Index-Based Microinsurance for Paddy Sector in Sri Lanka: An Evaluation of Demand Behavior

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ABSTRACT

The objective of this study is to support the making of a more efficient and realistic pricing policy for Index-Based Microinsurance Scheme (IBMS) by analyzing, using the contingent valuation method, the insurance demands (i.e. willingness to pay) of the paddy farmers in Sri Lanka. The results show that farmer's demand is substantially high and determinants are highly location specific; hence indicating a potential discriminating and flexible policy in the insurance scheme. It means that insurance policy concerning crop insurance product should be designed and implemented with synergies of different approach in micro-insurance rather than a uniform structure.

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

Introduction

Risk is an unavoidable but manageable element in agriculture. Microinsurance has been recognized as one risk management tool in agriculture that secures the socio-economic condition of farmers. It is flexible contract and designed to serve low-income peoples. Growing numbers of literature on agricultural financial markets in developing countries provide opportunities for innovative agricultural insurance. As a matter of fact, many attempts have already been made to incorporate the microinsurance and index-based indemnification mechanism, which is based on reliable and independently verifiable indices. This instrument is increasing attention in present day risk management debates (Skees, and Barnett, 2006; Roth and McCord, 2008; Dercon, Kirchberger, Gunning and Platteau, 2008; Patt, Peterson, Carter, Velez, Hess and Suarez, 2009). The incorporation of these two concepts can be called Index-Based Microinsurance Scheme (IBMS). However, this has not been tested in the case in Sri Lanka. The main objective of this study is to assess the demand and applicability of an index-based microinsurance for paddy crop 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, hopefully, be used to support the making of a more efficient and realistic pricing policy for IBMS. The study will examine the farmers' willingness to join (WTJ) as well as their willingness to pay (WTP) for the hypothetical index-

[1] In Sri Lank, the composition of agricultural land under small holdings is 80 percent and they are less than 20 acres and average farm size in the small holding sector is less than 2.5 acres. Agricultural Census -2002

based crop insurance scheme. The results will help 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 of natural disasters in Sri Lanka.[2] Currently, Sri Lankan farmers can insure most of their crops through the conventional crop insurance schemes conducted by government-owned Agricultural and Agrarian Insurance Board (AAIB). Although the Board has been operated for more than five decades, voluntarily participation has been drastically decreased. Its level of penetration among potential clients is currently less than 5 percent. One of the main causes for low confidence in this scheme is the little transparency in loss assessment and underestimation in indemnity payment (Rambukwella, Vidanapathirana and Somaratne, 2007). Moreover, rain-fed areas are not promoted for insurance by the Board. However, According to the national extent of sown by irrigation category in the last ten years (2000-2010), rain-fed irrigation sown extent contribution is 24 percent[3]. AAIB insurance products are performing as individual contract and indemnity based on the individual's own yield. Usually this type of contract suffers from asymmetric information problems like moral hazard and adverse selection. Also, high administrative cost is another impediment. Moreover, the government schemes are not based on actuarial principles and are deemed unsustainable. 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 claim settling process resulting from indemnity-based insurance relative to the values insured in developing countries, index-based schemes have become increasingly useful for particularly smallholder farmers, with limited government involvement (Skees, Hazell, and Miranda, 1999). Therefore, this innovative insurance may enjoy a huge potential for the development in Sri Lanka. Up to this date, only one feasibility study has been conducted on this subject by a commercial insurance company under the International Labour Organization (ILO) microinsurance facility program[4]. Its findings have not been published. We believe that this is the first study conducted the demand side perspective on index-based agricultural microinsurance in Sri Lanka.

The paddy sector, being the dominant crop in Sri Lanka cultivated by a large number of small-scale subsistence farmers living in the rural areas. Still 90 per cent of the poor live in the rural agricultural economy. Therefore, most of farmers' live under the poverty line or close to poverty line. In this context attracting private sector to agricultural insurance is cumbersome. Only one private insurance company has started limited schemes in selected areas, since opening 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). The draft version circulated for comment furthermore highlighted that "a national agricultural insurance scheme will be implemented to cover all farmers and all crops thought the country to insulate the farmers from financial distress cased by

[2] National Disaster Management Centre, Sri Lanka, 2009
[3] http://www.statistics.gov.lk
[4] http://www.ilo.org/public/english/employment/mifacility/grantees/sanasa.htm

natural disaster and making agricultural financially viable" emphasizing "collaboration with public and private sector" (SLNAP-D, 2006 p.11). Therefore, agricultural insurance appear to be more important, among many risk mitigation measures adopted in the country.

Emerging research 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 towards government involvement on market-based insurance and encourage to the private sector for agricultural insurance (Nieuwoudt, 2000;Dercon, 2005; Leftley and Roth, 2006; Skees , Barnett and Hartell , 2006; Bhattamishra and Barrett, 2008).

An Innovation in Agricultural Insurance

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 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, and price and even mortality rate of livestock. In developing countries, more than 25 index-based risk transfer schemes report on the practical feasibility and investigate start-up and implementation of pilot schemes; majority was an insurance product with payouts linked to a publicly-verifiable aggregate index. Most of index-based insurance schemes address either production (yield) risk or price risk, and aim at a specific crop (Skees, Murphy, Collier, McCord and Roth, 2008).

Experience is too limited in some programs and too early to draw general conclusions about the long-run sustainability of these efforts due to the fact that majority of these schemes are still in preliminary stages. The experience in Mexico and India suggests that, at least in some areas, these programs may confirm to be a considerable risk transfer mechanism for the rural poor (Levin and Reinhard, 2006 ; Barnett and Mahul, 2007). However, scalability and sustainability are depending on several factors. Under the scalability, access or coverage participation and the operating and administering cost of products are included. For long term sustainability, program should achieve several elements such as the willingness of farmers to contribute over the long term, country's regulatory environment and private sector participation (Smith and Watts, n.d.).

Increasing interest to implement index-based insurance products rather than traditional agricultural insurance are well documented. Index-based products offer various advantages over more problems associated with other risk-coping mechanisms and traditional insurance programs such as, no moral hazard, no adverse selection, and low administrative costs.Moreover it has standardized and transparent structure, re-insurance function, availability and negotiability (Skees, et al.,2006; Roth and McCord, 2008). Nevertheless, it can be used even as recourse to large number of social perils including famine and other catastrophes (Skees, 2008).

The main challenge in index-based insurance is called basis risk where there is the possibility of a mismatch between the index and the losses of the insured, which is the biggest problem with index insurance (Miranda, 1991). However, there are substantial suggestions in discussing to manage of this problem. Improved data and product design may be able to minimize basis risk (Roth and McCord, 2008). Index-based product has to be developed for small geographic area (Smith and Watts, n.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 to design the product and government intervention trough providing infrastructure and services would help minimize this basis risk problem (Clarke and Dercon, 2009). As a matter of fact, many attempts have already been made to incorporate this index-based indemnification mechanism and microinsurance concept therefore fallowing section briefly summaries 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 country context. It has some basic risk reduce features (farmer participation to design, small group involved, quick response, and implementing small geographic area) 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: Osgood and Warren 2007). Among the main attributes, this product reflects members' willingness to pay and low-cost transactions. It involves payment of premiums in small amounts and often designed to accommodate clients' irregular cash flows, in return for pre specified payouts when a specific condition occurs. Microinsurance can be implemented either individual or group-based 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, McCord and Liber, 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).

Due to group-based nature it 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 index-based microinsurance is affordable risk management tool for smallholder farmers with limited government involvement. 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, Linnerooth-Bayer, and Peppiatt, 2006). The best example is Andhra Pradesh in India, where a microfinance institution (BASIX) has collaboration with an insurer (ICICI-Lombard) to provide index cover to farmers (Gine, Townsend and Vickery, 2007).

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 • Very 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 (eg 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 (eg credit)
Claims handling	• Complicated processes • Extensive verification documentation	• Simple and fast procedures for small sums • Efficient fraud control

Source: Adapted from Lloyds- Microinsurance Report 2009, http://www.lloyds.com

Methods

Study Area, Sample and Data Collection

Ampara district, eastern plain in Sri Lanka was selected to conduct the field survey. The selection of 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, Ralapanawe, Tennakoon, Yahiya and Perera, 2005) and highest rice producing district among the paddy producing districts in Sri Lanka. Out of 29 agrarian service centers in Ampara district, ten agrarian service center divisions[5] were selected to collect the primary data. This selection also particularly based on disaster occurrence within last ten years period.

Agriculture is the most important income source of the people in 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 are representing risk disparity. Moreover, existing AAIB insurance coverage and premiums are depending on irrigation land class in particular area. Approximately, 75 percent of paddy cultivation lands are under the major irrigations systems. There are about 6 percent and 18 percent lands 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 irrigation types (stratums), in these sample 25 percent households from at least one time member of AAIB insurance scheme and rest of 75 percent was non member of any crop insurance scheme. The household was chosen through a simple random sampling technique. AAIB member list and election registration list (excluding the name of the AAIB members) were used as the sampling frame and the total sample size being 180 farmers.
The study of insurance demand behavior is often done using willingness to pay with hypothetical questioning. We used face to face interview method with structured questionnaire schedule for data collection. Before each field session, brief education session for explaining how insurance works was conducted. Further, an illustration handout was used to educate core concepts of index insurance with all possible indexes for particular area and explaining the benefit and implementing procedure for farmers were carried out. The questionnaires were followed with explanations to get farmers answers and reaction. Nevertheless, in these sessions we specially emphasized on the micro insurance attributes such as group based design, possibility of involvement to product design process, possibility of delivery through farmers' affiliated association and payment flexibility and affordability.

The survey was begun with 'warm-up' questions, which had introductory questions with an aim to understanding risk and risk management. This process was used to avoid non-response bias. The social capital and socio-economic questions are included in the last section of the questionnaire, which were mostly considered sensitive to interviewees. The survey conducted by trained university post graduate students together with local enumerators interacts with farmers, clarifying their doubts to minimize non-response rates and judging their sincerity.

Measurement of Variables and Method of Analysis

The contingent valuation method (CV) is used to elicit individual's WTP for the hypostatical index-based insurance. However a 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 countries context McCarthy (2003) and Sarris, Krfakis and Christiaensen (2006) studies have examined willingness to pay for rainfall index-based on crop insurance used single and one and half CV questions based on Morocco and Tanzania, respectively.

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

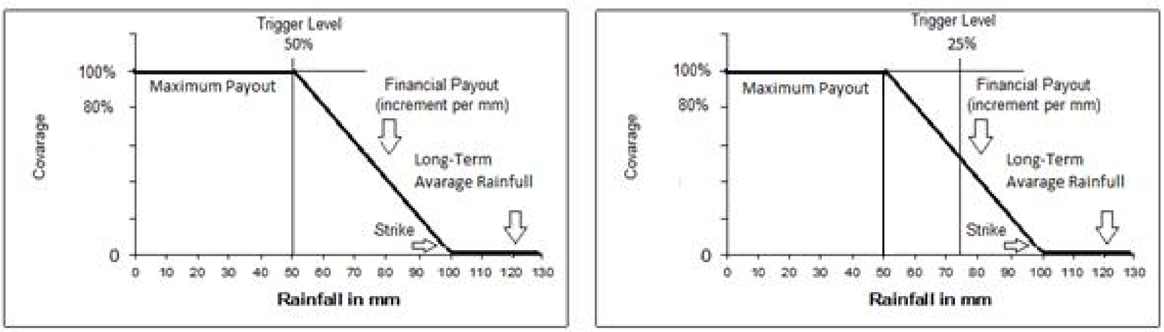
We model farmer's demand for IBM as a four distinct decisions, which were included for 50 percent and 25 percent tolerance levels and 100 percent and 80 percent coverage contracts. See box: 1, (this example is extract from the illustration handout which was used in survey education session.) Each contract has a lower and upper bound value; in this study used initial or stating value as existing AAIB premiums. Maximum premium amount and minimum amount have used to construct the bid value range. The lower bound coincided as the existing AAIB contract premium value minus 15 percent load. And the upper bound was equal to the AAIB premium value plus 15 percent load. All fractional numbers were rounded. The upper (lower) bound of WTP thus reflects the minimum (maximum) offer price that household's response to the willingness to pay question.

Box: 1 Payout structure for a hypothetical index base 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 120 Trigger 180	Limit 210 Trigger 250	Limit 250 Trigger 300	Limit 300 Trigger 320

Risk tolerance and coverage for stage 1



Source: *Adapted from Skees (2003) and modified*

Risk tolerance and coverage for stage 1

"According to above diagram, area long team average rainfall is 120 mm, the amount of rainfall received at the area 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, (50 percent trigger level) which is given as the exit limit, the crop is expected to have suffered from water shortage that even if there are good rains thereafter, the crop will not recover. Thus at and below this level, the total sum insured is to be paid which is depend on farmers contract coverage. The implementation is the same for all stages and coverage scenarios. At the end of the growing period, the payout from each stage will be added to come up with the total payout for the whole contract."

Note: all figures are hypothetical

Table 2: Contract parameters

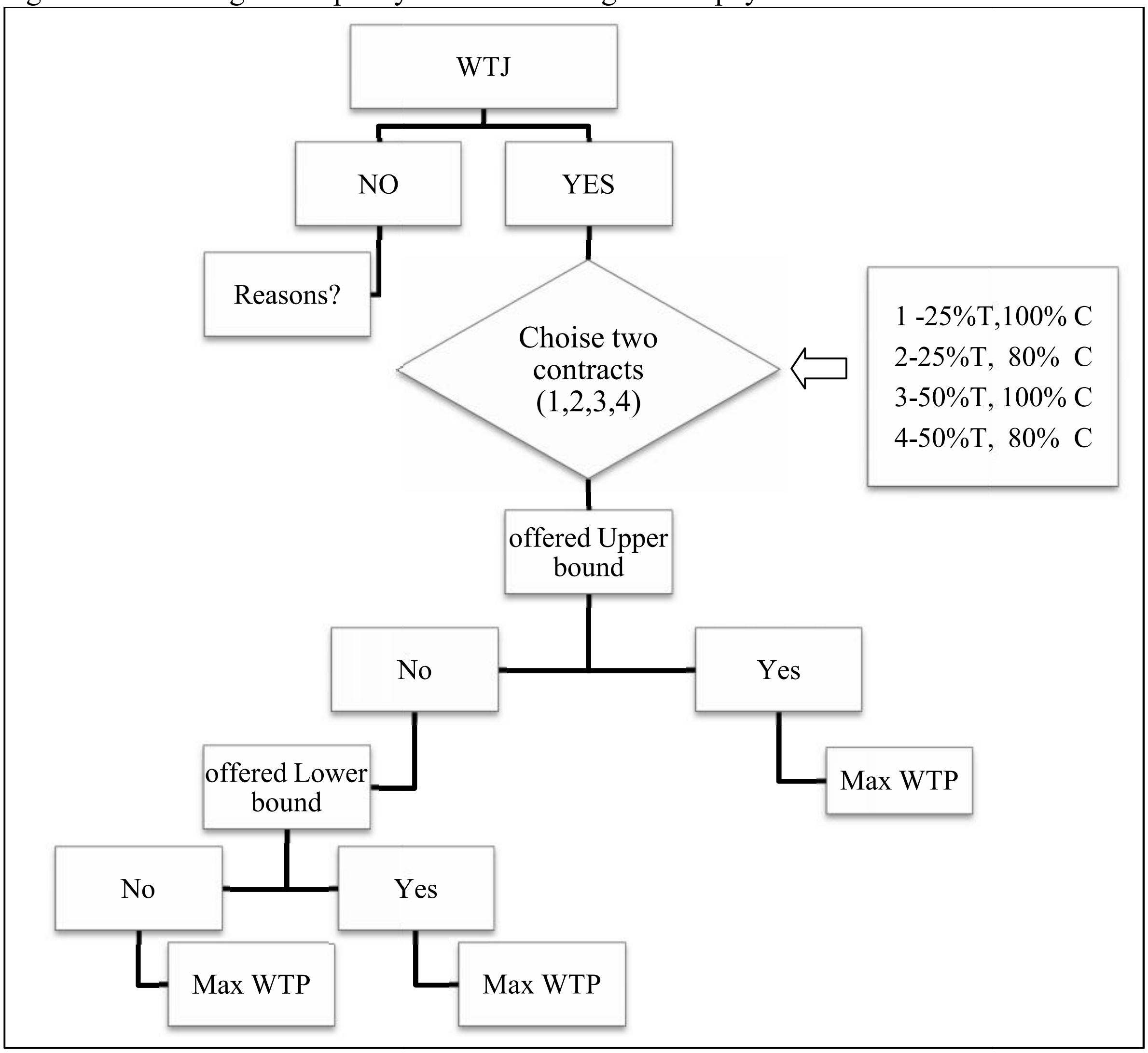
Trigger	Coverage	Premium - Sri Lanka Rupees (SLRs)./acre per full crop season					
		Major Irrigation		**Minor Irrigation**		**Rain-fed**	
		Lower Bound Bid value (Rs)	Upper Bound Bid Value (Rs)	Lower Bound Bid value (Rs)	Upper Bound Bid Value (Rs)	Lower Bound Bid value (Rs)	Upper Bound Bid Value (Rs)
25% Trigger	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 base on AAIB data

In this study, we used the one and half bound dichotomous choice format by a following up questions for the purpose of the statistical efficiency and consistency (Saleem, Coble, Hudson, Miller, Hanson and Sempier, 2008). Under this design farmers were first asked to select two contracts and educated to consider each contract as if it were the only choice available. Above four possible combinations, first offered higher coverage (100% level) and lower damage (25% from strike level) contract and if farmer decline, then we offered the lower coverage (80%) of similar damage level. If the farmers are still not interest in the product we offered higher damage (50%) design and followed likewise.

Then, moved to applicable bid questions construct in term of irrigation type, each farmer is asked if s/he is willing to pay an upper bound contract then offered follow- up question. If s/he says ‘no’ to the first bid, a lower bid will be given and her/his willingness to pay is asked and offered follow- up question if response is “yes”. This follow- up question was open ended. If s/he says ‘no’ to the upper bound bid, then s/he will be asked to how much s/he is willing to pay. If s/he says ‘yes’ to lower bound of bid then s/he will be asked to mention the maximum that s/he is willing to pay. Under this elicitation procedure, one potential limitation of contingent valuation method is related to the bias which may come from the starting point of the bid. In this study, this bias is reduced by using the follow- up question was open ended (McCarthy, 2003). Figure 1 describes the structure of CV Bid design.

Figure 1: Flow diagram of paddy farmers' willingness-to-pay outcomes



Note: where, WTJ is willingness to join for IBMS and WTP is willingness to pay for IBMS

Explanatory variables

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

Table 3: Description of independent variables hypothesized to explain WTJ and WTP for IBMS

Variables	**Explanation**	**Measurement**	**Hypothesized relationship**
Age of farmer AGE_HH AGE_SQR	How old (in years) the Farmer's are the square of the age variable	A continuous quantitative measure	The younger the people, the more the WJP and WTP
Education level EDU_LVL	Education grade 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 WJP and WTP
Labour capital LAB_CAP	15 to 65 years old members in household (Active members)	A continuous quantitative measure	Higher numbers of household residents will lead to lower WJP and WTP
Farming experience FAR_EXP	How many years paddy cultivation are	A continuous quantitative measure	Higher experience in years will lead to lower WJP and WTP
Paddy farm size FAM_SIZE	how many acres are paddy land belongs	A continuous quantitative measure Number of acres	The higher land holding the higher the WJP 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 measure	The higher the expenditure, the higher the WJP and WTP
Outstanding debt OUT_DEBT	Total value of all the outstanding debts SLRs.	A continuous quantitative measure	Borrowing money will lead to decreased WJP 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 miner Irrigation, 0 = otherwise 1 = If farm is located in rain-fed, 0 = otherwise	Rain-fed farmers will be more WJP and WTP for insurance than irrigated area farmers

Social capital index (SCP_INDEX)

In addition to above typical demographic and socio economic characteristics, we hypothesize that social capital would influence farmers' WTJ and WTP for the IBMS. This concept and it's influential on microfinance has been growing rapidly in the developing world. A recent literature state that community or group based microinsurance schemes able to mobilize social capital to encourage voluntary affiliation of resource-poor persons in the informal economy. It has been suggested that social capital is an explanatory variable for the degree to which communities can solve collective problems. It suggested that trust and community networks at the local level (proxies for social capital) have a significant impact on effectiveness of activities within microinsurance program (Dror, 2007). Therefore we include social capital index for our analysis. Social capital is measured by trust, reciprocity and associations. Each of which is composed of seven questions with the answers scaled, 5 point Likert scales were used to measure people's attitudes by asking them the degree of importance with the statements in the research questionnaire ranked from (1) strongly disagree to (5) strongly agree. We used questionnaire related to social capital suggested by Grootaert, Narayan, Jones and Woolcock (2003) to choose the five questions for each. The variables were reduced to using factor analysis. [6] Each household level social capital is calculated by the sum of scores from each question divided by total maximum sum of scores.

Income diversification index (IND_INDEX)

Similar method was used to construct the other indexes as well. Regarding the diversification of income, survey used 14 different incomes sources. For simplicity to analysis income sources other than paddy income are divided into four categories. Such as wage employment, self-employment, agriculture as only income generating activity and other sources like received social benefits or grants from government or other organizations. In all, the four variables was used together to construct the income diversification index. Higher numbers of income sources will lead to lower WTP and WTJ was hypothesized.

Assets index (AST_INDEX)

Assets base play a pivotal role among households, particularly in agrarian societies where incomes are closer to the subsistence level. We constructed an asset index which captures the ownership of physical assets within last six years period as reflect of wealth and saving. The assets considered include consumer and farm durables such as colour televisions, CD player/radio, refrigerator, gas cocker, tractor, motorbikes etc. are an indication of the level of disposable income in a household. A point to remark is that constructed assets index using a weighted newest one and none weighted the assets were more than six years older. We hypothesized the relationship higher asset index will lead to higher the WTJ and WTP.

Awareness index (AWR_INDEX)

In addition, we created an awareness index also using the weighted to AAIB members and none weighted for the rest of farmers. Moreover, we combined deferent questions such as knowledge about types of insurance products, attitude towards insurance, numbers of insurers as names

[6] The number of principal components is identified by using cumulative explanation tool in principal component analysis.

known to the households which operating in Sri Lanka to build this index. We hypothesized people with experience of insurance affairs will be more WTJ and WTP than others.

Dependent variables
Based on contingent valuation questions described above, we generate a series of dependent variables for analyses on difference aspect. 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 for IBMS	1 = willing to join the IBMS 0 = if otherwise
WTP	Mean willingness to pay for IBMS	A continuous quantitative measure SLRs.
BID	Willingness to preference for IBMS across the risk tolerance 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 premium paid, thus including only farmers who WTJ for 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 characteristic to preference on bid scenarios using multinomial logit regression. All data are analyzed with STATA statistical software.

Results and Discussion

This section before discussing the econometric analytical results, we quickly summarized descriptive characteristics of sample households'. The age distribution shows that majority of respondent farmers were slightly older, their average age is 52 years and every farmer has completed some level of formal education. Almost 70 percent respondent farmers fell to primary education category (Passed grade 5 to grade 10) and rest of 22 percent and 8 percent obtained the GCE (O/L) and the GCE (A/L) qualifications[7], respectively. Most of farmers with an average of 38 years of total paddy farming experience and range within 14 to 70 years in the study area. This study also revealed that majority of the household have generally large family sizes with an average of 5 individuals and range from 3 to 7 persons and an average active member who fall 15 to 65 years category is 3 persons. The average farm operation size was 3 acres and the entire

[7] The General Certificate of Education (GCE) Ordinary Level (O/L) and Advance Level (A/L) conducted by the Department of Examinations of the Ministry of Education in Sri Lanka.

sample is owner cultivation. The class-size classification of agricultural holdings clearly reveals the dominance of small and marginal farmers in agricultural operation of the study area.

Farmers reported that they tend to rely heavily on farm income sources. Many rural households grow paddy for their own consumption and sell their surpluses. While 95 percent of the farm household members engaged more than one off- paddy farm activates to support their livelihood. Survey revealed that most of these assets were purchased more than six years before and assets base is comparatively high in major irrigation community. Assets also serve as a form of saving; however, the above discus which kind of assets that may be used by a household at any point in time depends on the severity of the income failure and the liquidity of the assets. An average monthly expenditure was used as a proxy for income, which was 2500 SLRs. per person at the 2010 price level in this sample. Majority (99 percent) of farmer households were below the mean national average income per person per month (SLRs.6463)[8] and 95 percent below the average income per person per month at district level too (SLRs.4754)[9] . Most of the sample households (75 percent) live below the official poverty line[10] at national level for June 2010 (SLRs.3098) defined by the department of census and statistics in Sri Lanka. The level of outstanding debt may be inherently risk loving, or may have less resource to spend on insurance. Approximately 40 percent of the sample farmer's had outstanding debt.

Farmers were well aware of different types of insurance products in study area. Survey revealed that households were aware of 92 percent of agricultural and crop insurance in full sample. Even 71 percent were aware about agricultural and crop insurance who were not members of government AAIB. Moreover all farmers in study area about 74 percent were aware of life insurance, 27 percent were aware of funeral insurance, 44 percent are aware of health insurance and 10 percent are aware of disability insurance. Only 5 percent of the households are not aware of any insurance products at all. Awareness is high in the major irrigation area, and very low in the extreme poor income group.

Determinants of the demand for the IBMS

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. In the final part of our analysis we observe influence of this farmer characteristic to preference on above discussed difference contract scenarios.

There is encouraging according to descriptive statistic, Participants expressed a clear willingness to join for index-based microinsurance, out of 180 farmers entered, sample of 88 percent willing to join the proposed index base insurance scheme including microinsurance attribute. Further, the probit regression model was undertaken to estimate probabilities of WTJ. Farmer's participation is assumed to be explained by the following function.

$$WTJ_{(1,0)} = \beta_0 + \beta_1 X_i + \beta_2 X_2 + \ldots\ldots\ldots \beta_k X_k + u_i$$

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[8] Household Income and Expenditure Survey - 2006/07- Department of Census and Statistics - Sri Lanka

[9] Household Income and Expenditure Survey - 2006/07- Department of Census and Statistics - Sri Lanka

[10] Minimum Expenditure per person per month to fulfill the basic needs

Where WTJ, one represents willing to join the IBMS and zero not, $\beta_{0 \ldots\ldots} \beta_k$ are the estimated coefficients parameter, X_i are the explanatory variables that are consistent with demand theory, and u_i is the error term.

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 results present 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	Miner irrigation	**0.189*****	**0.7800**
RAIN_FED	Rain-fed	Base Variable	
Number of obs.	80		
Wald chi2(7)	13.55		
Prob> chi2	0.0000		
Pseudo R2	0.9090		
Pseudo likelihood	-7.7611886		

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

Estimation result reveals that, miner irrigation farmers were more likely to join the IBMS than the others relative to rain-fed farmers, while holding all other variables in the model constant. Moreover, expenditure plays a significant role in determining the decision of farmers to join the scheme. Result noticed that the young farmers in 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 more knowledgeable farmers are more willing to join insurance. Farmers with such characteristics are excellent indicators to put into practice for new insurance program. Considering, the marginal effects of the expenditure per capita variable shows that a one unit increase in the SLRs. will increase the probability of respondents to join the insurance scheme by 6.3 percent, ceteris paribus. Same interpretation for awareness index, it shows that increase the probability is 2.5 percent and vis-a-vis. For age, one unit increase will decrees the probability of joint 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 respondents to join the scheme. The regression was correction specification using link test in STATA and evaluate the statistical significance of this regression model ran the robust standard errors for heteroskedasticity problem. The pseudo R^2= 0.9090, proved the regression line fit data very well.

The study revealed that about 12 percent was not considered this product. Table 6 indicates the reasons for which some households declared that they were not interested in the IBMS contracts.

Table 6: Reasons for not buying the IBMS

Statements	%
Insurance is too expensive for me	33
My crop has not needed insurance because we can manage problems ourselves	24
I had bad experience with insurance	19
No trust in insurer - heard that insurers do not pay (manipulate with conditions, etc.)	10
My crop has not needed insurance, I think nothing serious will happen to my arable farm	10
I don't like group insurance	5

Source: IBMS for agricultural risk mitigation in Sri Lanka, field survey- 2010

Around 33 percent of the farmers believe that contracting an insurance product is too expensive for them, altogether 34 percent farmers answered, that paddy crop insurance is not needed because they can manage problems on their own and no serious damage has occurred in recent past, which is an indication that the understanding of the insurance concept or awareness levels are incomplete. Famers were reported due to bad experience or low confidences were also considerable reason for not buying. Whereas other reason apparently play a negligible role for not buying insurance.

Next, we consider spatial analysis using OLS estimation. In this section we ran separate three deferent regression models across the irrigation types. The dependant variable is a maximum amount (SLRs.) of willingness to pay for acre per full crop season in IBMS product. We enter in this analysis the entire variables which we assumed WTP is influenced by a certain number of farm characteristics described above. A summary of the final OLS models developed at irrigation types are presented in Table 7.

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 miner irrigation farmers while age square variable was positively significant only at major irrigation community. We also hypothesize that younger and more educated farmers could understand the product more easily, and be more likely to pay; in this sense, education and asset bases were significant with positive sign at major irrigation area. Farm size was not significant in irrigated area because it may almost in homogenize plot size. However the positive significant relationship on farm size at rain-fed area, which indicates that farmers who have more land to cultivate are more willing to pay a higher premium for insurance.

Table 7: 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 positively influence on the probability of farmers WTP in rain-fed area. This variable is insignificant factors for other areas. This could imply that farmer with more debt demonstrate higher demand for insurance since their risk is higher than other irrigated lands. Awareness index was again important determinant in minor and rain-fed communities, which is positively significant. But this index was not significantly association with major irrigation farmers' decision. The similar trend also appears in income diversification and labor capital indexes. One of common characteristic of these models is the greater dependency on the social capital variable. As we expected, it indicates that enough possibility for a group formation to group based product. Its indicate society's social interactions, which is facilitate to act together more effectively to pursue shared objectives (Putnam, 1993). We discussed in previous section, expenditure per capita was most influential variable to WIJ. However in WTP setting, which was only significant at major irrigation. Its negative coefficient estimate imply that more expenditure less the probability of WTP for insurance.

In the CV studies, typically present a mean or median WTP of respondents. According to methods suggested by Hanemann and Kanninnen (1996), Gunatilake, Yang, Pattanayak and Choe(2007) we estimate 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 8.

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

Table 8: 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 (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)	

Source: IBMS for agricultural risk mitigation in Sri Lanka, field survey- 2010

Note: At time of survey exchange rate equaled SLRs.110 to US$1.00.

WTJ farmers reported that they interested to cover whole farm from insurance coverage, and majority was preferred a monthly installment premium plan. Therefore we estimated monthly WTP as percentage of mean per capita expenditure based on farmer's entire farm size. We reveled that which was 4-8 percent for irrigated area and 1-2 percent on rain-fed area. However no significant disparity is observed in WTP as percentage of mean per capita expenditure across different income quartiles. The results are presented in Table 9.

The premium bids reflect the farmers' risk preferences, major irrigation farmers more risk averse than others farmers. all most half of major irrigation farmers were concentrate on 25 percent trigger level, however miner and rain-fed farmer's toleration capacity were comparatively high , which was 55 and 57 percent respectively. Rain-fed farmers were highly attractive on 80 percent coverage level and most irrigated farmers more like to 100 percent coverage than rain-fed. Contract preferences percentages are reported in table 10.

Table 9: Mean WTP per month by income quintile

	Major Irrigation		**Minor Irrigation**		**Rain- Fed****	
Income quartile	Mean WTP premium per month*	WTP as percentage of mean per capita expenditure	Mean WTP premium per month*	WTP as percentage of mean per capita expenditure	Mean WTP premium per month*	WTP as percentage of mean per capita expenditure
Quartile 1	373	6	319	8	39	1
Quartile 2	889	8	541	6	96	2
Quartile 3	602	4	738	5	147	2
Quartile 4	1049	6	953	4	285	2
Total	728	6	638	6	142	2

Note: *Mean WTP premium per month= (WTP premium SLRs. /acre per full crop season X farm size)/6 (6=months for one crop session) and

**For rain-fed, we assume that one crop session for one year (divided by 12)

Table 10: Preference for bid contracts by irrigation types- Percentage

	Major Irrigation		Minor Irrigation		Rain-Fed		Total
25% Trigger, 100% Coverage	38		27		16		
		48		**36**		**16**	**100**
25% Trigger, 80% Coverage	18		18		27		
		30		**33**		**36**	**100**
50% Trigger, 100% Coverage	27		42		27		
		29		**48**		**23**	**100**
50% Trigger, 80% Coverage	16		13		30		
		30		**27**		**43**	**100**
Total	100		100		100		

Source: IBMS for agricultural risk mitigation in Sri Lanka, field survey- 2010

Finally, we measured other explanatory variables that may affect farmer's 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 area were selected as the base cases and the influences of the explanatory variables are expressed relative to their influence in the base case. The results are presented in table 11.

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

Table 11: 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 was significant in the models developed for 1st bid contract and the 2nd bid contract samples. However, this variable was not significant in the 3rd bid contract (50% trigger, 100% coverage) relative to base contract. This index was positively association with farmer preference for risk-averse decision compare to risk- taker bid contract. Income diversification and assets indexes were negatively significant for 2nd and 3rd bid contract. Thus, other things held constant. As we expected, it may imply that more assets base and income sources are less risky which may shift toward to risk tolerance contract decision. Awareness index and education level of farmer variables had a positive and statistically significant, this coefficient estimate indicating that more awareness farmers and more educated were more likely to preferred low risk insurance contract relatively higher risk contract. It appears in our 1st bid contract model. The minor irrigation variable was significant and had a positive influence on the preference of select the 1st and 2nd bid contract compare to the rain-fed farmers. The marginal effects of the coefficient MIN_IRR implies that if a one unit increase in MIN_IRR for 1st and 2nd bid contract relative to 4th bid contract would be expected to increase by 0.9 unit while holding all other variables in the model constant. However major irrigation community was not significant any bid contract which was comparing to rain-fed. Age is negatively significant in 3rd bid contract, it confirm the younger farmers' were more likely to choose a risk tolerance plan than elders to compare with the 4th bid contract. Farm size also negatively influence on 3rd bid contract choices. It appears, hence, that more land owner farmers are low in probability to gets more risky insurance contract. The variables, labor capital and age square were not statistically significant in these models.

Conclusion

This paper reports the results of a contingent valuation survey that elicits WTP for IBMS. The robust evidence supporting this type of insurance schemes was well accepted by peasants, potential demand for insurance in the survey area seems to be very high. Results indicate that the strongest influence on age, expenditure and awareness variables to willingness to join and it's more concentrated on irrigated area. In WTP context, these observed preferences are highly location specific. Some classic explanatory variables were significant in varies on spatial and insurance contract. Most of irrigated area farmers were relatively in favor of risk-aversion behavior than rain-fed area farmers. Farmers' perceptions about harm and coverage levels, irrigated area farmers preferred low damage contract and high coverage levels, which were probably more important in their WTP decisions and the relatively high mean values emerged in this category. We found that rain-fed area farmers who were less likely to buy insurance have a low mean WTP. However study exhibit more scattered WTP values even within each irrigation type, these outliers should get into a right design through innovative mutual or community-based microinsurance intervention. Social capital was a high influence on famer's preference, therefore participatory approach insurance design where farmers are involved to design based on their own requirement. This demand-led approach may get more welfare than supply-led designed one. In this context we could conclude that uniform structure of crop insurance products do not achieve maximum efficiency. Therefore, to improve welfare, product should be designed and implemented with the synergies of different approaches. For example, price discrimination and spatial discrimination with disaster or peril-based as well as farmer requirement specified diversification needs to be explored.

Any index-based insurance programs require well-developed infrastructure and institutional network arrangements in order to run in an efficient and effective insurance system. Such conditions can be relatively difficult to find in developing countries. However in Sri Lanka well established high density metrological stations network, historical data availability and rural favorable financial culture, comparatively well-educated and literate population can help bridge this gap. The high level of social organization, widespread network of banking and microfinance institutions, postal, agrarian services network or telecommunication system and retail network may be standing as a platform to deliver microinsurance products. Moreover, well establish farmer organizations can be linked with the insurance supply chain. It would be developed with more trust rather than commercial insurance company. Survey reveals that farmers were more interested to work with the farmer organization.

Up to now in Sri Lanka, microinsurance approach is mostly concentrate on health sector. Outreach is seems to be rather limited. However these providers will be able to reach a much higher number of clients in the agriculture sector bundling with crop-product or unbundling contract design. There are clear indications of the framework conditions are also favorable for microinsurance development in the agricultural sector, however, further research is needed to investigate this supply side perspective to initiate the IBMS in Sri Lanka. This is beyond the scope of this study.

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