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Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

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RISK AVERSION AMONG SMALLHOLDER HIGH-VALUE CROP FARMERS IN THE SOUTHERN PHILIPPINES

Sonny N. Domingo¹, Kevin A. Parton², John Mullen³, and Randall Jones⁴

Abstract

Several elicitation techniques were employed to gauge the attitudes to risk of smallholder high-value crop farmers in the southern Philippines. Results showed varying degrees of risk aversion, neutrality, and preference among smallholder farmers. Although some of the techniques classified distinct groups of local growers as either risk-averse or risk-preferring, the estimated risk aversion coefficients were relatively low signifying an inclination toward risk-neutrality. These may partly explain the degree of openness or non-openness of smallholder farmers to cultural changes and development interventions. Variations in farmers' risk attitude classification among the different elicitation methods indicate the need for further validation studies and more definitive evaluation standards.

Keywords: risk attitude elicitation, farmers' risk aversion, smallholder high-value crop farming

1.0 Introduction

Hardaker *et al.* (1997) define risk as uncertainty or imperfect knowledge with exposure to unfavorable consequences. To take a risk is to allow for the possibility of loss or failure in achieving one's desired objectives. In agriculture, uncertainties about yields and prices that have direct bearing on farm productivity and profitability constitute the most significant sources of risk for farmers. The farmers' attitudes to risk, then, largely determine how they act on perceived opportunities and challenges in the field.

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In line with this, farmers' attitudes to risk have long been studied for their relevance to on and off-farm decision making. Attitudes to risk may greatly vary among individuals, but it has been asserted in the literature that farmers' preference or aversion to risk directly impacts on what is done in the field and how post-production and marketing operations are executed.

Ridier *et al.* (2012), in their study on the adoption of innovative cropping systems under price and production risks, showed that both high risk aversion and good market prospects for agricultural produce tend to slow down farmers' conversion toward novel systems. They claimed that small farmers perceive innovative cropping systems as risk increasing because of the uncertainty about yields in the field. Pannell *et al.* (2013), as gathered from Dong and Saha (1998) and Marsh *et al.* (2000), stated that before trying on a new practice, farmers rely mostly on information from outsiders. Social and information networks are important influences. But when trialing commences, personal experience becomes the driving reason for continued adoption. Farmers' goals are usually heterogeneous, but for smallholder farmers, economic factors must be the main driver of adoption. People also have personal characteristics, like aversion to risk, that influence adoption decisions fairly consistently.

The relationship of risk attitudes to farm productivity and income therefore becomes a topic of great interest. Every time a farmer commits a resource, he essentially gambles it for an uncertain return. It is not an overstatement to say that most farming decisions entail risks--from the choice of crop, time of planting, technology to adopt, levels of inputs to apply, to even the time to harvest and where or to whom to sell the produce. Farmers' resources, experience,

overall psychology, and the palatability of alternatives all influence the decision-making dynamics, making the process far from simple. However, as generally acknowledged, the greatest returns come with the greatest risks (Patrick 1984).

From the above discussion, it follows that the more progressive farmer will likely risk more to gain more (given that higher risks are typically associated with higher returns), while the conservative many will most of the time avoid risk. Previous studies have pointed to the risk averse nature of most farmers and individuals (Dillon and Scandizzo 1978; Thomas 1987; Moscardi and de Janvry 1977; Harrison, Lau and Rutstrom 2007; Lence 2000). However, prudence dictates that generalisations do not always apply especially when dealing with dynamic influences on people and intangibles like peoples' experiences, cultures and backgrounds.

Understanding smallholder farming and farm productivity as a function of farmers' attitudes to risk is a complex task and an inexact science at best. As such, more studies covering subjects of diverse backgrounds need to be done to give a clearer validation of results. This study contributes to the body of knowledge by attempting to characterize the farming and risk attitude profiles of smallholder high-value crop farmers in selected areas in the southern Philippines. Alternative ways of characterizing risk attitudes were explored providing systematic observations on smallholder farmers' preference or aversion to risks and how these possibly affect on-farm production decisions. The correlation between socioeconomic variables and farmers' risk attitudes was also examined.

2.0 Review of Related Literature

Farmers' attitudes to risk have long been studied for their relevance to decision making. The willingness of producers to engage in potentially rewarding, but risky endeavors sets a limit to the level of success that a farming operation can achieve. Researchers, particularly agricultural economists, have risen to the challenge in extending their analysis beyond deterministic production economics when confronted with production risks and risk attitudes (Hardaker, Huirne and Anderson 1997; Binswanger 1981; Collender 1989).

Farmers' attitudes to risk can be represented by the shape of individual utility functions. Indifference to risk or neutrality is reflected by a linear utility function while aversion to risk is represented by decreasing marginal utility as the level of payoff is increased. Risk preference is indicated by the convex utility curve (Figure 1).

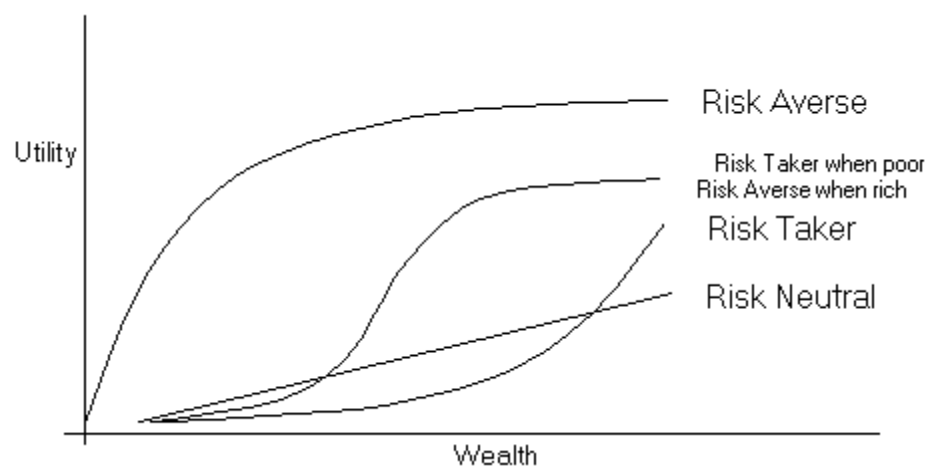


Figure 1 Utility curves of different risk attitudes with respect to wealth

Though some studies showed risk-preferring farmers (Kim 2008) most have emphasized the seeming inclination of agricultural producers, particularly marginal and smallholder farmers, to be risk averse (Binswanger 1981; Dillon and Scandizzo 1976; Thomas 1987; Holt and Laury 2002; Toledo and Engler 2008). Proper profiling of specific farmer groups needs to be made if research and development initiatives are to be better grounded.

This rationale has led to a number of approaches focused on measuring levels of risk aversion among farmers, and determining the factors behind such attitudes. Dillon *et al.* (1976) categorized such approaches under the following headings: (a) economic anthropology; (b) econometrics; (c) risk programming; and (d) expected utility and safety first theory. Young (1979), Lins *et al.* (1981), Robison *et al.* 1984 and Gomez-Limon *et al.* (2003) redefined the categories as (a) direct estimation of utility function; (b) experimental methods; and (c) observed economic behavior. Direct utility function estimation and experimental methods seem to be variants of each other as both make use of personal elicitation techniques such as surveys and games. Observed economic behavior, on the other hand, covers Dillon's econometric and mathematical programming classifications. The following selective review of literature is but a small representation of the amount of work already done on the subject matter. It is restricted to that which is directly relevant to the current study.

Economic anthropology has been useful in exploring human risk behavior using tools of both economics and anthropology. Many of the models in both economics and anthropology have a basis in some form of utility maximization. Individuals are considered to generally pursue the

satisfaction of their needs and wants, but how such pursuits are rationalized and actualized differ from one person to the next. March (1988) for instance observed that risk preferences affecting life decisions not only depend on values of possible outcomes or rewards, but also on levels of individual aspirations. Such is easily translated in agriculture when farmers are faced with production risks and relative rewards. Newbery (1977) further highlighted the subjective and anthropologic nature of decision-making by acknowledging the risk-sharing value of sharecropping in agriculture. Farmers in this instance preferred the security of a partnership arrangement even though it may have meant sharing profit with others and earning less.

Other researchers have aptly qualified risk attitudes and related decision-making as a function of individualized utility-seeking profiles and community patterns (Barlett 1980; Newbery 1977; Chibnik 1978; March 1988).

Econometric and mathematical programming approaches are based on observed economic behavior of farmers. Bardsley and Harris (1987) estimated farmers' risk aversion coefficients by using combined time-series and cross-sectional data from Australian broadacre agriculture. Lence (2000) used a generalized expected utility model fitted to farm data in the United States to estimate farm operators' time preferences and risk attitudes. Moscardi and de Janvry (1977) used a combination of approaches as they explained attitudes toward risk using socio-economic and structural variables that characterized peasant households in Mexico. Risk attitude assessments through mathematical programming were mostly based on cropping pattern selection (Gomez-Limon *et al.* 2003; Brink and McCarl 1978; Wiens 1976).

The expected utility and safety first theory are the basis of many studies. Determining the certainty equivalence (CE) of risky prospects had figured in many risk attitude studies. Certainty equivalence is the amount of money that is equivalent to the risky undertaking. It may be lower or higher than the expected monetary value (EMV) depending to whether the person is risk averse or risk preferring. The amount of money one is willing to pay to avoid the risk is called the risk premium. Figure 2 shows a graphical view of a risk averse farmer's CE, EMV and risk premium.

The studies by Dillon and Scandizzo (1976), Binswanger (1980), Pennings and Garcia (2001) and Fausti and Gillespi (2000), among others, were rooted in the expected utility framework.

Through farmer interviews, Dillon and Scandizzo (1976) used hypothetical choices between risky and sure farm alternatives to determine certainty equivalents and assess the risk attitudes of farmers in Northeast Brazil. They computed three sets of risk attitude coefficients (α, β, λ) using the mean-standard deviation function $U(x) = E + \alpha V^{1/2}$, mean-variance function

$U(x) = E + \beta(E^2 + V)$ and exponential utility function $U(x) = \int_{-\infty}^{\infty} (1 - e^{-\lambda x})(1 - e^{-\lambda})^{-1} f(x) dx$. By

comparing the risk attitude coefficients of different tenure groups, they concluded that both land owners and sharecroppers were more risk averse when subsistence is at risk than when it is not. In an expected utility context, they also deduced that peasant risk attitude coefficients were diverse, with most, but not all, being risk averse.

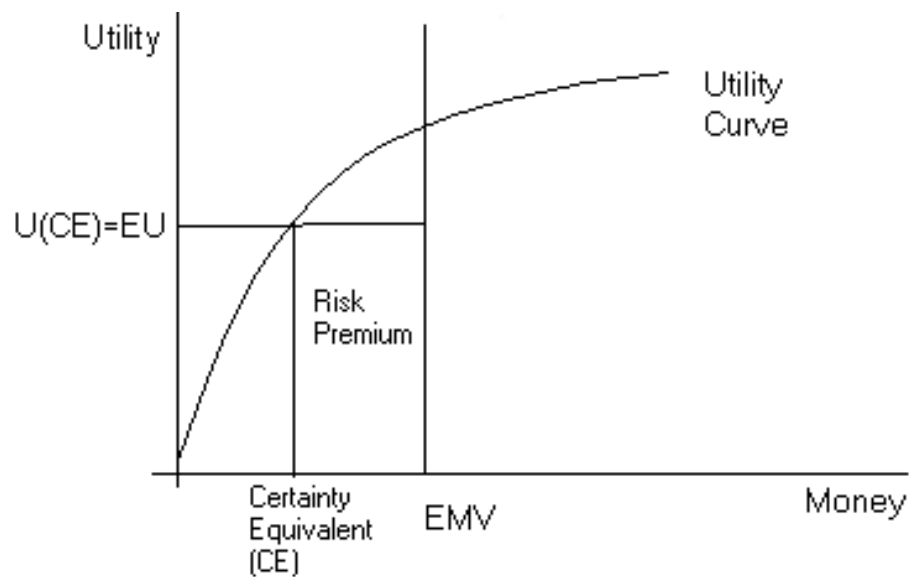


Figure 2 Graphical representation of certainty equivalent, expected monetary value and risk premium.

Binswanger (1980) acknowledged the weaknesses of simple farmer interviews in eliciting certainty equivalents and used a combination of interview and experimental gambling approaches to measure risk attitudes in rural India. Playing with real money payoffs, 330 farmers were asked to reveal their risk preferences by choosing among eight options with different expected returns and standard deviations. They found that when payoffs are small, around 50% of farmers were intermediate to moderately risk averse. The figure increased to 80% with higher payoff. The percentage of extremely risk averse farmers never exceeded 2.5%. The constant partial risk aversion function of the form $U(x) = (1 - \lambda)M^{(1-\lambda)}$, where λ is the partial risk aversion coefficient and M is the certain income, was used to estimate numerical risk aversion measures by solving the equation for indifference between two alternatives.

Pennings and Garcia (2001) and Fausti and Gillespi (2000) exhibited a more advanced set of risk attitude elicitation techniques by using expected utility and multi-item scale frameworks while

touching on previous methodologies. Fausti and Gillespi designed a set of hypothetical investments, much similar to the game experiments employed by Binswanger (1980). In this case, the exponential constant absolute risk aversion (CARA) utility function of the form $U(x) = -e^{-\lambda x}$ where λ is the absolute risk aversion coefficient and x is the certain income, was used to set the intervals of risk aversion coefficients. Details of this approach are further discussed in the methods section. Conclusions from the studies confirmed that farmers' risk attitudes influence their adoption of risk-management practices and that inconsistency and differences in results abound with the use of different elicitation techniques.

In most of the literature the algebraic representation of utility functions was either based on wealth, income or gains and losses. Heinemann (2007) showed how wealth estimates for utility functions affect the estimation of risk attitude parameters. Arrow (1965) and Pratt (1964) previously defined a now-accepted measure of the degree of risk aversion through the coefficient of absolute risk aversion. The absolute risk aversion coefficient, $\lambda_a(x)$, was defined as the negative ratio of the second and first derivative of the utility of payoff $\lambda_a(x) = -U''(x)/U'(x)$; where x is the payoff in terms of wealth or income; and $U''(x)$ and $U'(x)$ are the 1st and 2nd derivatives of the function, respectively. Detailed elaboration of utility as a function of risk attitude and value can be read in the works of Hardaker, Huirne and Anderson (1997) and Anderson, Dillon and Hardaker (1977). The other functional forms commonly used in specifying algebraic expressions include the quadratic and CARA functions (see above); decreasing absolute risk aversion (DARA) $U(x) = x^\lambda, 0 < \lambda < 1$; Logarithmic $U(x) = \ln(X)$; and constant relative risk aversion (CRRA) $U(x) = [1/(1-\lambda)]x^{1-\lambda}$; where x is the payoff in terms of

wealth or income and λ is the measure of risk aversion. More discussions on these including the functional forms adopted in different sections of the study are presented in the methods section.

Safety-first principles focus on minimizing the chances of possible unfavorable outcomes (Hardaker *et al.* 2004). This set of rules was first raised by Roy (1952) and further developed by his contemporaries (Pyle and Turnovsky 1970; Telser 1956; Kataoka 1963). With the safety first portfolio theory the decision-maker is assumed to minimize the probability of ruin or disaster. The unfavorable outcome in this case may mean one's resources falling below subsistence levels or a certain level of significant loss (Roy 1952; Pyle and Turnovsky 1970). Though utilising a different framework from the expected utility theory and sometimes having mean-negative deviation as the approach, the safety-first criteria may also be used in the maximization of expressions involving mean and standard deviations (Pyle and Turnovsky 1970; k Parton, personal communication, 2010).

Each of the abovementioned techniques has its respective inherent advantages. Proponents of econometric tools in measuring risk attitudes have highlighted the use of realistic data sets and observed economic behavior (Bardsley and Harris 1987; Antle 1987; Chavas and Holt 1996). Utility-based estimation presents a convenient and snapshot method of eliciting risk attitude coefficients. With safety-first principles, the general rule is satisficing often using heuristics or experience-based techniques (Roy 1952; Simon 1955; Nawrocki 1999; K Parton, personal communication, 2010).

For purposes of this research the utility-based estimation methods presented by Dillon and Scandizzo (1976), Pennings and Garcia (2001) and Fausti and Gillespi (2000) were adopted. Running the risk aversion parameters from this elicitation method made the most sense when the risk-efficient expected value-variance frontier was generated for reference.

3.0 The Southern Philippines Study Site

Though the potential of the southern Philippines as a high-value crop producer is sizeable, it is not traditionally a major contributor to the total vegetable (considered high-value) supply in the country. This distinction belongs to the main island of Luzon or the northern Philippines which supplies more than three-quarters of the country's major vegetable produce. For instance, the Ilocos region and Central Luzon, both from the northern Philippines, combined to produce 99% of the domestic and export requirements for onion. The former alone supplied 69% of total domestic garlic production. The whole of Luzon also accounted for 74% of Tomato, 70% of eggplant and 82% of Cabbage production (BAS 2010). These figures paint the southern Philippines as a minor contributor to the country's aggregate vegetable production.

It is ironic that the northern Philippines, especially the main island of Luzon, has been the location of typhoons and seasonal climatic disasters. In contrast and notwithstanding the current climate change scenario, Mindanao island, which constitutes a major part of the southern Philippines, is mostly typhoon free and generally exhibits a well distributed rainfall throughout the year. The Philippine Atmospheric, Geophysical and Astronomical Services

Administration (PAGASA) classifies the region's climate as type III and IV, which means it has evenly distributed rainfall with some areas exhibiting a short 1-3 month dry season (PAGASA 2010). These, coupled with Mindanao's vast plains and fertile valleys make the southern Philippines an ideal location for vegetable production.

Within the southern Philippines, the Northern Mindanao region, specifically Bukidnon, where the study was conducted, proved to be one of the best performers in agricultural production activities in recent years (BAS 2010). Bukidnon has a typical agriculture-based economy and holds the title of being a leading producer of the country's staple rice and corn. It has extensive areas devoted to plantation crops like sugarcane, Cavendish banana, pineapple, and coffee. A more recent venture for many Bukidnon farmers is vegetable production. The province now leads the region and most of the southern Philippines in the production of Broccoli, Cabbage, Carrot, Cauliflower, Beans, Chinese Cabbage, Tomato, White Potato and Squash.

Survey data were based on two samples from the village of Songco, Lantapan, Bukidnon. A total of 164 smallholder vegetable growers from the seven sitios or sub-villages of Songco were interviewed. (Five of the 169 originally approached gave incomplete interviews). Each respondent represented a farming household as only the respective heads of family were interviewed.

The data collected were divided into two sets. The first data set represented a complete enumeration of 62 vegetable growers in Mapawa, a remote pure vegetable-growing sub-village

within Songco, accessible only through rough road and mountain path. The second data set was a sample consisting of 102 smallholder vegetable farmers from the rest of the village.

4.0 Methodology on Risk Attitude Elicitation

Farmers' attitudes to risk were assessed through four sets of questions. The sets of questions were designed in progression, from simple self-ranking of risk attitude to presenting choices between hypothetical, but realistic farm alternatives involving risky versus sure outcomes.

4.1 Self-Rank Method

This is the simplest among the employed methods. Farmer respondents were asked to choose among three statements which best describe their attitude to risk. Farmers were asked whether they tend to take on substantial levels of risk, tend to avoid risk, or neither seek nor avoid risk when making on-farm decisions (Table 1). The choice of answer simply classifies them as risk preferring, risk averse, or risk neutral.

Table 1. Statements representing risk attitudes

- a. I tend to take on more risk in order to increase my returns when making on-farm decisions
 - b. I tend to avoid risk when possible when making on-farm decisions even though this may result to lower returns
 - c. I neither seek nor avoid risk when making on-farm decisions
-

4.2 Risk Attitude Scales

Farmers were asked to indicate on a Likert scale from -4 ("I strongly disagree") to 4 ("I strongly agree") the extent to which they agreed with statements describing their preference or aversion to risk (see Table 2). A total of seven statements translated in the local vernacular and read verbatim to respondents were used to gauge risk aversion attitudes. Some of the statements, such as b, c, and d in Table 2, were formulated in reverse so that answers will have the effect of validating each other. The answers were then translated for consistency during data processing.

Farmers with negative sum scores were considered risk seeking and those with positive sum scores were considered risk-averse. Farmers with a sum score of zero were classified as risk neutral. As an example, a mildly risk averse farmer might have scores of 1,-1,0,-1,2,1, and 2 (with b,c and d reversed) with an overall score of 4.

The series of statements were consistent with the study by Pennings and Garcia (2001) where farmers' risk preferences were measured using the same construct. The statements were pre-tested with farmers and local agricultural technicians to ensure applicability and relevance to the local situation.

Table 2. Statements representing farmers' risk attitude

| | |
|---|---|
| a. When growing vegetable crops, I prefer to know with certainty the financial returns | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |
| b. In crop production, I am willing to take higher financial risks in order to realize higher average returns. | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |
| c. I like taking financial risks in crop production. | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |
| d. When selling my produce, I am willing to take higher financial risks in order to realize higher average returns. | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |
| e. I like "playing it safe" when growing vegetable crops and selling produce. | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |
| f. In making on-farm decisions, I (am risk averse) don't like taking risks. | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |
| g. In making on-farm decisions, I prefer certainty to uncertainty in terms of decision outcomes. | <div><div></div><div>Strongly Disagree -4 -3 -2 -1 0 1 2 3 4 Strongly agree</div></div> |

4.3 Hypothetical Investments and States of Nature

This method was adopted from Fausti and Gillespie (2000). Respondents were asked to assume a certain level of resource availability for investment in a season's crop. They were then asked to choose from five hypothetical crop choices characterised by varying degrees of return. Each of the cropping options was presented with three potential states of nature—lowest possible return, average return and highest possible return with each state having equal probabilities of occurrence.

With the assumption that they have P100,000 to invest in five possible vegetable production options, farmers were asked to choose from a crop with constant return to crops with varying degrees of possible low and high returns. Consistent with Fausti and Gillespie (2000), the first crop presented a constant net return of 10,000; the subsequent crop options had respective low, average and high net returns of: [8170, 10600, 13030]; [6420, 11200, 15980]; [5420, 11200, 16980]; and [3440, 10600, 17760] (Table 3).

Each of the five investment options was developed based on defined intervals of risk premium percentage and absolute risk aversion coefficient. Selection of any of the options will classify the farmer's risk attitude based on the constant absolute risk aversion (CARA) intervals.

As shown by Fausti and Gillespie (2000) the exponential CARA utility function of the form $U(x) = -e^{-\lambda x}$ can be used to come up with the different investment options. Given two intervals for the coefficient of absolute risk aversion, $[\lambda_1, \lambda_2]$ and $[\lambda_2, \lambda_3]$, and a lottery X_1 with elements $\{a, b, c\}$, a lottery X_2 with elements $\{d, e, f\}$ may be determined that would make the individual with CARA of λ_2 indifferent between lotteries X_1 and X_2 using the equation below:

$$-e^{-\lambda_2 a} - e^{-\lambda_2 b} - e^{-\lambda_2 c} = -e^{-\lambda_2 d} - e^{-\lambda_2 e} - e^{-\lambda_2 f}$$

Satisfaction of this equation indicates that the certainty equivalents of both investments are equal. This is based on the solution of the relationship that the utility of a risky prospect is equal to the utility of its certainty equivalent. Thus a farmer who selects crop #3 has an estimated

CARA of between 0 and 0.000109. This relatively low positive risk aversion coefficient indicates that he is mildly risk averse. In a similar manner, a farmer who selects option crop #1 with an estimated coefficient of more than 0.000317 professes his high aversion to risk. Table 3 presents the hypothetical options with their respective intervals of coefficient of absolute risk aversion.

Table 3. Cropping options with hypothetical states of nature

| | Lowest possible return | Average return | Highest possible return | Interval, Coefficient of Absolute Risk Aversion | Interval, Risk Premium |
|-------------|------------------------|----------------|-------------------------|---|------------------------|
| Probability | .33 | .33 | .33 | | |
| Crop #1 | 10,000 | 10,000 | 10,000 | [0.000317, +.] | [66.7, +.] |
| Crop #2 | 8,170 | 10,600 | 13,030 | [0.000109, 0.000317] | [33.3, 66.7] |
| Crop #3 | 6,420 | 11,200 | 15,980 | [0, 0.000109] | [0, 33.3] |
| Crop #4 | 5,420 | 11,200 | 16,980 | [-0.000109, 0] | [-33.3, 0] |
| Crop #5 | 3,440 | 10,600 | 17,760 | [-, -0.000109] | [-, -33.3] |

Note: adopted from Fausti and Gillespie (2000)

4.4 Subsistence Assured vs Subsistence at Risk

The method described in this segment is consistent with that employed by Dillon and Scandizzo (1978) in their study of risk attitudes of subsistence farmers in Northeast Brazil.

The farmers' risk attitudes were assessed based on their responses to two sets of realistic, but hypothetical questions involving sure and risky farm prospects. The first set of questions

involved returns above household subsistence requirements, while the second set presented varied returns with the possibility of not producing enough to meet subsistence needs.

Both subsistence-assured and subsistence-at-risk prospects involved only two possible outcomes with specific probabilities. The line of questioning was setup to allow for the computation of certainty equivalents of risky prospects with the assumed probabilities. To determine the certainty equivalent of the risky prospect, the payoff of the chosen outcome was progressively changed until the respondent showed indifference between the risky and sure options. At the point of indifference, the value of the sure prospect was the certainty equivalent of the risky prospect.

The actual progression of questions followed the same pattern for both subsistence assured and subsistence at risk scenarios (see Table 3.4). With subsistence assured, the farmers were asked which option they preferred—(A) farm income which meets all subsistence requirements plus a net cash return of P50,000 every year; or (B) farm income which in 3 years out of 4 (prob 0.75) gave them a net return of P80,000 with no income in the 4th year. If A was preferred over B, the cash return in A was reduced by decrements of P5,000 until indifference or a switch to B was established. If B was preferred over A, the cash return in A was increased by increments of P5,000 until indifference or a switch to A was established.

With subsistence at risk, respondents were asked which they preferred—(A) farm income which just met the household subsistence requirements; or, (B) farm income which only met

subsistence requirements and gives surplus income of P10,000 in 3 years out of 4 (prob. 0.75) but in the 4th year just met half of the households' subsistence requirements. If A was chosen over B, cash return in B was increased by increments of P5,000 until indifference or a switch to B is established. If B was chosen over A, the cash return in A was increased by increments of P5,000 until indifference or a switch to A was established. Table 4 presents the method in obtaining certainty equivalents.

Table 4. Progressive questions asked to obtain certainty equivalents

Question set 1: Subsistence assured:

| | | |
|---|---|---|
| <input type="checkbox"/> a) net of 50T every year | If (a), decrease 50T by 5T until switch or indifference | If (b), increase 50T by 5T until switch or indifference |
| <input type="checkbox"/> b) net of 80T every 3 years out of 4 (probability =0.75) | | |
| | <input type="checkbox"/> 45T | <input type="checkbox"/> 55T |
| | <input type="checkbox"/> 40T | <input type="checkbox"/> 60T |
| | <input type="checkbox"/> 35T | <input type="checkbox"/> 65T |
| | <input type="checkbox"/> 30T | <input type="checkbox"/> 70T |
| | <input type="checkbox"/> 25T | <input type="checkbox"/> 75T |
| | <input type="checkbox"/> 20T | <input type="checkbox"/> 80T |
| | <input type="checkbox"/> 15T | <input type="checkbox"/> 85T |
| | <input type="checkbox"/> 10T | <input type="checkbox"/> 90T |
| | <input type="checkbox"/> 5T | <input type="checkbox"/> 95T |

Question set 2: Subsistence at risk:

| | | |
|--|---|--|
| <input type="checkbox"/> a) farm income meets subsistence requirement every year | If (a), increase 10T by 5T until switch or indifference | If (b), increase cash return in (a) by 5T until switch or indifference |
| <input type="checkbox"/> b) farm income meets subsistence requirement every 3 years out of 4 (probability =0.75); gives a net of 10T; but earns only half of subsistence requirement in 1 year | | |
| | <input type="checkbox"/> 15T | <input type="checkbox"/> 5T |
| | <input type="checkbox"/> 20T | <input type="checkbox"/> 10T |
| | <input type="checkbox"/> 25T | <input type="checkbox"/> 15T |
| | <input type="checkbox"/> 30T | <input type="checkbox"/> 20T |
| | <input type="checkbox"/> 35T | <input type="checkbox"/> 25T |
| | <input type="checkbox"/> 40T | <input type="checkbox"/> 30T |
| | <input type="checkbox"/> 45T | <input type="checkbox"/> 35T |
| | <input type="checkbox"/> 50T | <input type="checkbox"/> 40T |
| | <input type="checkbox"/> 55T | <input type="checkbox"/> 45T |

Eliciting the certainty equivalent of the risky proposition was key in estimating the risk aversion coefficient. Estimation of the risk attitude coefficient was based on the solution of the relationship that the utility of a risky prospect is equal to the utility of its certainty equivalent. The mean-variance utility function of the form $U(x) = E + \beta(E^2 + V)$ and the exponential utility function of the form $U(x) = 1 - e^{-\lambda x}$ were considered in computing for risk attitude coefficients (β, λ) with mean E, variance V and certainty equivalent x.

5.0 Results of Risk Attitude Elicitation

As Bobcock *et al.* (page 1, 1993) mentioned, "The assumed, elicited, or estimated values of ARA for risk-averse agents in empirical studies differ widely. Love and Buccola (1991) estimated a maximum value of 0.538 while Collender and Zilberman (1985) used a minimum value of 0.000000921". For the subsistence-at-risk and subsistence-assured elicitation techniques, the range of absolute risk aversion was set at a minimum value of 2.74E-06. The limit was set though the use of mathematical programming models configured to run a representative farm in the southern Philippines. This is the point where the optimal farm plans in a quadratic risk programming model equated the optimal farm plans in the linear programming, risk neutral runs. The range seems consistent with the values generated by Collender and Zilberman (1985). As such, for the elicitation methods which yielded risk aversion coefficients, these figures were used in defining the limits of risk neutrality ($0 \pm 2.74E-06$). The coefficients above

the range refer to risk aversion, while those below signify risk-seeking behaviour.

5.1 Risk Attitude Classification

Farmers' aversion to risk as classified by the five risk attitude elicitation methods yielded varied results (Table 5). Using certainty equivalence from the subsistence assured and subsistence-at-risk questioning showed that 42 to 66% of farmers were risk averse. The likert scale classification pointed to greater risk aversion, with more than 90% shown as risk averse. However, the self-ranking and hypothetical investments methods resulted in a majority of farmers being classified as either risk neutral or risk seeking.

With subsistence assured, 42% in Songco were shown to be risk averse, while 26% and 32% were respectively grouped as risk neutral and risk preferring. More than half (53%) in Mapawa were risk averse while 23% and 24% were risk neutral and risk preferring respectively.

With subsistence at risk, the percentage of farmers classified as risk averse increased to 55% for the whole of Songco and 66% for Mapawa. Overall, one-third of the farmers still showed a risk preferring attitude while one-fourth exhibited neutrality.

With the likert scale method, Songco and Mapawa respectively showed risk aversion rates of 92% to 95%. A minimal number fell into the risk neutral and risk preferring classifications.

Table 5. Farmers' risk attitudes as classified using different elicitation methods

| SONGCO | | | MAPAWA | |
|--|-----------|---------|-----------|---------|
| Subsistence assured: averse-neutral-preferring | | | | |
| | Frequency | Percent | Frequency | Percent |
| risk averse | 69 | 42.1 | 33 | 53.2 |
| risk neutral | 42 | 25.6 | 14 | 22.6 |
| risk preferring | 53 | 32.3 | 15 | 24.2 |
| Total | 164 | 100 | 62 | 100 |
| Subsistence at risk: averse-neutral-preferring | | | | |
| | Frequency | Percent | Frequency | Percent |
| risk averse | 90 | 54.9 | 41 | 66.1 |
| risk neutral | 18 | 11 | 3 | 4.8 |
| risk preferring | 56 | 34.1 | 18 | 29 |
| Total | 164 | 100 | 62 | 100 |
| Classification RA likert scale | | | | |
| | Frequency | Percent | Frequency | Percent |
| risk averse | 150 | 91.5 | 59 | 95.2 |
| risk neutral | 7 | 4.3 | 2 | 3.2 |
| risk seeking | 7 | 4.3 | 1 | 1.6 |
| Total | 164 | 100 | 62 | 100 |
| RA1self rank | | | | |
| | Frequency | Percent | Frequency | Percent |
| risk averse | 19 | 11.6 | 4 | 6.5 |
| risk neutral | 64 | 39 | 34 | 54.8 |
| risk seeking | 77 | 47 | 23 | 37.1 |
| Total | 160 | 97.6 | 61 | 98.4 |
| System | 4 | 2.4 | 1 | 1.6 |
| | 164 | 100 | 62 | 100 |
| Classification RA hypothetical investment | | | | |
| | Frequency | Percent | Frequency | Percent |
| risk averse | 56 | 34.1 | 28 | 45.2 |
| risk neutral | 54 | 32.9 | 14 | 22.6 |
| risk seeking | 51 | 31.1 | 20 | 32.3 |
| Total | 161 | 98.2 | 62 | 100 |
| System | 3 | 1.8 | | |
| | 164 | 100 | | |

The self-ranking method, the simplest technique among the different elicitation methods, showed classifications heavily yielding risk neutral and risk seeking behaviours. Only 12% professed aversion to risk in Songco, while the number is even smaller in Mapawa at 7%.

The hypothetical investment method yielded a more evenly dispersed set of figures. For Songco, 34%, 33% and 31% respondents were respectively classified as risk averse, risk neutral and risk preferring. More risk averse farmers were recorded in Mapawa at 45%.

The diverse results are consistent with the literature. Babcock et al. (1993) and even Fausti and Gillespie (2000) had reported very little consistency across different risk attitude elicitation procedures. This only highlights the need for more refined and consistent standards in estimating risk aversion parameters

5.2 Risk Attitude Coefficient Estimates

Among the five risk attitude elicitation methods, only the subsistence assured and subsistence at risk methods using certainty equivalence, and the hypothetical investment technique yielded absolute risk aversion coefficients.

Table 3.6 presents a summary of computed risk attitude coefficients for the survey population. Compared with previous literature (i.e. Babcock *et al.* 1993), the estimates obtained are low in value, and suggest that the sample are close to risk neutral. The hypothetical investment

method yielded a maximum figure of 0.000317, a minimum of -0.000545 and a mean of 0.00005699 for Songco implying risk aversion on the average. Mapawa showed slightly higher risk aversion with mean at 0.0000714. Figure 3 shows the cumulative distribution function of coefficient estimates using the hypothetical investment method.

More subtle numbers came out from the subsistence-assured and subsistence-at-risk methods. For the whole of Songco, the former gave a maximum coefficient of 0.000020 and a minimum of -0.0000074; while the latter showed similar maximum and minimum numbers at 0.000028 and -0.0000082 respectively. Mean values showed a slight transition from being risk preferring with subsistence assured to risk averse with subsistence at risk. But the closeness of the means to zero also imply risk neutrality in general. Computed coefficients for Mapawa were similarly small, but both means for subsistence assured and subsistence at risk can be classified as slightly risk preferring to neutral at $-7.028\text{E-}7$ and $-1.3796\text{E-}6$, respectively. Figures 3 and 4 show the cumulative distribution functions of the estimated coefficients for the two methods.

Table 6. Summary table of risk attitude coefficient estimates⁵

| | Songco | | | Mapawa | | |
|------|-------------------------|---------------------|---------------------|-------------------------|---------------------|---------------------|
| | Hypothetical Investment | Subsistence Assured | Subsistence at risk | Hypothetical Investment | Subsistence assured | Subsistence at risk |
| Max | 0.000317 | 0.00002002 | 0.00002822 | 0.000317 | 0.000005961 | 0.00000639 |
| Min | -0.000545 | -0.00000741 | -0.00000816 | -0.000545 | -0.000006385 | -0.00000679 |
| Mean | 5.69938E-5 | -2.439E-12 | 6.10E-13 | 7.14032E-5 | -7.028E-7 | -1.3796E-6 |

⁵ Note: Units are the same as the Constant Absolute Risk Aversion (CARA) parameters presented by Babcock *et al.* (1993).

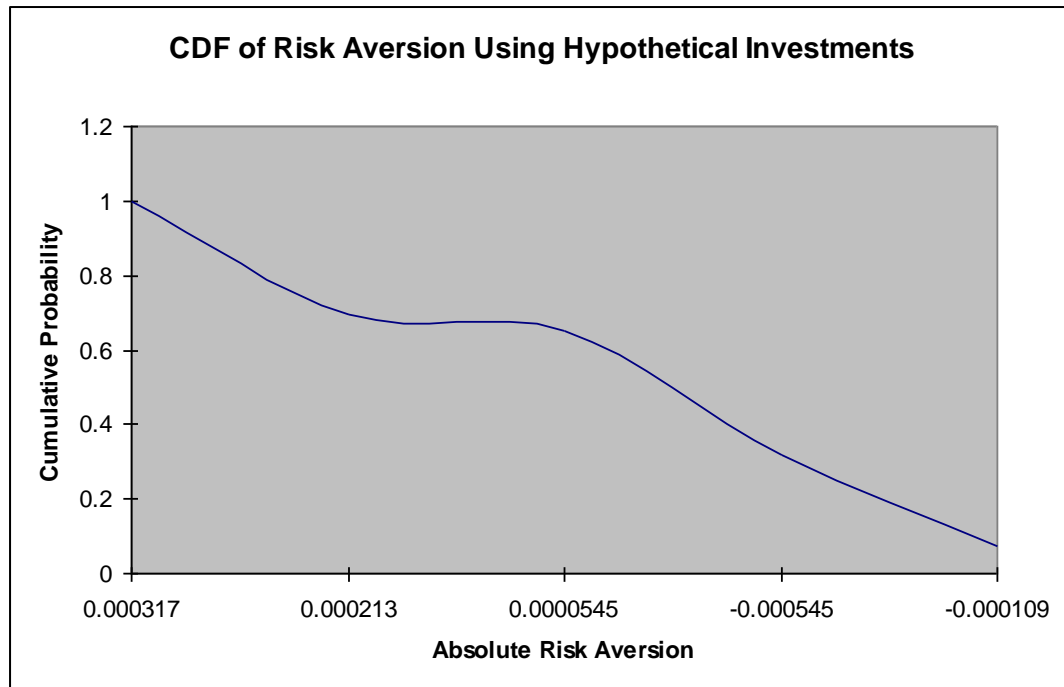


Figure 3 CDF of ARA coefficients using hypothetical investments

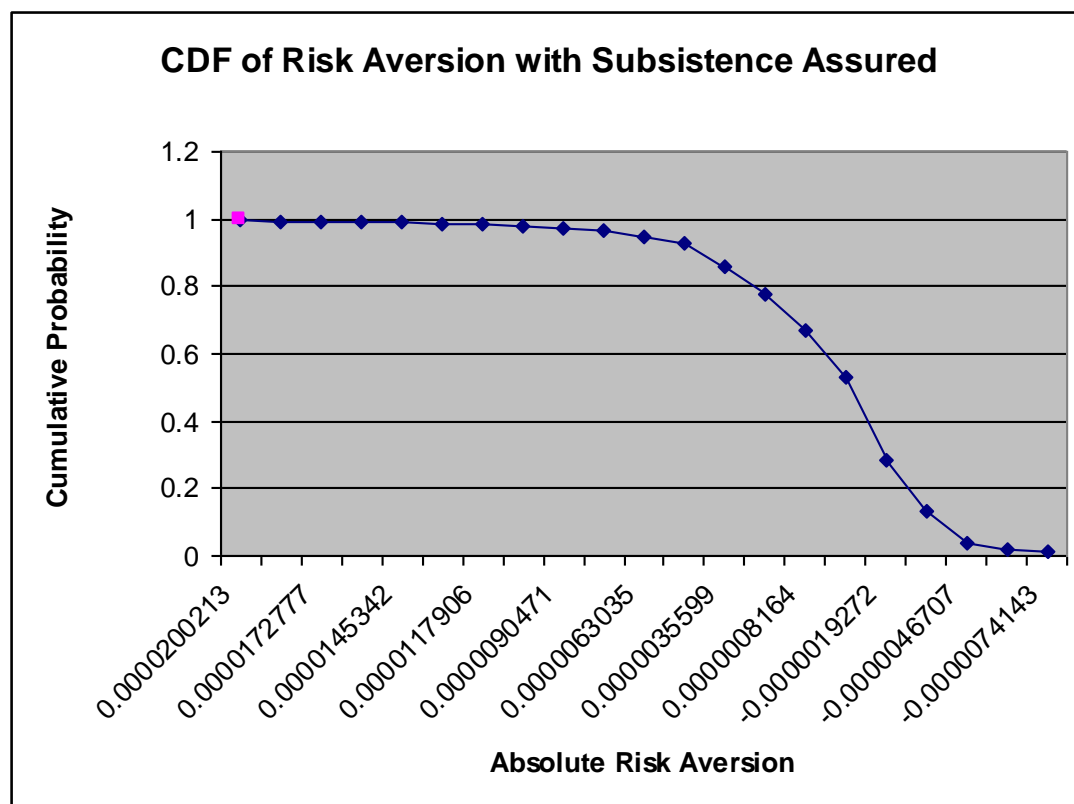


Figure 4 CDF of ARA coefficients with subsistence assured

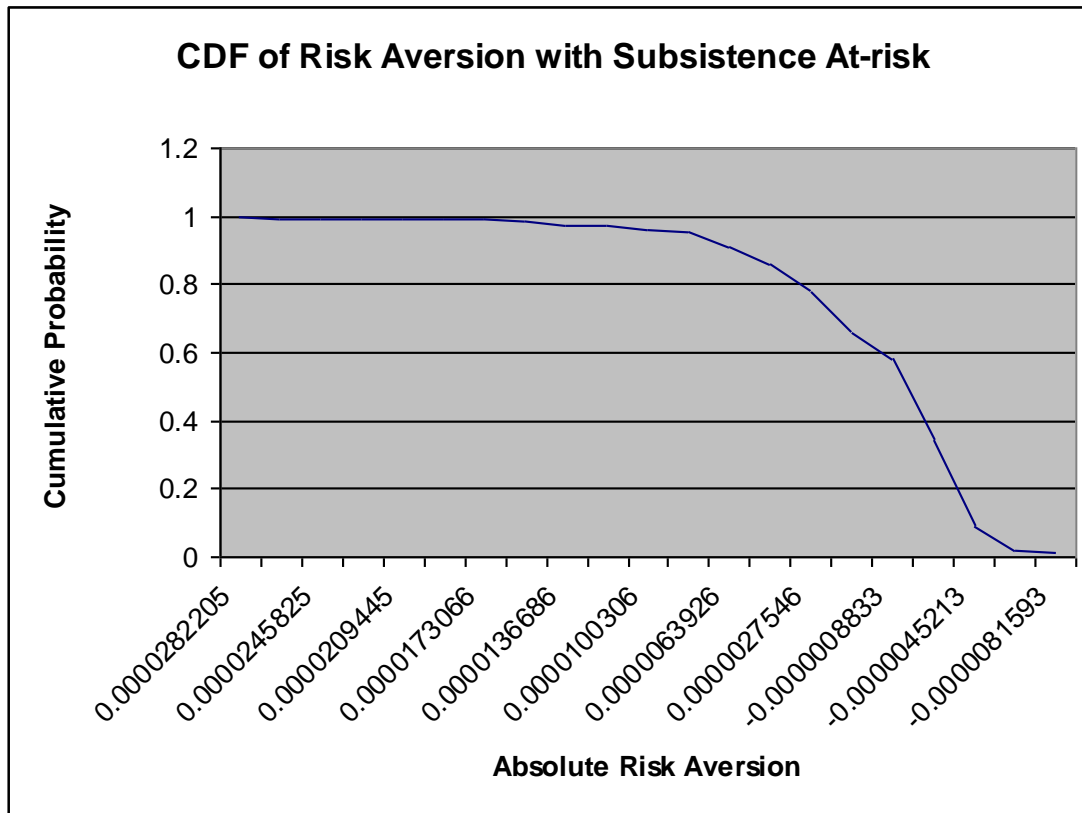


Figure 5. CDF of ARA coefficients with subsistence at risk

5.3 Consistency of Elicitation Methods

The previous table showed that different elicitation methods yielded different risk attitude classifications. A more telling tabulation is one that shows the consistency of classification (either risk averse, risk neutral or risk preferring) by individual across the different methods employed. Table 7 presents the Spearman rank correlation coefficients for each of the five elicitation methods. Results showed that the hypothetical investment method was rank-order correlated to subsistence assured, subsistence at-risk, and self-rank elicitation methods at .01

level. Aside from this, only the subsistence assured and subsistence at-risk methods were rank-order correlated.

Table 7. Matrix of Spearman rank correlation coefficients

| Spearman's rho | | Subsistence assured | subsistence at risk | likert scale | self rank | hypothetical investment |
|-------------------------|-------------------------|---------------------|---------------------|--------------|-----------|-------------------------|
| subsistence assured | Correlation Coefficient | 1.000 | .718** | -.019 | .153 | .218** |
| | Sig. (2-tailed) | . | .000 | .812 | .053 | .005 |
| | N | 164 | 164 | 164 | 160 | 161 |
| subsistence at risk | Correlation Coefficient | .718** | 1.000 | .075 | .138 | .203** |
| | Sig. (2-tailed) | .000 | . | .342 | .083 | .010 |
| | N | 164 | 164 | 164 | 160 | 161 |
| likert scale | Correlation Coefficient | -.019 | .075 | 1.000 | -.060 | -.022 |
| | Sig. (2-tailed) | .812 | .342 | . | .454 | .782 |
| | N | 164 | 164 | 164 | 160 | 161 |
| RA1self rank | Correlation Coefficient | .153 | .138 | -.060 | 1.000 | .235** |
| | Sig. (2-tailed) | .053 | .083 | .454 | . | .003 |
| | N | 160 | 160 | 160 | 160 | 159 |
| hypothetical investment | Correlation Coefficient | .218** | .203** | -.022 | .235** | 1.000 |
| | Sig. (2-tailed) | .005 | .010 | .782 | .003 | . |
| | N | 161 | 161 | 161 | 159 | 161 |

** Correlation is significant at .01 level (2-tailed)

5.4 Symmetric Measure of Significance

Correlation analysis was used to relate risk attitudes as elicited from the different methods to the socio-economic characteristics of farmers. Age, gross income, farm size, tenure, education level, years farming and household size were correlated with farmers' preferences or aversion to risk (Table 8).

Taking all the methods together, there were very few significant correlations. Results showed that at 0.05 level of significance, risk attitude is significantly correlated with age, gross income, tenure, and farm size—that is depending on the risk attitude elicitation method employed. A good illustration of farmers' behaviour can be glimpsed from the results of subsistence-assured and subsistence-at-risk methods. When farmers were assured of their subsistence requirements, income and tenure were the only factors that registered positive correlation with risk attitude. However, when their subsistence requirement were put at risk, age, income, farm size and tenure all came into play and exhibited positive correlation with risk attitude.

Gross income also showed significant correlation with risk attitude using the self-ranking method.

The Likert scale and hypothetical investment methods both showed no significant correlation between risk attitude and the above-mentioned socioeconomic characteristics.

Table 8. Symmetric measures of significance

| | SONGCO | | | MAPAWA | | |
|--|-------------|-------|------------|-------------|-------|------------|
| Nominal by Nominal Contingency Coefficient | Valid Cases | Value | Approx Sig | Valid Cases | Value | Approx Sig |
| SUBSISTENCE ASSURED | | | | | | |
| vs Farmer's Age | 164 | 0.273 | 0.11 | 62 | 0.278 | 0.52 |
| vs Gross Income | 164 | 0.304 | 0.16 | 62 | 0.579 | 0.00* |
| vs Farm Size | 162 | 0.312 | 0.06 | 62 | 0.416 | 0.11 |
| vs Tenure | 163 | 0.236 | 0.05* | 62 | 0.198 | 0.28 |
| vs Educational level | 164 | 0.119 | 0.88 | 62 | 0.16 | 0.81 |
| vs Years Farming | 163 | 0.244 | 0.59 | 61 | 0.47 | 0.14 |
| vs Household Size | 164 | 0.148 | 0.45 | 62 | 0.197 | 0.64 |
| SUBSISTENCE AT RISK | | | | | | |
| vs Farmer's Age | 164 | 0.335 | 0.01* | 62 | 0.327 | 0.29 |
| vs Gross Income | 164 | 0.386 | 0.00* | 62 | 0.576 | 0.00* |
| vs Farm Size | 162 | 0.324 | 0.04* | 62 | 0.446 | 0.05* |
| vs Tenure | 163 | 0.248 | 0.03* | 62 | 0.15 | 0.50 |
| vs Educational level | 164 | 0.211 | 0.27 | 62 | 0.124 | 0.91 |
| vs Years Farming | 163 | 0.333 | 0.06 | 61 | 0.46 | 0.18 |
| vs Household Size | 164 | 0.144 | 0.48 | 62 | 0.168 | 0.77 |
| LIKERT SCALE | | | | | | |
| vs Farmer's Age | 164 | 0.191 | 0.62 | 62 | 0.243 | 0.69 |
| vs Gross Income | 164 | 0.198 | 0.88 | 62 | 0.311 | 0.88 |
| vs Farm Size | 162 | 0.141 | 0.97 | 62 | 0.372 | 0.27 |
| vs Tenure | 163 | 0.16 | 0.37 | 62 | 0.221 | 0.20 |
| vs Educational level | 164 | 0.195 | 0.37 | 62 | 0.159 | 0.81 |
| vs Years Farming | 163 | 0.268 | 0.40 | 61 | 0.381 | 0.59 |
| vs Household Size | 164 | 0.224 | 0.07 | 62 | 0.273 | 0.29 |
| SELF RANKING | | | | | | |
| vs Farmer's Age | 160 | 0.097 | 0.99 | 61 | 0.157 | 0.96 |
| vs Gross Income | 160 | 0.366 | 0.02* | 61 | 0.608 | 0.00* |
| vs Farm Size | 158 | 0.203 | 0.74 | 61 | 0.312 | 0.58 |
| vs Tenure | 160 | 0.154 | 0.42 | 61 | 0.13 | 0.59 |
| vs Educational level | 160 | 0.255 | 0.08 | 61 | 0.25 | 0.40 |
| vs Years Farming | 159 | 0.183 | 0.94 | 60 | 0.411 | 0.43 |
| vs Household Size | 160 | 0.079 | 0.91 | 61 | 0.213 | 0.57 |
| HYPOTHETICAL INVESTMENTS | | | | | | |
| vs Farmer's Age | 161 | 0.189 | 0.65 | 62 | 0.202 | 0.85 |
| vs Gross Income | 161 | 0.281 | 0.31 | 62 | 0.349 | 0.74 |
| vs Farm Size | 159 | 0.28 | 0.20 | 62 | 0.268 | 0.78 |
| vs Tenure | 161 | 0.172 | 0.30 | 62 | 0.052 | 0.92 |
| vs Educational level | 161 | 0.2 | 0.35 | 62 | 0.195 | 0.65 |
| vs Years Farming | 160 | 0.264 | 0.45 | 61 | 0.494 | 0.07 |
| vs Household Size | 161 | 0.139 | 0.53 | 62 | 0.231 | 0.48 |
| NOTE: * significant at .05 | | | | | | |

6.0 Conclusions

Results showed that a good number of farmers in the study site had degrees of aversion to risk.

The following discussions further elaborate on the findings.

On risk attitude classification and coefficient estimates. The levels of risk aversion as measured by the different elicitation methods were not as defined as one would conventionally think. First, the value of risk aversion coefficients obtained were relatively low, suggesting that many farmers are close to being risk-neutral. Then, except for the results of the Likert scale method which showed high numbers of risk averse individuals, the employed methods point to significant groups with risk-neutral to risk-preferring behaviour. This is especially evident with the self-ranking technique where the majority of the farmers were classified as risk-neutral to risk-preferring. The hypothetical investment technique showed an almost evenly distributed number of farmers with risk-averse, risk-neutral and risk-seeking attitudes.

The different risk attitude elicitation methods may have yielded varying degrees of risk attitude classifications among farmers, but their usefulness lie behind the intention and limitations of the research. Efforts that are constrained in time and other resources may prefer the simplicity and convenience of self-ranking and likert scale. However, the other methods are best used for researches necessitating risk aversion coefficient estimates for mathematical modelling work. Risk aversion parameter estimates showed mean figures close to zero or neutral attitude. Such is more pronounced when looking at Songco as a whole. Mapawa, on the other hand, showed mean scores that were mildly risk preferring. Farmers in this remote area may be more open to

taking risks as they do not have much to lose. Significant numbers of risk-neutral farmers may mean that development initiatives have better prospects than if farmers were highly risk averse. Also, the remoteness of the farm area implies a lot when dealing with marginal or smallholder farming. It is a practical reality check that speaks about the level of resource available to the farmers. In a way, a certain degree of desperation brought about by subsistence pressures may define their attitudes to risk and response to seasonal events.

The sensitivity of farmers to socio-economic variables can be glimpsed by comparing the subsistence assured and subsistence at risk methods. It is worth noting that risk attitude in Songco changed from slightly risk preferring to slightly risk averse when their subsistence status was changed from assured to at-risk.

On consistency of elicitation methods. Consistency among the elicitation methods employed seemed to be weak. About one-third of all classifications were unique, meaning only one among the five methods classified them as such. On the other hand, close to one-fourth of all classifications were consistent in three or more of the methods. Only one percent was consistently classified by all the elicitation methods.

Results of the Spearman rank-order correlation were more optimistic, with the hypothetical investment method exhibiting significant correlation with all the other methods except the likert scale technique.

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