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Case study analysis on household attitudes towards weather index crop insurance in rural China

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Abstract

The paper extends on the literature assessing China's current "policy-oriented" agricultural insurance crop system to understand and to investigate the factors influencing the relative merits and potential demand for weather index crop insurance as a means for individual farmers in rural China to cope with weather-related production risks. Using the case of Huojia County in Henan Province, an empirical analysis is conducted of information collected from households' survey and interviews with local village leaders. The key finding is that there is a significant potential demand for weather index crop insurance product as households seek time-efficient risk management strategies although this demand is influenced by generally poor awareness of insurance, small areas, and relatively low profitability of crop production.

Keywords Weather index crop insurance, risk management, rural livelihoods

Introduction

The pressure to feed a large population and secure the livelihoods of a plethora of small-scale farmers presents a serious challenge for the Chinese government. Natural disasters, particularly weather-related, have increased both in frequency and intensity, heightening the demand for risk management strategies to enable households to cope with crop production

risks. Among risk management strategies, agricultural insurance has been mooted as a powerful poverty-alleviation mechanism and important agricultural protection tool. In China, the development of agricultural insurance has gone through a: trial period (1950-1958); recovery period (1982-1992); recession period (1993-2003); and breakthrough period (2004 onwards). A new round of pilot experiments commenced in 2004 with "policy-oriented" agricultural insurance conducted throughout China from 2007 supported by either the central government or provincial governments. The experiments and program rollout uncovered several problems that have significantly constrained farmers' demand for agricultural insurance including difficulties in claims procedures and low indemnity. Weather index insurance has been proposed as one means of overcoming these difficulties.

Weather index insurance has been defined by the United States Agency for International Development (Skees, 2006) as a "special form of insurance that can be used to compensate for losses that are strongly related to extremes in weather which often plague agricultural enterprises and increase the level of risk involved in agricultural endeavors". Payouts are not directly related to crop outputs of individual farmers but to objective weather indicators provided by an independent third party (weather station) (Collier et al., 2009; Vedenov and Barnett, 2004). A consensus appears to have emerged over the theoretical advantages of index-based insurance over traditional insurance. With a growing number of researchers such as Alderman and Haque (2007), Murphy et al. (2008) and Skees (2008) advocating and supporting weather insurance in developing countries, pilot projects have been conducted by the Commodity Risk Management Group of World Bank in Mongolia, Ethiopia, Malawi, India, Peru, Mexico, Kenya, Nicaragua, and Ukraine.

However, abundant evidence from the field suggests that pilot schemes in developing countries have encountered low demand (Binswanger-Mkhize, 2012). The opinion of Chinese scholars on the viability, potential demand and capacity to implement the schemes is mixed

(Tuo and Li, 2003; Zhang, 2008; Chen, 2010). From an economic perspective, farmers will only purchase insurance if it increases their expected utility, which depends on its net average cost to them, the likelihood and extent to which it shields them from losses, and their personal level of risk aversion (Churchill, 2006; Nadolnyak and Vedenov, 2010). From a social perspective, they will purchase insurance based on whether they trust the people who are selling it and whether they observe other members in their community doing the same (Suarez et al., 2007). As potential policyholders, farmers represent the demand for weather index insurance and so studies on their attitudes and opinions are critical to understanding how to design and implement schemes that can contribute to their needs. The information also underpins the development of a weather index insurance market from the perspective of government agencies and insurance companies. This study seeks to provide an investigation of farmers' real needs and attitudes to weather index insurance scheme. After a brief conceptual overview, Section 3 outlines the methods to be used in the empirical analysis. The results and findings from the household surveys and the insights from the interviews with village leaders are reported in Section 4 while the conclusions are presented in Section 5.

Methods

In Conceptual overview, three main questions arise for farmers in deciding whether to choose weather index crop insurance. First, should the farm household expend their income on insurance premiums or on other consumption goods? Second, if the farmer chooses insurance products to avoid risk, how important are risk and insurance for crops compared with other household insurance needs? Third, if crop production risks are considered important relative to other household risks, how does crop insurance or weather index crop insurance in particular, compare with other risk management strategies and instruments?

If farmers are rational and their goal is to maximize utility then human needs are arranged in a hierarchy (biological/physiological needs, safety, love/belonging, esteem and self-actualization) according to Maslow's hierarchy of needs (Maslow, 1934). Insurance belongs to the level of safety requirements that is normally sought after the achievement of biological and physiological needs. That is, for low-income farmers, the demand for insurance depends primarily on whether conventional necessities have been met. According to expected utility theory (Von Neumann and Morgenstern, 2007), farmers will compare the utility of paying for risk avoidance with spending on other goods. Only if the marginal utility per unit expenditure on insurance is equal to the marginal utility per unit spent on other goods, will utility maximization be achieved. The demand will also be influenced by the farmer's attitude towards risk, the level of risk associated with particular activities, as well as by other factors including economic conditions, social factors, customs and traditions.

Risks facing farm households are multi-faceted including health, income in old age, children's education, and property risk. Theoretically, farmers will only be attracted to insurance if the marginal net benefits of crop insurance exceed the marginal net benefits of other insurance products such as medical insurance and education insurance. In practice, risks that exert a significant impact on farmers' livelihoods will attract farmers' attention first, and the influence of the insured coverage on farmers' livelihoods will determine the attraction of the insurance product.

If natural risks encountered in crop production occupy an important position in the livelihoods of households, farmers will consider ways to disperse these risks and reduce uncertainty in their crop production. A key consideration is whether to buy crop insurance to cope with natural risks or to employ other strategies such as crop diversification, advanced technology, good management, savings accumulation or credit access. Even if crop insurance weighs highly in these considerations, the type of crop insurance will impact on the net benefits and

demand for insurance from farmers. As long as the net benefits from crop insurance are more than the net benefits from other risk management tools, there will be a strong incentive for farmers to participate in crop insurance.

To explore the factors impacting on farmers' perceptions and demand for crop insurance highlighted in last section, a two-fold approach involving a survey of farm households and detailed interviews with selected village leaders was undertaken. The dual approach was undertaken to address perceived difficulties in eliciting responses from individual farmers about a hypothetical insurance instrument, and that village leaders would play a crucial role in implementing any such instruments. Selected villages scattered throughout Huojia County in Henan were used with respondents in the village sampled at random from a list of all households. In the household survey, 152 households were interviewed. A stratified sampling method was used to select the village leaders to be interviewed based on the distance between the village and the local county meteorology station as distance and the robustness of the yield-weather indicator relationship was identified as a key factor in relevance and attitudes. Specifically, two villages were selected within each 2km successive band around the central county meteorology station.

Table 1. Basic characteristic of respondents

	Classification	Sample	Proportion (%)
Age	Less than 30 years old	4	3
	30-40 years old	49	32
	40-50 years old	84	55
	50-60 years old	15	10
Farming experience	Less than 5 years	8	5
	5-10 years	16	11
	10-20 years	47	31
	More than 20 years	81	53
Education level	Primary school	23	15
	Middle school	99	65
	High school	26	17
	University and higher	4	3
Family size	3 people and less	6	4
	4 people family	51	33

	5 people family	34	22
	6 people family	36	24
	7 people family	18	12
	8 people and more	7	5
Farming scale	4 mu and less	52	34
	4-7 mu	79	52
	7-10 mu	19	13
	10 mu and more	2	1

Table 1 reports basic characteristics of the household respondents in the survey. The respondents are primarily responsible for the farming activities and decisions on crop insurance in the household and comprise 87 males and 65 females (57% and 43%). Only a small proportion of respondents are younger than 30 with most respondents aged between 30 to 50 years. In the small-scale farming systems that still characterize much of rural China, young people tend to pursue opportunities off-farm. Reflecting the age distribution, more than half of the survey respondents had 20 years or more farming experience. The vast majority (85%) had secondary school education because of China's nine-year compulsory education system (including 6 years of primary school and 3 years of middle school) that began in 1986. As for family size, on average there are 5 people in a household and households with 4 to 7 people account for 91% of the sample. The scale of each farm is extremely small with an average arable land area of 5.3 mu (There are 15 mu in one hectare). The small arable land area means that the income that can be generated from the limited land is insufficient to meet the expenditure needs of the whole family.

An average household income of the respondents (including both farm and non-farm income) is CNY28879 (Table 2). However, it also reveals that income inequality in China exists not only between urban and rural households but also among rural households. From the figures for agricultural inputs (all outgoings except own labor) and outputs (cash sales except own consumption), one-third of households spend less than CNY2000 on agricultural production while more than half of the respondents earn CNY5000 to CNY10000 from agricultural

production. Thus agricultural production can generate a positive cash flow, although determining profitability requires account for unpriced inputs especially labor and land.

Table 2. Annual income and expenditure characteristics of the interviewed households

	Classification	Sample	Proportion (%)
Total income	20000 CNY and less	62	41
	20000-30000 CNY	49	32
	30000-40000 CNY	21	14
	40000-50000 CNY	9	6
	More than 50000 CNY	11	7
Total expenditure	10000 CNY and less	24	16
	10000-20000	84	55
	20000-30000	27	18
	30000-40000	10	6
	More than 40000 CNY	7	5
Agricultural income	5000 CNY and less	45	30
	5000-10000 CNY	84	55
	10000-15000 CNY	16	10
	More than 15000 CNY	7	5
Agricultural input	2000 CNY and less	53	35
	2000-3000 CNY	44	29
	3000-4000 CNY	30	20
	More than 4000 CNY	25	16

Agricultural income accounts for one third of the total income on average among the 152 survey households and so is no longer their main income source. The declining relative importance of agricultural income is likely to intensify in the future. In addition, 94% of respondents cannot rely on agricultural income to meet their household expenditure with more than half the households needing two to four times their agricultural income to cover their family expenditure (Table 2). Even if weather index crop insurance stabilizes agricultural income, it may not have an overwhelming influence on the capacity to meet current household expenditure. Nevertheless, it may still help in securing basic living expenses and improving existing living standards for rural households.

Results

1. Risks faced by household and their awareness of insurance

Agricultural households face risks from many sources including natural conditions, market, policy, labour, technology, and finance. Apart from these agricultural risks, they also encounter other household risks related to health and medical conditions, ageing, children's education, and housing construction.

a. Relative importance of household risks

Table 3 sets out respondents' perceptions of risks to household livelihoods in a hierarchical way. Respondents could list several risks of importance and so the sum of proportions in the rows in Table 3 does not equal 100%. The four main livelihood issues for households identified in the survey and reported in the first tier of Table 3 are children's education (48%), medical issues (42%), agricultural risk (39%) and problems related to aging (36%). Subsequent interviews with village leaders reported in section 4 reinforce these results. According to the respondents, issues of education, medical conditions and aging have become more important. The aging problem is likely to become more prominent in the future as more-and-more 'only children' become the main workforce of the family.

Key agricultural risks identified (second tier of Table 3) include natural risks (91% of respondents) and market risk (26% of respondents). Risk from policy changes, labor and technology were mentioned less frequently. In recent years, government support for agriculture has increased steadily as reflected in stronger investment, expanded scope of subsidies, and improved incentives (Wu et al. 2012). Households take an optimistic view of changes of agricultural policy and technical progress. Various studies highlight the serious challenges posed by the large flow of agricultural labor to urban areas and the aging of the agricultural workforce (Liu and Zhang, 2009; Tian et al., 2010; Qian and Zheng, 2011).

However, a perceived risk of labor shortage was not reflected in this survey. Farmers may not be aware of the risk or it is not as important to them as other risks. Financial risk involving interest rates and access to finance was rarely mentioned during the interviews, as many of the respondents are small-scale producers who use little formal credit while interest rates had been relatively stable around the time of the interviews. Overwhelmingly, natural disasters affecting their crop production and livelihoods are the agricultural risk that households are most concerned about.

Table 3. Respondents' perceptions on risks important to their households

Tier 1: Household risk							
	Medical risk	Elderly relatives	Children's education	Housing construction	Children's marriage	Grandchildren's birth	Agricultural risk
Numbers	64	54	73	41	24	9	59
Proportion (%)	42	36	48	27	16	6	39
Tier 2: Agricultural risk							
	Natural risk	Market risk	Policy risk	Labor risk	Technique risk	Financial risk	Other risk
Numbers	139	40	15	12	7	0	0
Proportion (%)	91	26	10	8	5	0	0
Tier 3: Natural risk							
	Drought	Flood	Wind	Hail	Frost	Pests and diseases	Fire
Numbers	123	70	59	32	10	71	1
Proportion (%)	81	46	39	21	7	47	1

Thus Tier 3 in Table 3 focuses on the perceptions of the respondents to natural risks. Although farmers have a certain view of these risks based on their own knowledge and experience, the questionnaire sought to provide some consistency by providing a general definition of natural risk; that is, whether the weather event was 30% lower or higher than the 30-year average. Around four-fifths of respondents perceived drought as a major risk while almost half of respondents considered floods and pests and diseases as major risks. Two-fifths

of respondents considered wind a major risk while hail was considered significant by one-fifth of the respondents.

Table 4. Respondents' perceptions on likelihood of natural risks and their impacts

Tier 1: Possibility of natural disaster					
	Most likely	More likely	Likely	Less likely	Unlikely
Number	9	29	74	37	3
Proportion (%)	6	19	49	24	2
Tier 2: Possibility of a crop production loss of:					
	80-100%	60-80%	40-60%	20-40%	0-20%
Number	13	32	50	48	9
Proportion (%)	9	21	32	32	6
Tier 3: Possible impact on your livelihood					
	Most serious	More serious	Serious	Less serious	No effect
Number	15	66	56	14	1
Proportion (%)	10	43	37	9	1

Households' perception on the likelihood of the risks occurring and their potential impacts appears in Table 4. Only 26% of households believed that natural disaster is unlikely to happen in the near future. If a natural disaster did occur, 62% of households think that more than 40% of income will be lost from crop production (Tier 2 in Table 4). More than half of households (53%) indicated these crop losses would impact their family livelihoods moderately or most seriously (Tier 3 of Table 4) while less than 10% of households believe that the natural disaster will not have a serious influence on their livelihoods.

Overall, natural risks are considered by farm households to have a major influence on crop production, although agricultural risks were ranked only third in importance in terms of risks to farmer's livelihoods. Nonetheless a viable agricultural insurance product may be an important component households' overall strategy to manage risks.

b. The priority for crop insurance

Insurance instruments for several of the risks identified in the previous section are available to households. Table 5 outlines the demand for different types of insurance among the

respondents by indicating whether they have purchased the specific insurance previously and whether they would like to. Medical insurance shows the highest participation rate, purchased by 76% of the surveyed households, with crop insurance (31%) being the second most widely sourced insurance. Children's insurance for education or weddings accounts for 21%, while 11% of households have previously purchased pension insurance, and 8% of households have bought vehicle insurance. Other forms of insurance include livestock insurance (pigs and cows), accident insurance (bought mainly by migrant workers engaged in hazardous work like construction) and life insurance.

Table 5 Respondents' demand for different kinds of insurance

Insurance Category		Medical	Pension	Children	Crop	Vehicle	Other
Purchased previously	Number	115	17	32	47	12	26
	Proportion (%)	76	11	21	31	8	17
Want to purchase	Number	123	82	44	87	14	1
	Proportion (%)	81	54	29	57	9	1

In terms of what households want to purchase, medical insurance again dominated being desired by 81% of households. Some households indicated that they not only wanted to have rural cooperative medical insurance which is supported by the central government, but they also want to supplement it with other health insurance that offers better protection provided it is affordable. Another feature of the table is the difference between the proportion of respondents who had previously purchased crop insurance (31%) and those who wanted to purchase the insurance (59%) indicating a potential latent demand for the crop insurance provided issues surrounding affordability, convenience and trust can be addressed.

c. Farmers' risk management strategies

The importance of risk management strategies such as diversification, contract production, government programs, maintaining financial reserves, and off-farm investments to the respondents is outlined in Table 6. Diversification included crop diversification (such as planting different crop varieties, fruits or vegetables), plot diversification (planting on

different plots), and market diversification (selling at different times or through different markets).

The first three columns in Table 6 reveal that 39% of the respondents do not use crop diversification or plot diversification as a risk management strategy, with only 23% of respondents considering them to be important or the most important tools. Market diversification was considered by 44% of respondents although 22% indicated they do not use market diversification. Overall, diversification is not a popular strategy to reduce crop production risk in the survey area. The land is of relatively uniform quality and the plots in a similar location. The farming system of two crops a year (wheat and corn) has become a tradition in this area and many farmers are reluctant to change these systems.

Market diversification obtained a more positive response from surveyed households than crop or plot diversification. According to respondents, there are only two channels for selling grain; private grain dealer or through the township grain management office. The acquisition price from the township grain management office is set in accordance with national minimum standards, and requires the farmer to deliver the grain to a designated location whereas the private dealer picks up the grain on farm but at a slightly reduced price. Thus, households with the vehicles and labor choose the township grain management office whereas the private dealer is popular with the households without the labor or vehicles. Zhu (2011) found that farmers' grain selling behavior in major grain production areas of China was changing significantly from ‘only considering the price’ to ‘considering the price, convenience and opportunity cost as a whole’. This partly explains why 44% of the respondents considered market diversification as an important instrument for agricultural risk management (Table 6).

Table 6. Importance of each risk management strategies

	Crop diversification	Plot diversification	Market diversification	Contract production	Government programs	Maintain financial reserves	Invest off-farm
Tier 1: Do not use							

Number	60	59	33	46	37	37	32
Proportion (%)	39	39	22	30	24	24	21
Tier 2: Not important							
Number	26	26	11	12	21	14	13
Proportion (%)	17	17	7	8	14	9	9
Tier 3: Less important							
Number	20	19	20	8	4	15	11
Proportion (%)	13	13	13	5	3	10	7
Tier 4: Neither important nor unimportant							
Number	12	13	21	29	29	14	4
Proportion (%)	8	9	14	19	19	9	3
Tier 5: More important							
Number	31	31	56	38	34	45	47
Proportion (%)	20	20	37	25	22	30	31
Tier 6: Most important							
Number	3	4	11	19	27	27	45
Proportion (%)	2	3	7	13	18	18	30

Contract production involves farmers agreeing to sell or deliver all of a designated crop raised in a manner set forth in the contract to a processor (such as big agro-processing factories) and being paid according to the price specified in the contract (Wang et al., 2014). Formal production contracts usually specify in detail the production inputs to be supplied by the processor, the quality and quantity of the particular crop involved, the planting methods to be used, and the manner in which remuneration is to be paid to the farmer. Since such contracts are often very specific in their requirements about the planting process and crop quality, farmers need to pay more attention to their management of the crop. If there are adverse conditions during the growing period, the quality of the crop may be relatively poor and farmers will receive a discounted price. Difficulties and uncertainties surrounding meeting the contractual specifications may be a reason why 30% of respondents indicated that they did not want to use contract production to sell their crops with a further 13% of farmers rating it as not important or less important as a risk strategy. Nevertheless there were some mixed responses, with 25% of respondents listing it as important and 13% of farmers thinking it was the most important strategy.

Similarly, respondents' attitudes towards government supported production programs are mixed. Whereas 24% of respondents said they do not use government programs to avoid farm risks and 16% considered it as unimportant, 30% of respondents did think it was important. Much of the government support program focuses on more intensive, high-value agriculture such as the cultivation of high-value vegetables or other horticultural crops like flowers in greenhouses. These crops usually have special requirements on farm size and initial investment that often exclude many small-scale farmers. The eligible large-scale farmers like to participate in government programs, but they also need the government to provide appropriate financial and technical assistance.

The final two columns in Table 6 reveal general agreement among respondents that maintaining financial reserves and investing off-farm to generate other sources of income are important. Almost half of respondents considered maintaining adequate financial reserves as important while three-fifths of respondents perceived broadening income sources as important. Nevertheless almost a quarter of them did not use financial reserves or invest in off-farm sources of income either because they were too small-scale and could not afford the large up-front costs, or they considered other strategies as more relevant.

For respondents without crop insurance, 92 respondents (88%) bear the losses of natural disasters themselves. If they are unable to do so, 78% (72 households) choose to ask for assistance from relatives and friends; 9% (8 households) apply for small loans from banks; 5% (5 households) seek assistance from government subsidies; and another 7 farmers (8%) do not have any channel for assistance. Thus most farmers still rely on their own resources to cope with natural disaster risks or seek assistance from relatives and friends. The geographical scope of a natural disaster may impact on the capacity for mutual help. These traditional management strategies also face a variety of challenges, such as local conditions, up-front

costs, and opportunity costs. Thus improving the design and making the crop insurance more attractive to this group of respondents may be important.

2. Awareness of weather index crop insurance

For the households surveyed, weather index crop insurance is a new concept. In this part of the survey, the concept of weather index crop insurance was explained as providing indemnity against adverse weather events but only through a weather index specified in the contract based on weather measurements monitored at a local weather station. To reinforce their understanding, the example of weather index insurance for rice in Changfeng County of Anhui province was explained. Following the detailed explanation, 97 households showed an above average interest in the product and 25 households showed a very high interest. Some 27 households held a neutral attitude that was interpreted at the interviews as a “wait and see” attitude. Only 3 respondents had negative attitudes towards the idea. In addition, more than 80% of households indicated they would trust the weather reports from their nearest (county) weather station as the basis for the insurance.

Among the 30 respondents who held a neutral or negative attitude, 5 considered extreme weather as an occasional event with a very small probability and with no one being able to predict its timing. Thus they did not want to waste premiums in what they considered as safe years. Eight households said they would resolve the risk by other means, such as crop diversity, or they would transport well water to irrigate their crop in a drought season. Another 8 respondents believed that the government would provide disaster relief once a weather disaster event affects a widespread area. However, when asked if local government officials or village committees ever provided any kind of compensation after a serious natural disaster, 51% of respondents said no and 43% stated they did not know. Another 4 respondents were indifferent to weather events or disasters because their livelihoods were not

dependent on agriculture. Many households primarily dependent on off-farm income continue some farming to supply their family with what they perceive as healthy food relative to that provided through commercial farming channels. If the risk event occurs, their loss is limited by the small area planted and by their access to non-farm income sources. Conversely, they do not feel the premiums are excessive given their other sources of income and so are indifferent to the prospect of weather index crop insurance. Another 5 respondents did not want to buy weather index crop insurance because they did not understand it from the explanation nor did they trust insurance companies. Their main concern was deception whereby they pay the premiums but would not receive payouts for insured events.

The respondents who expressed a positive interest in weather index crop insurance also expressed concerns about weather index crop insurance products as shown in Table 7. About 30% of these households raised concerns with difficult claim procedures they had experienced with many other insurance products. They argued insurance companies were adept at finding excuses to shirk their responsibilities to pay compensation. Another 9 respondents indicated a biased view against insurance because of bad examples described by others or through the media, while 27 respondents expressed concerns about complicated transaction procedure and insurance policy terms. Around 18 respondents were anxious about the insurance simply because they did not know enough about it. Inadequate information can lead to a cycle of blame whereby farmers blame the insurance company as irresponsible and the company complains of unreasonable expectations of farmers. Around 10% of positive respondents expressed concern about the size of premiums and whether this would impact on other household expenditures such as children's education, or family medical fees. About one-sixth of respondents were concerned whether their neighbors would purchase or not, consistent with responses that personal contacts were an important source of information among Chinese farmers and reinforcing the need for a successful pilot or demonstration program.

Table 7. Problems expressed by respondents positive to weather index insurance

	Nobody buys around me	Claims too difficult to process	Procedures and terms are complicated	Bad experiences with insurance company	Premium too high	Do not know the insurance
Number	20	36	27	9	12	18
Proportion (%)	16	30	22	7	10	15

The survey also investigated whether government subsidies influence households' attitudes towards weather index crop insurance. The prospect of a subsidy did have a marked impact on the number willing to consider weather index crop insurance, increasing the proportion from 14% to 57% of respondents (Table 8). Nevertheless, well over one-third of respondents were still undecided and would need to see a lot more details before being convinced of its merits and committing to the scheme.

Table 8. Respondents' attitudes to weather index insurance with and without subsidy

		Willing	Undecided	Unwilling
Without subsidy	Number	21	98	33
	Proportion (%)	14	64	22
With subsidy	Number	87	55	10
	Proportion (%)	57	36	7

3. Regression analysis of factors affecting farmers' interest in weather index insurance

To examine the importance of the factors discussed in above 2 sections, a logistic regression analysis was undertaken with a categorical dependent variable representing farmers' "desire" for weather index insurance and a series of independent variables representing the factors discussed in the previous sections. The logistic regression is used to predict the likelihood of an event's occurrence by fitting data to a logistic function (Walsh, 1987). It is a generalized linear model used for describing the relationship between one or more independent variables and a categorical dependent variable (in this case the "desire" or "no desire" for weather index crop insurance) (Peng et al., 2010).

Because of the lack of exposure and hypothetical nature of the weather index insurance presented to the survey respondents, it was not possible to obtain direct responses concerning uptake or willingness to pay for such an instrument. Thus the dependent variable was defined as "a desire for weather index insurance" and was derived from one of the survey questions that asked, "What is your expectation of purchasing weather index crop insurance in terms of improving your livelihoods?". The question provided for 5 responses namely: "obviously worse than before"; "slightly worse than before"; "almost the same"; "slightly better than before"; and "obviously better than before". Responses of "slightly better than before" and "obviously better than before" were considered to reflect a desire for weather index crop insurance (with the dependent variable assigned a value of 1), while responses of "obviously less than before", "slightly worse than before" and "almost the same" were considered as indicating no desire for weather index crop insurance (with the dependent variable assigned a value of 0). In the sample, some 87 households (or 57% of respondents) indicated a positive demand or desire for weather index crop insurance with the remaining 65 households categorized as having no desire for weather index insurance.

Because of the limited number of samples in the study and associated concerns over sufficient degrees of freedom in the analysis, only 7 independent variables representing the *a priori* perceived main factors were included in the analysis. Table 9 provides the descriptive and the summary statistics for the 7 variables.

Table 9. Descriptive statistics for the independent variables used in the logistic model (N=152)

Variable	Min	Max	Mean	Std dev	Skewness	Kurtosis
X_1: Education level (Primary school =1, middle school=2, high school=3, undergraduate and higher=4)	1.00	4.00	2.07	0.65	0.51	0.94
X_2: Farming acreage	1.20	12.00	5.30	2.09	0.53	0.22
X_3: Risk recognition	1.00	5.00	3.02	0.87	0.20	0.28

(not likely=1, less likely=2, neutral=3,more likely =4, most likely=5)						
X_4: Understanding of insurance (No=1, Yes=2)	1.00	2.00	1.30	0.46	0.87	-1.26
X_5: Previous annual loss (0-20%=1, 20%-40%=2, 40%-60%=3, 60%-80%=4, 80%-100%=5)	1.00	5.00	2.89	1.02	0.29	-0.60
X_6: Proportion of agricultural income to total income	0.02	1.00	0.34	0.20	1.00	1.13
X_7: Proportion of migrant workers to total family members	0.00	0.75	0.25	0.13	0.94	2.09

A seven-predictor logistic model was fitted to the data using the logistic analysis function in IBM SPSS Statistics 20.0. SPSS provides several options for specifying the way independent variables come into the regression model. This study employed the 'Forward: Likelihood Ratio' as the means for testing entry of the independent variables into the model. The removal of variables from the model is based on the significance value of the change in the log-likelihood. Variables with significance of less than 0.05 were retained in the model. When no more variables satisfy the entry or removal criterion, the regression analysis stops.

Table 10. Evolution of logistic regression results

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	Income ratio X_6	-2.020	.853	5.607	1	.018	.133
	Constant	.984	.337	8.502	1	.004	2.675
Step 2	Education level X_1	.567	.274	4.285	1	.038	1.762
	Income ratio X_6	-2.160	.865	6.242	1	.012	.115
	Constant	-.135	.628	.046	1	.830	.874
Step 3	Education level X_1	.707	.291	5.916	1	.015	2.028
	Risk Recognition X_3	.515	.225	5.237	1	.022	1.674
	Income ratio X_6	-2.733	.929	8.650	1	.003	.065
	Constant	-1.776	.963	3.398	1	.065	.169

Table 10 presents the results of the last step where there are 3 significant independent variables (Sig. <0.05) in the binary logistic regression model, namely education level, risk recognition, and income ratio. Other variables such as farming acreage, farmers' understanding of insurance, previous losses experienced, and ratio of migrant workers to the family were not significant in explaining farmers' willingness to participate (Sig.>0.05). Both

education level and risk recognition have a positive impact on farmers' interest in insurance confirming the hypotheses mentioned earlier that households with educated members who are risk aware are more likely to buy weather index crop insurance. The variable for income ratio displayed a negative impact on farmers' interest in weather index crop insurance. That is, households' demand for weather index crop insurance is inversely proportional to the ratio of agricultural income to total household income. Households relying on crop production are less likely to participate in weather index crop insurance than households where agricultural income provides a small share of total income. For some small-scale households in the survey where agricultural income is their main income source, the economic condition of these households is usually not good. While a loss in agricultural income may be very serious for such households when an extreme weather event occurs, they will tend to use their limited income for more immediate family needs such as medical and children's education expenses rather than on premiums for crop insurance.

4. Interviews with village leaders

In general, the interviews with the village leaders consolidated the responses and findings from the household survey. However, there were several key areas where the responses and perceptions of the village leaders differed from the responses of the farm households and the regression results from the household survey reported in last section. First village leaders emphasized that affordability of weather index crop insurance is not a constraint for most households. Most villagers are no longer reliant on farming for a living, and more adult men and women have wage and small business incomes that are gradually increasing as a proportion of the net income. The majority of farmers are now reluctant to invest time and energy in their farm. Thus risk management strategies such as diversification, contract planting, or participating in government programs may not be as popular among households in the area simply because they can require a lot of time and effort, and the opportunity cost

of that time and effort is high. Countering this is the fact that as households become wealthier, they can be expected to take a more commercial attitude to insurance.

Second, village leaders believe that the importance of subsidies as an influence on farmers' willingness-to-participate may be exaggerated since commercial insurance companies have long been plagued by issues of integrity. Farmers look to governments to first and foremost provide a secure policy environment to regulate the behaviour of insurance companies and ensure that their own interests are not violated, rather than rely entirely or even primarily on the financial incentives. Thus regaining the trust of farmers will be crucial for the insurance industry both in respect of weather index insurance as well as other types of insurance. The lack of trust was exacerbated by and linked with a lack of knowledge by farmers about the insurance instruments.

Third, village leaders highlighted that in recent years, the central government has allowed farmers to transfer their land contracts and management rights in various ways so as to develop their scale of crop production. The county has successfully re-allocated nearly 3,240 hectares of rural collective land through various forms of subcontract, leasing, share farming, and exchange (Zhang and Sun, 2013). Ultimately, this policy will change the traditional pattern of small-scale farmers facilitating the emergence of larger grain producers and other forms of specialization. This raises a series of questions as to whether these larger, more specialized, farmers will be more inclined to buy weather index crop insurance and whether these large farmers need or should receive government subsidies.

Discussion

Analysis of the interviews with households and village leaders reported in this paper revealed generally favorable perspectives on weather index crop insurance. That is, crop production is no longer the only source of income for many farm households, and as these non-farm

activities and sources of income increase, so too does the opportunity costs of farmers' time in managing their farm activities including managing the risks associated with them. In essence, households are seeking time-efficient strategies to manage the risks associated with their cropping activities, and weather index insurance fits into this category relative to many of the other risk management strategies. However, the effective demand from farmers for weather index crop insurance will still be influenced by their limited education, generally poor awareness of insurance products, small areas, and relatively low profitability of crop production.

Farmers represent only one stakeholder in weather index insurance. The incentives and role of insurance companies as providers and sellers of weather index crop insurance products, and the government with multiple roles as both a user, provider and facilitator will be crucial in the development of weather index insurance. Zhang (2015) explore some of the factors influencing these other stakeholders. Nevertheless, farm households represent the key stakeholder and indeed weather index insurance is designed primarily to provide them with an efficient instrument to manage their crop risks. Studies such as reported in this paper to provide a more in-depth understanding of farmers' needs and perceptions of weather index insurance will be a crucial part in guiding the design of an instrument that is also acceptable to insurance companies and aligned with government objectives and support.

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