS thesis, University of the Philippines Los Baños.
- Moscardi, E., and A. de Janvry. 1977. "Attitudes Toward Risk among Peasants: An Econometric Approach." *American Journal of Agricultural Economics* 59 (4): 710-716.
- Patindol, R.A. 2001. "Stochastic Dominance Analysis in the Selection of Risk-efficient Cropping Strategies." Unpublished PhD thesis, University of the Philippines Los Baños.
- Provincial Planning and Development Office (PPDO). 1995. *Ilocos Norte Socioeconomic Profile*. PPDO: PPDO, Ilocos Norte.
- Rosenzweig, M.R., and H.P. Binswanger. 1992. *Wealth, Weather Risk, and the Composition and Profitability of Agricultural Investments*. Policy Research Working Paper. Washington D.C.: Policy Research Dissemination Center, World Bank.
- Roumasset, J., J.M. Boussard, and I. Singh. eds. 1979. *Risk, Uncertainty, and Agricultural Development*. Los Banos, Philippines: SEARCA and A/D/C.
- Roumasset, J. 1976. *Rice and Risk: Decision-Making among Low-Income Farmers in Theory and Practice*. Amsterdam, Netherlands: North-Holland Publishing Co.
- Starbird, S.A., and G.A. Baker. 2004. "Determinants of Consumer Perceptions of Food Safety Risk." Paper presented at the 14th Annual Conference of the International Food and Agribusiness Management Association, Montreux, Switzerland, June 12.
- Young, D.L. 1979. "Risk Preferences of Agricultural Producers: Their Use in Extension and Research." *American Journal of Agricultural Economics* 61 (5): 1063-1070.