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Agricultural Risk Management through Index-Based Microinsurance: Exploring the Feasibility of Demand Perspective

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Abstract

The main objective of this study is to explore, from a demand perspective, the feasibility of an index-based microinsurance scheme (IBMS) for paddy crop cultivated by small-scale (peasant) farmers in Sri Lanka to protect them against the production loss caused by natural disasters. The contingent valuation method (CV) has been used to elicit the insurance demands (i.e. willingness to pay) for the hypothetical IBMS. The results show that the interest in joining IBMS is 88% (*SD*=2.4%) overall and the strongest influence factors on farmers' willingness to join are age, total household expenditure and, awareness of crop insurance. However, willingness to pay determinant varies significantly on spatial and insurance contracts, indicating a potential for a discriminating and flexible policy in the insurance scheme. This means that insurance policies concerning crop insurance product should be designed and implemented with synergies of different approaches in microinsurance, rather than as a uniform structure.

Keywords: Contingent valuation, Index-based insurance, Microinsurance, Willingness to pay

Introduction

Microinsurance has been recognized as one risk management tool in agriculture that secures the socio-economic condition of farmers. Microinsurance is a flexible contract designed to serve people with a low-income. A growing number of studies on agricultural financial markets in developing countries provides opportunities for innovative agricultural insurance. As a matter of fact, some attempts have already been made concerning the incorporation of an index-based indemnification mechanism, which is based on reliable and independently verifiable indices, into microinsurance. This instrument is increasingly drawing attention in risk management debates(Skees and Barnett, 2006; Roth and McCord, 2008; Dercon, et.al, 2008; Patt, et.al, 2009). The incorporation of these two concepts can be called the Index-based Microinsurance Scheme (IBMS). However, IMBS has not yet been tested in the case of Sri Lanka. The main objective of this study is to assess the demand for and applicability of an index-based microinsurance for paddy crops cultivated by small-scale (peasant)[1] farmers in Sri Lanka in the context of production risk caused by natural disasters. The findings of this study will, it is hoped, be used to support the making of a more efficient and realistic pricing policy for the IBMS. The study examines farmers' willingness to join (WTJ) as well as their willingness to pay (WTP) for the hypothetical index-based crop insurance scheme. The results help to determine the relationships among different scenarios of index-based insurance contracts and characteristics of the farmers.

The study is motivated by the fact that Sri Lankan agriculture is highly vulnerable to risk and uncertainty. Sri Lanka frequently suffers from natural disasters, among which water-induced disasters such as floods, droughts and landslides are the most common and destructive types (DMC-SL, 2010). Currently, Sri Lankan farmers can insure most of their crops through the conventional crop insurance schemes conducted by the government-owned Agricultural and Agrarian Insurance Board (AAIB). Although AAIB has been

[1]. In Sri Lanka, the composition of agricultural land under small holdings is 80 percent and average farm is less than 2.5 acres. Agricultural Census -2002

operating for more than five decades, voluntary participation has drastically decreased. Its level of penetration among potential clients is currently less than 5 percent. Among the main causes for low confidence in this scheme are the lack of transparency in loss assessment and underestimation of indemnity payments (Rambukwella, et.al, 2007). Moreover, rain-fed areas are not targeted for insurance by the AAIB. However, looking at the paddy sown by irrigation types in the last ten years (2000-2010) at national level, it can be seen that rain-fed paddy sown extent is 24 percent[2]. AAIB insurance products perform as individual contracts and indemnities based on the individual's own yield. Usually this type of contract suffers from asymmetric information problems like moral hazard and adverse selection; high administrative cost is another impediment.

Moreover, government schemes are not based on actuarial principles and are deemed unsustainable. The performance of publicly supported crop insurance has been inefficient when all costs are considered (Hazell, 1992).Traditionally, insurers have been paying claims that were assessed based on individual losses, the so-called indemnity-based insurance (Mechler, Linnerooth-Bayer, and Peppiatt, 2006). Due to the high costs of the claim settlement process, resulting from indemnity-based insurance relative to the values insured in developing countries, index-based schemes have become increasingly useful for particularly smallholding farmers, with limited government involvement (Skeeset et. al.,1999). Therefore, this innovative insurance may have a huge potential for development in Sri Lanka. To this date, only one feasibility study has been conducted on this subject by a commercial insurance company under the International Labour Organization's (ILO) microinsurance facility program[3]. Its findings have not been published. We believe that this is the first study from the demand side perspective on index based agricultural microinsurance in Sri Lanka.

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[2]. http://www.statistics.gov.lk

3. http://www.ilo.org/public/english/employment/mifacility/grantees/sanasa.htm

Rice is the dominant crop in Sri Lanka, cultivated by a large number of small-scale subsistence farmers living in the rural areas. Ninety percent of poor households earn their living from the rural agricultural economy. Moreover, most farmers live below or close to the poverty line. In this context, attracting private sector investors to agricultural insurance is cumbersome. Only one private insurance company has started limited schemes in selected areas since the government opened up agricultural insurance to the private sector (Rambukwella et al., 2007).

In this context, Sri Lanka National Agricultural Policy (SLNAP) proposes to “introduce appropriate agricultural insurance schemes to protect the farmers from the risks associated with natural calamities” (SLNAP, 2006, p.6). Therefore, that agricultural insurance is a particularly important risk mitigation measure out of the many adopted in the country.

Research has been conducted in several developing countries focusing on innovative lower cost approaches to mitigate the conventional problems associated with crop insurance and affordability and sustainability of such products. The main theoretical and empirical arguments concentrate on, index-based products, microinsurance approach, community-based financial intermediaries and public policy to wards government involvement on market-based insurance and to encourage the private sector to engage in agricultural insurance (Nieuwoudt, 2000; Dercon, 2005; Leftley and Roth, 2006; Skees, et.al., 2006; Bhattamishra and Barrett, 2008).

Literature Review on Innovativ Agricultural InsuranceSchemes

Index-based insurance products: The potential for the use of index-based insurance products in agriculture is significant. Any independent gauge can be used and developed as an index for an insurance contract which is secure and must be highly correlated with agricultural losses (Skees, 2001). Various measures can be used as indices, such as meteorological *variables* (rainfall, temperature, wind speed, etc.), satellite images, area yield, etc. In developing countries, the practical feasibility of more than 25 index-based risk transfer schemes has been reported and implementation of pilot schemes have been investigated.The majority of these schemes are insurance products with payouts linked to a publicly-verifiable aggregate index. Most index-based insurance schemes address either production (yield) risk or price risk, and aim at a specific crop (Skees et al., 2008). Experience is too limited in some programs and it is too early to draw general conclusions about the long-term sustainability of these efforts due to the fact that the majority of these schemes are still in their preliminary stages. The experiences in Mexico and India suggest that, at least in some areas, these programs may be an effective risk transfer mechanism for the rural poor (Levin and Reinhard, 2006; Barnett and Mahul, 2007). However, scalability and sustainability depend on several factors. Scalability includes access or coverage participation and the operating and administering costs of products. For long term sustainability, a program should achieve several elements such as the willingness of farmers to contribute over the long term, fit with the country’s regulatory environment, and private sector participation (Smith and Watts, u.d.).

Increasing interest in implementing index-based insurance products rather than traditional agricultural insurance is well documented. Index-based products offer various advantages than other risk-coping mechanisms and traditional insurance programs, i.e. lack of moral hazard, lack of adverse selection, and low administrative costs. Moreover, index-based products feature standardized and transparent structure, re-insurance function, greater availability and negotiability (Skees et al.,2006; Roth and McCord, 2008). It can be used even as a recourse to large number of social perils including famine and other catastrophes (Skees, 2008).

The main challenge in index-based insurance is basis risk where there is the possibility of a mismatch between the index and the losses of the insured (Miranda, 1991). However, there are substantial proposals to manage this problem. Improved data and product design may be able to minimize this basis risk (Roth and McCord, 2008). The index-based product has to be developed for small geographic areas (Smith and Watts,u.d.) Conversely, spatial basis risk is less in size for client association and relative to individuals due to aggregation (Varangis, 2002; Glauber, 2004). Farmer participation in designing the product and government intervention through provision of infrastructure and services would help minimize this basis risk problem (Clarke and Dercon, 2009). Many attempts have already been made to incorporate this index-based indemnification mechanism and microinsurance concept. The following section briefly summarizes the microinsurance concept and its unique features.

Microinsurance Approach: Microinsurance, a subset of financial tools that belong to microfinance, is now widely recognized and emerging as a flexible and powerful instrument in developing countries. It has some basic risk reduction features (farmer participation indesign, small group involvement, quick response, and small geographic implementation areas) and follows excellent characteristics (See Table 1). Microinsurance specifically sets out to provide affordable and accessible insurance to low-income people who cannot gain access to traditional forms of insurance (Churchill, 2006). Among the main attributes of this product are consideration of members' willingness to pay and low-cost transactions. Microinsurance involves payment of premiums in small amounts and is often designed to accommodate the clients' irregular cash flows, in return for pre-specified payouts when specific conditions occur. Microinsurance can be implemented either on an individual or basis on groups, but typically communities are involved in the important phases of the process, such as package design and rationing of benefits. The essential role of the network of microinsurance units is to enhance risk management of the members of the entire pool of microinsurance units over and above what each can do when operating as a stand-alone entity. Microinsurance is implemented and distributed through various channels. Community-based and mutual insurance schemes now exist side by side with commercial insurers that have started to recognize the potential market among low-income clients (Churchill, 2006; Roth, et. al, 2007). In essence, microinsurance has the same purpose as traditional insurance. It draws on the same generally accepted practices as traditional insurance. For example, actuarial pricing, reinsurance, and claims handling practices follow traditional insurance. However, microinsurance products are not simply down-scaled conventional insurance products. Experience of microinsurance in low income markets has shown that there are fundamental differences (See Table 1).

Table 1: Differences between traditional insurance and microinsurance

	Traditional insurance	**Microinsurance**
Clients	• Low risk environment • Established insurance culture	• Higher risk exposure/high vulnerability • Weak insurance culture
Distribution models	• Sold by licensed intermediaries or by insurance companies directly to wealthy clients or companies that understand insurance	• Sold by non-traditional intermediaries to clients with little experience of insurance
Policies	• Complex policy documents with many exclusions	• Simple language • Few, if any, exclusions • Group policies
Premium calculation	• Good statistical data • Pricing based on individual risk (age and other characteristics)	• Little historical data • Group pricing • Often higher premium to cover ratios • Highly price- sensitive market
Premium collection	• Monthly to yearly payments, often-paid by mail-based on an invoice, or by debit orders	• Frequent and irregular payments adapted to volatile cash flows of clients • Often linked with other transactions (e.g. loan repayment)
Control of insurance risk (adverse selection, moral hazard, fraud)	• Limited eligibility • Significant documentation required • Screenings, such as medical tests, may be required	• Broad eligibility • Limited but effective controls (reduces costs) • Insurance risk included in premiums rather than controlled by exclusions • Link to other services (e.g. credit)
Claims handling	• Complicated processes • Extensive verification documentation	• Simple and fast procedures for small sums • Efficient fraud control

Source: Adapted from LLOYDS (2009).

Due to its group-based nature microinsurance can exploit informational advantages that are not available to private or public insurers that deal with individuals, thereby overcoming moral hazard and adverse selection problems. While moral hazard problems can be mitigated by peer monitoring, adverse selection problems are often addressed in a variety of ways, such as requiring a minimum pool size before insurance coverage comes into effect (Tabor, 2005). Although the microinsurance movement is relatively recent, it is becoming an increasingly popular way of addressing even disaster shocks. Agricultural microinsurance is an affordable risk management tool for smallholder farmers. In this context, index-based micro approach has been tested in many developing countries in an attempt to address conventional problems and could guarantee a higher degree of community participation as a new avenue to stabilize the income of the rural poor (Levin and Reinhard, 2006; Mechler, et.al, 2006). An example is Andhra Pradesh in India, where a microfinance institution (Bhartiya Samruddhi Investments and Consulting Services Ltd.) has collaborated with an insurer (ICICI Lombard General Insurance Company Ltd.) to provide index coverage to farmers (Gine, et. al., 2007).

Methods

Study Area, Sample and Data Collection

Ampara district, on Sri Lanka's eastern plain was selected to conduct the field survey. The selection of the study area was carried out through a multi-stage screening process based on multi hazard risk and paddy production. Ampara has considerable exposure to natural disaster risks (Zubair, et. al., 2005) and is the highest rice producing district among the paddy producing districts in Sri Lanka. Out of 29 agrarian service centers in the Ampara district, ten agrarian service center divisions[4] were selected to collect the primary data. This selection was also particularly based on disaster occurrence within the last ten years.

[4]. Agrarian Service Center is the lowest agricultural administrative unit in the country consisting usually of four to five villages

Agriculture is the most important income source of the people in the Ampara district. The sample households depend on paddy cultivation for their livelihood. The study was able to capture three different stratums based on irrigation types, which represent risk disparity. Moreover, existing AAIB insurance coverage and premiums are dependent on irrigation land class in a particular area. Approximately 75 percent of paddy cultivated lands are under the major irrigations systems. About 6 percent and 18 percent of land are under minor irrigation systems and rain-fed systems, respectively. A semi-controlled method was used to select a sample of 60 households within each of the irrigation types (stratums). In this sample, 25 percent of households were at least one time members of the AAIB insurance scheme and of the other 75 percent were non-members of any crop insurance scheme. The households were chosen through a simple random sampling technique. The AAIB member list and election registration list (excluding the names of the AAIB members) were used as the sampling frame with the total sample size being 180 farmers. We used face-to-face interview methods with a structured questionnaire schedule for data collection. Before each field session a brief education session for explaining how insurance works was conducted. Furthermore, an illustrated handout was used to educate and explain core concepts of index- based insurance with all possible indexes for a particular area and explain the benefits and implementation procedure for farmers.

Measurement of Variables and Method of Analysis

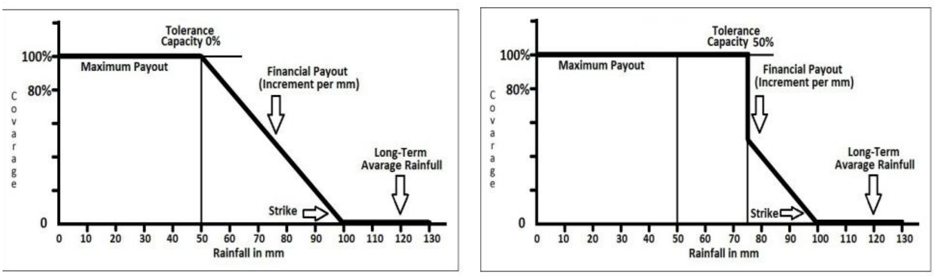
The contingent valuation method (CV) was used to elicit an individual's WTP for the hypostatical index-based insurance. However, very limited research has been done on WTP studies using CV methods for agricultural insurance. Patrick (1988) and, Vandeveer and Loehman (1994) use a single dichotomous (yes/no) choice question to study producers' demand for multiple peril crop insurance, rainfall insurance and other modifications of crop insurance. In the developing country context McCarthy (2003) as well as Sarriset et. al.'s (2006) studies have examined willingness to pay for rainfall index based on crop insurance by using single and one and a half CV questions based on Morocco and Tanzania, respectively.

We modeled a farmer's demand for IBMS as four distinct decisions, which were included for 50 percent and 25 percent tolerance levels and 100 percent and 80 percent coverage contracts. (See Box: 1, for an extract from the illustration handout which was used in the survey education session). Each contract had a lower and upper bound value; this study used initial or stating bid values as the existing AAIB premiums. The maximum premium amount and the minimum amount were used to construct the bid value range. The lower bound coincided with the existing AAIB contract premium value minus 15 percent load. The upper bound was equal to the AAIB premium value plus 15 percent load. All fractional numbers were rounded. The upper (lower) bound of the WTP thus reflects the minimum (maximum) offer price that households responded to the willingness to pay question. In this study, we used the one and a half bound dichotomous choice format by following up questions for the purpose of statistical efficiency and reliability (Saleem, et.al., 2008). Under this design farmers were first asked to select two contracts and were educated to consider each contract as if it were the only choice available. Of the above four possible combinations, the first offered a higher coverage (100% level) and lower damage (25% from strike level) contract and if the farmer declined this, then we offered the lower coverage (80%) for similar damage level. If the farmers were still not interested in the product we offered the higher damage (50%) design and followed likewise.

Box.1: Payout Structure for a Hypothetical Index -Based Contract

How does index insurance work? -Example for rain fall shortage situation

Growing Stages		Time frame				
		Seeding	Transplant	Booting	Flowering	Harvesting
		Stage 1		Stage 2		Stage 3
Type of Disaster	**Index and criteria**					
Rainfall shortage	Cumulative Rainfall (mm)	Limit 50 Trigger 100		Limit 210 Trigger 300		Limit 300 Trigger 320



Source: *Adapted from Skees (2003, p.18) and modified by the author*

Risk tolerance and coverage for stage 1

According to the above diagram, a reference weather station area long team average rainfall is 120 mm, the amount of rainfall received at the weather station is below 100 mm (strike or threshold level) for the first stage, and the insurer will start to pay Rs. 1000 per each mm below 100. However, when the amount is below 50mm, which is given as the exit limit, the crop is expected to have suffered from too much water stress such that even if there are good rains thereafter, the crop will not recover. Thus, at and below this level, the total sum insured to be paid will depend on the farmer’s contract coverage. The implementation is the same for all stages and coverage scenarios. Where the left diagram is 0 tolerance capacity, the right diagram is an example for 50 % tolerance capacity. At the end of the growing period, the payout from each stage will be added to calculate the total payout for the whole contract.

Note: All figures are hypothetical.

Table 2: Contract parameters

		Premium - Sri Lanka Rupees (SLRs)./acre per full crop season					
		Major Irrigation		**Minor Irrigation**		**Rain-fed**	
Trigger	Coverage	Lower Bound Bid value (Rs)	Upper Bound Bid Value (Rs)	Lower Bound Bid value (Rs)	Upper Bound Bid Value (Rs)	Lower Bound Bid value (Rs)	Upper Bound Bid Value (Rs)
25% Trigger[1]	100% Coverage	1900	2600	600	775	500	700
25% Trigger	80% Coverage	1500	2000	460	625	450	600
50% Trigger	100% Coverage	775	1000	425	575	340	460
50% Trigger	80% Coverage	250	350	212.5	290	170	230

Source: Author's calculation based on AAIB data

Then, moving to applicable bid questions, constructed in terms of irrigation type, each farmer was asked if s/he was willing to pay an upper bound contract, and then offered a follow- up question. If s/he said ‘No’ to the first bid, a lower bid was given, and her/his willingness to pay was questioned and offered a follow- up question if the response was “Yes”. This follow- up question was open ended. If s/he said ‘No’ to the upper bound bid, then was asked the amount s/he was willing to pay. If s/he said ‘Yes’ to the lower bound bid then s/he was asked to mention the maximum that s/he was willing to pay. Under this elicitation procedure, one potential limitation of contingent valuation method is related to the bias which may result from the starting point of the bid. In this study, this bias was reduced by using an open ended follow- up question (McCarthy, 2003).

Explanatory variables: The basic description and the definition of explanatory variables used in the analysis are presented in Table 3 in the following section.

Social capital index *(SCP_INDEX)*:In addition to the above typical demographics and socio-economic characteristics, we hypothesized that social capital would influence farmers’ WTJ and WTP for the IBMS. This concept and its influence on microfinance have been growing rapidly in the developing world. A recent study states that community or group based microinsurance schemes are able to mobilize

1. Damage is 25% from strike level

social capital to encourage voluntary affiliation of resource-poor persons in the informal economy. It is suggested that trust and community networks at the local level (proxies for social capital) have a significant impact on the effectiveness of activities within microinsurance programs (Dror, 2007). Therefore we included social capital index for our analysis.

Table 3: Description of independent variables and hypothesized relationship

Variables	Explanation	Measurement	Hypothesized relationship
Age of farmer AGE_HH AGE_SQR	The square of the age variable	A continuous quantitative measurement	The younger the people, the more the WTJ and WTP
Education level EDU_LVL	Education level completed by farmer	1 – no schooling 2 - up to Grade 5 3 - Grade 6 to 9 4 – GCE /Ordinary Level 5 – GCE /Advance Level 6– higher (college/ university)	Higher level of education will increase WTJ and WTP
Labour capital LAB_CAP	15 to 65 years old members in household (Active members)	A continuous quantitative measurement	Higher numbers of household residents will lead to lower WTJ and WTP
Farming experience FAR_EXP	Number of years of paddy cultivation	A continuous quantitative measurement	Higher experience in years will lead to lower WTJ and WTP
Paddy farm size FAM_SIZE	Number of acres of paddy land owned by farmer	A continuous quantitative measurement of number of acres	The higher land holding the higher the WTJ and WTP
Natural log of household expenditure per capita LOG_EXP-PC	Average amount that household spent on household needs per month divided by household size	A continuous quantitative measurement	The higher the expenditure, the higher WTJ and WTP
Outstanding debt OUT_DEBT	Total value of all the outstanding debts SLRs.	A continuous quantitative measure	Borrowing money will lead to decreased WTJ and WTP
Geographic location MAJ_IRR*** MIN_IRR** RAIN_FED*	Measures whether a farmer 's farm is located in major*** irrigation , minor irrigation** or rain- fed* area	1 = If farm is located in major irrigation, 0 = otherwise 1 = If farm is located in minor irrigation, 0 = otherwise 1 = If farm is located in rain-fed, 0 = otherwise	Rain-fed farmers will be more WTJ and WTP for insurance than irrigated area farmers

Social capital was measured by trust, reciprocity and associations, each of which was composed of seven questions with the answers scaled. Five point Likert scales were used to measure peoples' attitudes by asking them for the degrees of importance of the statements in the research questionnaire each of which contained ranking from (1) strongly disagree to (5) strongly agree. We used a questionnaire related to social capital suggested by Grootaert, et.al, (2003) to choose the questions. The variables were reduced using factor analysis. Household level social capital was calculated by the sum of scores from each question divided by the total maximum sum of scores.

Income diversification index *(IND_INDEX):* Similar methods were used to construct the other indexes as well. Regarding the diversification of income, the survey used 14 different incomes sources. For simplicity in analysis, income sources other than paddy income were divided into four categories: wage employment, self-employment, agriculture (as the only income generating activity), and other sources such as social benefits or grants from the government or other organizations. In all, the four variables were used together to construct the income diversification index. It was hypothesized that a higher number of income sources will lead to lower WTP and WTJ.

Assets index*(AST_INDEX)*: Assets base plays a pivotal role among households, particularly in agrarian societies where incomes are closer to the subsistence level. We constructed an asset index to capture the ownership of physical assets within the last six years as a reflection of wealth and savings. The assets considered included consumer and farm durables such as colour televisions, CD players/radios, refrigerators, gas cookers, tractors, motorbikes etc. and were an indication of the level of disposable income in a household. It should be noted that the assets index was constructed using a weight on newest ones and non-weight on assets which were more than six years old.We hypothesized that a higher asset index will lead to a higher WTJ and WTP.

Awareness index *(AWR_INDEX)*: In addition, we also created an awareness index using a weighted for AAIB members and a none-weight for the rest of the farmers. Moreover, we combined different questions such as knowledge about types of insurance products, attitudes towards insurance, and number of insurance companies known by name by the households, to build this index. We hypothesized that people with experience in insurance affairs will be more WTJ and WTP than others.

Dependent variables: Based on the contingent valuation questions described above, we generated a series of dependent variables for analyses. All dependent variables are listed in Table 4.

Table 4: Description of dependent variables

Variables	Description	Measurement
WTJ	The dummy variables representing the farmers who are willing to join IBMS	1 = willing to join the IBMS 0 = if otherwise
WTP	Mean willingness to pay for IBMS	A continuous quantitative measure SLRs.
BID	Preference for IBMS across the risk to lerance and coverage bid value	
1	25% Trigger, 100% Coverage	1 = Bid value 1 0=if otherwise
2	25% Trigger, 80% Coverage	1 = Bid value 2 0=if otherwise
3	50% Trigger, 100% Coverage	1 = Bid value 3 0=if otherwise
4	50% Trigger, 80% Coverage	1 = Bid value 4 0=if otherwise

Data analysis: The study employed a probit regression model to estimate probabilities of WTJ for the IBMS. Linear regression analysis was carried out to estimate the impact of variables on the amount of the premium paid, thus including only farmers who were WTJ the proposed IBMS across the irrigation types. Then we estimated the mean WTP by using probit regression in terms of preference and geographical location with bid contract as an explanatory variable. Finally, we observed farmer preference on bid scenarios using multinomial logit regression. All data was analyzed with STATA statistical software.

Results and Discussion

The following analysis has three parts. The first is to identify the characteristics associated with farmers' responses for the WTJ for IBMS. In the second part we examine the factors that may affect farmers' demand for IBMS and Mean WTP. In the final part, we observe the influence of farmer characteristic to preference on the above discussed different contract scenarios.

Determinants of willingness to join: Encouragingly, according to the descriptive statistics, participants expressed a clear willingness to join for index-based microinsurance. Out of 180 farmers who entered, a sample of 88 percent were willing to join the proposed index-based insurance scheme including the microinsurance attribute. Further, the probit regression model was undertaken to estimate the probabilities of WTJ.

The results of the probit regression reveal that some of the explanatory variables used in this study were either not statistically significant or were highly correlated with other variables at the coefficient of correlation (r) > 0.8 level. Thus, it was decided to remove some of these variables from the regression. In this probit regression, we set rain-fed irrigation farmers as the base group and the results are presented in Table 5.

Table 5: Determinants of willingness to join

Parameter	Explanation	Coefficients	Robust standard error
INTERCEPT		3.6787	4.1389
AGE_HH	Age of farmer (household head)	**-0.2219****	**0.1464**
LOG_EXP-PC	Natural log of total household expenditures per capita	**3.9954****	**3.1401**
IND_INDEX	Income diversification index	-0.0216	0.0253
AST_INDEX	Asset index	0.1918	0.1017
AWR_INDEX	Awareness index	**0.1867***	0.0935
MAJ_IRR	Major irrigation	**3.5971***	**2.1836**
MIN_IRR	Minor irrigation	**0.189*****	**0.7800**
RAIN_FED	Rain-fed	Base Variable	
Number of obs.	180	Wald chi2(7)	13.55
Prob> chi2	0.0000	Pseudo likelihood	-7.7611886
Pseudo R2	0.9090		

*P<0.10; **P<0.05; ***P<0.01.

Estimation results reveal that when other factors are held constant, minor irrigation farmers were more likely to join the IBMS than rain-fed farmers. Moreover, expenditure plays a significant role in determining the decision of farmers to join the scheme. Results also show that young farmers (below 40 years old) in the study area were more likely to willingly join the IBMS than the elderly farmers. The awareness index was positively related to the decision to join the insurance. It appears, therefore, that the more knowledgeable the farmers are the more willing to they are join insurance. Farmers with such characteristics are excellent indicators to put into practice for new insurance program. The marginal effects of the expenditure per capita shows that, a one unit increase in expenditure will increase the probability of respondents to join the insurance scheme by 6.3 percent, ceter is paribus. The same interpretation applied to the awareness index shows the increase in the probability is 2.5 percent and vice-versa. In regards to age, one unit's increase will decrease the probability of joining by 1.3 percent. However, most of the risk aversion status indicator variables such as formal education, asset base, income diversification variables and social capital are statistically insignificant in explaining the decision of the respondents to join the scheme. The regression was correction specification using link test in STATA and evaluated the statistical significance of this regression model ran the robust standard errors for heteroskedasticity problem. The pseudo R2= 0.9090, proved the regression line fit data very-well.

Willingness to pay behavior: We considered spatial analysis using OLS estimation and ran three separate regression models across the irrigation types. The dependant variable is a maximum amount (SLRs) of willingness to pay per acre for full crop season in IBMS product. A summary of the final OLS models developed at irrigation types is presented in Table 6.

As we expected, the younger farmers were more likely to pay than the elderly in rain-fed and major irrigation areas, but age was insignificant to WTP among the minor irrigation farmers while age square variable was positively significant only in the major irrigation community. We also hypothesized that younger and more educated farmers could understand the product more easily, and would be more likely to pay; in this sense, education and asset bases were significant with positive sign at major irrigation areas. Farm size was not significant in irrigated areas because it may homogenize the plot size. However, the positive significant relationship on farm size at rain-fed areas indicates that farmers who cultivate larger farms are more willing to pay a higher premium for insurance.

Table 6: Factors influencing farmers' willingness to pay for the IBMS by irrigation type

	Major Irrigation		**Minor Irrigation**		**Rain- Fed**	
	Coefficients	Robust Std. Err.	Coefficients	Robust Std. Err.	Coefficients	Robust Std. Err.
AGE_HH	**-290.635****	95.917	-28.007	65.457	**-112.422****	46.762
AGE_SQR	**2.213****	0.668	-0.208	0.336	0.855	0.433
EDU_LVL	**529.738**	279.448	142.472	149.291	1.321	109.599
LAB_CAP	-86.958	105.275	**-127.941***	85.879	**-1.540***	40.905
FAR_EXP	46.655	64.744	54.944	47.521	**25.806***	19.820
FAM_SIZE	-93.257	91.799	-35.506	42.300	**-50.192***	26.708
OUT_DEBT	0.014	0.580	0.048	0.387	**0.031****	0.116
SCP_INDEX	**13.897****	2.922	**15.886****	3.306	**18.685****	2.045
IND_INDEX	-1.130	3.615	**-3.801***	2.372	**-0.711***	0.986
AST_INDEX	**8.177***	5.277	0.269	4.449	7.788	4.436
AWR_INDEX	1.415	2.609	**2.716****	1.415	**1.711****	0.998
LOG_EXP-PC	**-401.220***	264.134	170.359	147.847	-179.803	128.611
INTERCEPT	**7299.234***	2151.053	**-671.860***	1317.765	**1495.585***	1067.860
R-squared	0.7711		0.7997		0.8522	
Number of obs.	60		60		60	

*P<0.10; **P<0.05; ***P<0.01.

Outstanding debt index is a positive influence on the probability of farmers' WTP in rain-fed areas. This variable is insignificant for other areas. This could imply that farmers in rain-fed areas and in more debt demonstrate higher demand for insurance since their risk is higher than those from irrigated lands.

Awareness index was again an important determinant in minor and rain-fed communities, which is positively significant. But this index was not significantly associated with major irrigation farmers' decisions. A similar trend also appears in income diversification and labor capital indexes. One of the common characteristics of these models is the greater dependency on the social capital variable. As we expected, it indicates that there is enough possibility for a group formation to group based product. In terms of its indication on social interactions is to facilitate farmers to act together more effectively to pursue shared objectives (Putnam, 1993). As we discussed in the previous section, expenditure per capita was the most influential variable to WIJ. However in WTP setting, it was only significant at major irrigation areas. Its negative coefficient estimate implies that more expenditure results in less probability of WTP for insurance.

CV studies typically present a mean or median WTP of respondents. According to the methods suggested by Hanemann and Kanninnen (1996) and Gunatilake, et. al, (2007), we estimated the mean WTP by using probit regression in terms of preference and geographical location with bid contract as an explanatory variable. The results are presented in Table 7.

Table 7: Mean WTP for bid contract across the irrigation type

	Major Irrigation		**Minor Irrigation**		**Rain-Fed**	
	Mean WTP (Stranded deviation)	Average (SLRs.)	Mean WTP (Stranded deviation)	Average (SLRs.)	Mean WTP (Stranded deviation)	Average (SLRs.)
25% Trigger, 100% Coverage	2460 (121.29)	**1398**	1599 (97.68)	**852**	1103 (302.69)	**783**
25% Trigger, 80% Coverage	1136 (153.59)		575 (53.79)		707 (171.53)	
50% Trigger, 100% Coverage	1325 (199.39)		986 (130.65)		906 (242.18)	
50% Trigger, 80% Coverage	672 (301.19)		246 (38.77)		418 (306.25)	

Note: At time of survey exchange rate equaled SLRs110 to US$1.00.
Source: IBMS for agricultural risk mitigation in Sri Lanka, field survey- 2010

According to the currently operative premium structure of the existing government paddy crop insurance scheme (AAIB), the maximum and minimum premium rates for major irrigation areas are from 2250 to 300 SLRs (SLRs /acre per full crop season) and range from SLRs 675 to 250 and SLRs 600 to 200 for minor irrigation and rain-fed respectively. An interesting finding emerges with regard to this premium structure. We found that farmer WTP falls into SLRs 3062 - 219 range with an average SLRs 1398 in major irrigation areas. In this area, 36 percent of farmers' willingness to pay was above the AAIB limit (SLRs 2250) and 2 percent was below the AAIB limit (SLRs 300). Minor irrigation areas obtained a value range of SLRs 2524 -130 and an average of SLRs 852. According to our findings, 53 percent of farmers' WTP were beyond the AAIB maximum limit and 10 percent were below its minimum level. The same approach was applied to rain-fed areas as well, and farmers' WTP was in the range of SLRs 2500 to 159 and the average was SLRs 783. Moreover, 20 percent were above the AAIB maximum level limit and nearly 8 percent below the AAIB lower limit. This means that there is even more possibility to improve welfare through price discrimination and spatial discrimination with contract discrimination.

Factors influencing farmers' preference:

Finally, we measured other explanatory variables that may affect farmers' demand for insurance, at four different scenarios. This multinomial logit model, highest risk bid contract (4th bid contract - 50% trigger, 80% coverage) and rain-fed areas were selected as the base cases and the influences of the explanatory variables are expressed relative to their influence on the base case. The results are presented in Table 8.

Of the main finding that emerges from the regressions' results in this sample, farm household log expenditure per capita (LOG_EXP-PC) was the most significant factor of a farmer's bid contract selection for the future risk reduction across all the communities. In addition to considering the marginal effects of the coefficient, if one unit increases in farm household log expenditure per capita (LOG_EXP-PC) for 1st bidcontract (25% trigger, 100% coverage) relative to 4th bid contract (50% trigger, 80% coverage), 1st bid contract would be expected to increase by 0.43 unit while holding all other variables in the model constant. Similar interpretations apply to 2nd bid contract (25% trigger, 80% coverage) which would decrease by 0.52 and 3rd bid contract (50% trigger, 100% overage) which would be increased by 0.39 units.

Table 8: The factors influencing farmers' preference for the contract bids

Bid	**25% Trigger, 100% Coverage**		**25% Trigger, 80% Coverage**		**50% Trigger, 100% Coverage**	
	Coefficient	Robust Std. Error	Coefficient	Robust Std. Error	Coefficient	Robust Std. Error
AGE_HH	-.536542	.2286355	-.318295	.2361341	**-.1424839***	.2285926
AGE_SQR	.0048914	.0020812	.0027833	.0021294	.0013634	.0020876
EDU_LVL	**1.538475***	.8821999	.0126642	.6070897	.0542027	.5838011
SCP_INDEX	**.0479856*****	.0132559	**.0460936*****	.0134274	.0578491	.0125742
IND_INDEX	.0057868	.0105278	**-.0064772****	.010435	**-.0016619***	.0100819
AST_INDEX	.0037058	.0246507	**-.0097576****	.0221332	**-.0224276***	.0211446
AWR_INDEX	**.000145***	.0080371	-.0016731	.0075772	-.0021658	.0068933
LOG_EXP-PC	**.4370879***	1.121598	**-.5294897***	.8634272	**.3903087***	.8349556
LAB_CAP	.4454488	.3348031	.6252325	.3189738	.3847385	.2899588
FAM_SIZE	-.6391164	.2664661	-.5446482	.2565901	**-.3418533***	.236381
MAJ_IRR	.8120786	.7697659	.1060952	.7289062	.2157784	.7170418
MIN_IRR	**2.132335***	.9927099	**1.533167***	.9042899	2.062953	.8479137
INTERCEPT	**8.161169***	6.041402	**5.518685***	6.097014	**-.6990855***	5.738567
Numb Ob.	88		66		104	
Pseudo R2 =	0.7725		Log pseudo likelihood = -179.26841			

Note: 50% trigger, 80% coverage bid contract was base value for contract scenarios (60 observation)
Rain-fed farmers were base value for irrigation types, *P<0.10; **P<0.05; ***P<0.01.

Social capital index (SCP_INDEX) was significant in the models developed for 1st and 2nd bid contract samples. However, this variable was not significant in the 3rd bid contract relative to base contract. This index was positively associated with farmer preferences for risk-averse decisions compared to risk- taker bid contracts. Income diversification (IND_INDEX) and asset indexes (AST_INDEX) were negatively significant for the 2nd and 3rd bid contracts. Thus, other variables held constant, as we expected, it may imply that more assets' base and income sources are less risky, which may shift preference towards risk tolerance contract decisions. Awareness index (AWR_INDEX) and the education level of a farmer (EDU_LVL) variables had a positive and statistically significant.This coefficient estimate indicates that the more aware and more educated the farmers are the more likely to they are prefer low risk insurance contracts rather than higher risk contracts. It appears that way in our 1st bid contract model. The minor irrigation variable (MIN_IRR) was significant and had a positive influence on the preference of selection of the bid contracts compared with rain-fed farmers. The marginal effects of the coefficient MIN_IRR imply that if one unit increases in MIN_IRR for 1st and 2nd bid contracts relative to 4th rain-fed farmers, 1st and 2nd bid contracts would be expected to increase by 2.1 and 1.5 units, respectively while having all other variables in the model held constant. However, major irrigation community was not significant any bid contract when compared to rain-fed farmers. Farmer's Age (AGE_HH) is negatively significant for the 3rd bid contract; it confirmed that younger farmers were more likely to choose a risk tolerance plan than their elders. Farm size (FAM_SIZE) also negatively influenced the on 3rd bid contract choices. It appears, therefore, that more farmers who own more land are less likely to choose more risky insurance contracts. The variables, labor capital (LAB_CAP) and age square (AGE_SQR) were not statistically significant in these models.

Conclusion

This paper reports the results of a contingent valuation survey that elicits producers' willingness to pay (WTP) for Index-based Microinsurance (IBMS). There is robust evidence suggesting that this type of insurance schemes is well accepted by peasants, and that the potential demand for insurance in the survey area is very high. Results indicate that the strongest influence on willingness to join are fromage, total household expenditure, and awareness of crop insurance, and that demand is more concentrated in irrigated areas. When WTP was assessed, it was found that the most potential purchasers would prefer a higher level than offered by the existing conventional insurance plan. Observed preferences affecting WTP are highly location specific. Some classic explanatory variables were significant in the variation on spatial and insurance contracts. Most farmers in irrigated areas showed more risk-averse behavior than farmers in rain-fed areas. In terms of farmers' perceptions about harm and coverage levels, farmers from irrigated areas preferred low damage contracts and high coverage levels, which were likely to be more important in their WTP decisions, as shown by the relatively high mean values in this category. We found that farmers in rain-fed areas were less likely to buy insurance and so 1st and 2nd have a low mean WTP. However, the study exhibited more scattered WTP values, even within each irrigation type. Outliers in terms of WTP values can be better served through innovative interventions.

Social capital exhibits a high influence on farmer's preferences. Therefore, we adviseon a participatory or community-based approach to insurance design where farmers are involved in the designing process based on their own requirements. This demand-led approach may provide more benefits than a supply-led design. In this context we conclude that a uniformly structured crop insurance product does not achieve maximum efficiency. Therefore, to improve effectiveness, products should be designed and implemented with the synergies of different approaches. For example, price discrimination and spatial discrimination with regard to disaster or peril, as well as farmers' requirements for diversification need to be explored.

The results of the preference analyses demonstrate that IBMS products can be adapted for specific locations in order to maintain demand. These findings provide strong support for launching IBMS in Sri Lanka. Further, the findings of this study will, hopefully, be used to support the making of a more efficient and realistic pricing policy for IBMS.

References

Barnett, B. J. and O. Mahul (2007). Weather index insurance for agriculture and rural areas in lower-income countries. American Journal of Agricultural Economics, 89 (5): 1241-1247.

Bhattamishra, R. and C. B. Barrett (2008). Community-Based Risk Management Arrangements: An Overview and Implications for Social Fund Program Design. Social Protection Discussion Paper, World Bank.

Churchill, C. (eds.) (2006). Protecting the Poor: A Microinsurance Compendium. International Labor Organization, Geneva.

Clarke, D. and S. Dercon (2009).Insurance, Credit and Safety Nets for the Poor in a World of Risk, Working Papers 81, Department of Economics and Social Affairs. United Nations

Dercon, S., (eds.) (2005).Insurance against Poverty. Oxford: Oxford University Press.

Dercon, S., M .Kirchberger, J.W. Gunning, J. Platteau (2008) Literature review on microinsurance. International Labour Organization, Geneva.

DMC-SL, 2010, Disaster Management Center, Sri Lanka, Ministry of Disaster Management, available from URL www.dmc.gov.lk (Accessed 05 March 2010)

Dror, I., (2007). Social Capital and Microinsurance: Insights from Field Evidence in India. Microfinance Insights, 5: 22-24

Gine, X., R.M. Townsend and J.I. Vickery (2007).Patterns of Rainfall Insurance Participation in Rural India, *World Bank Policy Research Working Paper* No. 4408, World Bank.

Glauber, J.W. (2004). Crop insurance reconsidered. American Journal of Agricultural Economics, 86(5): 1179-1195

Grootaert, C., D. Narayan, N. Jones and M. Woolcock (2003). Measuring social capital: an integrated questionnaire. World Bank Working Paper No. 18. World Bank. Washington, DC.

Gunatilake, H., J. Yang, S. Pattanayak and K. Choe (2007). Good Practices for Estimating Reliable Willingness-to-Pay Values in the Water Supply and Sanitation sector. Asian Development Bank.

Hanemann, M. W., and Kanninen, B. (1996).The Statistical Analysis of Discrete-ResponseCV data, Working Paper No. 798, Dpt. of Agr.and Res. Economics, Univ. of California at Berkeley.

Hazell, P. B. R. (1992). The appropriate role of agricultural insurance in developing countries. Journal of International Development, 4 (6): 567-581.

Leftley, R. and J. Roth (2006). Beyond MFIs and community-based models: Institutional alternatives. In C. Churchill (eds.) Protecting the poor, A microinsurance compendium, International Labor Organisation, Geneva.

Levin, T. and D. Reinhard (2006). Microinsurance aspects in agricultural insurance. Munich: Munich Re. Foundation.

LLOYDS (2009).Insurance in developing countries: Exploring opportunities in microinsurance. Lloyd's 360° Risk Insight and Microinsurance Centre. Retrieved March 01, 2010, from http://www.lloyds.com/NR/rdonlyres/5CFE7CAF-0075-415C-B0F2-BEBF0323059E/0/Microinsurancereport_Nov2009.pdf

McCarthy, N. (2003). Demand for Rainfall Index insurance: A Case Study from Morocco. EFTD Discussion Paper No 106. Washington DC: Environment and Production Technology Division, International Food Policy Research Institute (IFPRI).

Mechler, R., J. Linnerooth-Bayer and D. Peppiatt (2006). Disaster Insurance for the poor?: A review of microinsurance for natural disaster risks in developing countries. ProVention/IIASA Study.

Miranda, M.J. (1991). Area yield crop insurance reconsidered. American Journal of Agricultural Economics ,73(2): 233-242.

Nieuwoudt, W.L. (2000). An economic evaluation of a crop insurance programme for small-scale commercial farmers in South Africa.*Agrekon,* 39(3): 269-291.

Osgood, D., Warren,D. (2007) Drought insurance in Malawi. In: Hellmuth, M., Moorhead, A., Thomson, M.C., Williams, J. (eds) Climate risk management in Africa: learning from practice. International Research Institute for Climate and Society (IRI).New York: Columbia University, p.75–88.

Patrick, G. E. (1988). Mallee Wheat Farmers' Demand for Crop Insurance. Australian Journal of Agricultural Economics, 32(1): 37-49.

Patt, A., N. Peterson, M.Carter, M. Velez, U. Hess and P. Suarez (2009).Making index insurance attractive to farmers.Mitigation and Adaptation Strategies for Global Change. 14(8): 737-753.

Putnam, R. (1993). The Prosperous Community: Social Capital and Public Life. The American Prospect, No 13. (Spring): 35-42.

Rambukwella, R.N.K., Vidanapathirana, R.P. and Somaratne, T.G. (2007).Evaluation of Crop Insurance Scheme in Sri Lanka. Colombo: Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI).

Roth, J. and M .J. McCord (2008). Agricultural microinsurance: global practices and prospects, Appleton, Wisconsin: Microinsurance Centre.

Roth, J., M. J. McCord and D. Liber (2007) .The Landscape of Microinsurance in the World's 100 Poorest Countries, Appleton, Wisconsin: MicroInsurance Centre

Saleem, S., K. H., Coble, D. Hudson, J. C. Miller, T.R. Hanson and S.H. Sempier (2008).Willingness to Pay for a Potential Insurance Policy: Case Study of Trout Aquaculture, Agricultural and Resource Economics Review, 37(1): 1-10.

Sarris, A., P. Krfakis and L. Christiaensen, (2006).Producer Demand and Welfare Benefits of Rainfall Insurance in Tanzania. FAO Commodity and Trade Policy Working paper Number 18, Rome.

Skees, J. R. (2001). The Potential Role of Weather Markets for U.S. Agriculture. The Climate Report Vol. 2, No 4. Climate Risk Solutions, Inc.

Skees, J.R. (2003). Risk management challenges in rural financial markets: Blending risk management innovations with rural finance. Thematic paper presented at Paving the Way Forward for Rural Finance: an International Conference on Best Practices, June 2 – 4, 2003 Washington, DC. RetrievedSeptember 02, 2010, fromhttp://www.fao.org/docs/up/easypol /532/3-5_Risk-management-Challenges-rural-Finmkts_162EN.pdf

Skees, J., and B. Barnett. (2006). Enhancing microfinance using index based risk-transfer products. Agricultural Finance Review, 66: 235–250.

Skees, J.R., B.J. Barnett and J.Hartell (2006). Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia (August 12–18, 2006) Retrieved March 03, 2010, from http://ageconsearch.umn.edu/bitstream/25548/1/ cp060649.pdf

Skees, J., A. Murphy, B. Collier, M. J. McCord and J. Roth (2008). Scaling Up Index Insurance: What is needed for the next big step forward?: German Financial Cooperation. Retrieved September 09, 2010, http://www.globalagrisk.com/Pubs/2007_Skeesetal_Scaling%20UP%20In dex%20Insurance_KfW_dec.pdf

Smith, V.H., and M. Watts (u.d.). Index Based Agricultural Insurance in Developing Countries: Feasibility, Scalability and Sustainability: A Paper submitted to the Bill and Melinda Gates Foundation. Retrieved September 09, 2010, from http://www.agecon.ucdavis.edu/research/seminars/files/ vsmith-index-insurance.pdf

SLNAP.(2006). Sri Lanka National Agricultural Policy. Colombo: Ministry of Agriculture. Retrieved December 15, 2009, from http://www.mimrd.gov.lk/ upload/docs/1253183180AgPolicy4.pdf

Tabor, S. R. (2005).Community-based Health Insurance and Social Protection Policy.Social Protection Discussion Paper No. 0503. Social Protection, World Bank, Washington DC.

Varangis P. (2002). Innovative approach to cope with weather risk in developing countries.The Climate Report, 2 (2). Climate Risk Solutions Inc.

Vandeveer, M. L. and Loehman, E. T. (1994). Farmer response to modified crop insurance: a case study of corn in Indiana: American Journal of Agricultural Economics, vol. 76:128-140.

Zubair, L., V. Ralapanawe, U. Tennakoon, Z. Yahiya, and R. Perera (2005). Natural Disaster Risks in Sri Lanka: Mapping Hazards and Risk Hotspots. In Margaret Arnold (eds.)Natural Disaster Hotspots Case Studies.World Bank.109-136.