Drought Risk Management through Rainfall-Based Insurance for Rainfed Rice Production in Pangasinan, Philippines

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Abstract - *Climate risk management which includes risk transfer through crop insurance is an important and reasonable step toward reducing the agricultural losses due to typhoons, floods and droughts. Weather index-based insurance is an innovation in crop insurance which uses indices based on weather parameters to characterize crop loss or failure. It uses historical weather data from reliable weather gauging stations and its main issue is the determination of weather index that is closely correlated to crop yield loss. In this study, the rainfall-based insurance model is based on the amount of rainfall (weather-index) to meet the rice crop water requirement in its different phases of growth and development. For PSBRc14, a typical rainfed rice variety with 110 maturity days, the cumulative crop water requirement for vegetative, reproductive and maturity stages are 270mm, 210mm, and 180mm, respectively. From these threshold values, the probability of cumulative rainfall deficit for each stage based on the relative frequency of rainfall distribution indicate drought risk. The probability of drought used in the computation of premium rates varies with planting period. For Pangasinan, the planting periods with minimum probability of drought and consequently with low insurance premiums are from the fourth week of May to third week of June. The challenges and constraints in the implementation of rainfall-based insurance that need to be addressed through institutional and policy recommendations include: (a) availability of weather gauging station; (b) affordability of insurance premium; and (c) policy support and regulatory framework for its implementation.*

Keywords: crop water requirement, drought risk, rainfall-based insurance, rainfall deficit

INTRODUCTION

Global climate is changing and further changes are inevitable. This is evidenced by observed increase in climate variability and extreme weather events including more intense floods, droughts and storms. These changes are already having major impacts on the lives and livelihood of people around the world. According to the Intergovernmental Panel on Climate Change (IPCC), water and agriculture sectors are likely to be most sensitive to climate change-induced impacts. Agricultural productivity in Asia is likely to suffer severe losses because of high temperature, severe drought, flood conditions, and soil degradation [1].

Agricultural production in the Philippines with an agricultural land area of 14.1 million hectares [2] (www.da.gov.ph) is highly vulnerable to the adverse impacts of climate change. Data from the Department of Agriculture (DA) show the vulnerability of the farming sector to the unpredictability of nature due to the problems caused by droughts, floods and typhoons. From 1990-2006, the average annual disasters losses in agriculture caused by typhoon (70.3%), drought (17.9%), flooding (4.5%) and others (8.3%) is PhP 12.43 billion [3]. Also, from 2000 to 2010 alone, the total value of damage to agricultural crops due to typhoons, floods and droughts amounted to a total of P106, 882.70 million. Crops with the most damage were rice, corn and high value cash crops. Other commodities damaged included vegetables, coconut, abaca, sugarcane, tobacco, fisheries products, and livestock [4].

Rainfed rice production system contributes 26.27 percent of the total palay production in the Philippines based on the annual data from 1987-2013 [5]. It is totally dependent on rainfall and thus, highly vulnerable to drought risk. The more frequent occurrence of severe El Niño and La Niña events in the recent years are likely local manifestations in the Philippines of global climate trends. There has not been a single year from 1994 up to present when either the cold or warm phase of El Nino Southern Oscillation (ENSO) was not present [6].

The occurrence of extreme climate variability such as El Niño or La Niña episodes is characterized by a prolonged dry period or heavy rainfall spell respectively. This often coincides with the critical stages of crop growth and development which leads to significantly reduced crop yields and extensive crop losses. The risk related with climate variability on rice production, in general, depends mainly on the growth stage of the rice crop when the weather aberration happens [7].

Reducing the impact of climate risks means lessening the vulnerability of the different stakeholders in rice production by managing risks and vulnerability of the rice production systems to the changing and varying climate [8]. Climate risk management (CRM) is an important and feasible step toward reducing long-term vulnerability to variable and changing climate. It includes: (a) systematic use of climate information to reduce the uncertainty that impacts planning and decision making, (b) climate-informed technologies that reduce vulnerability to climate variability (e.g., crop diversification, water harvesting, irrigation, improved water use efficiency, breeding for heat or drought tolerance); and (c) climate-informed policy and market-based interventions that transfer some part of risk away from vulnerable rural populations (e.g., innovative use of insurance and credit) [9].

Risk transfer through crop insurance is a means of protecting farmers against uncertainties of crop yields arising from all natural factors beyond their control. It is a financial sharing mechanism which lessens the uncertainty of loss in crop yields by pooling most uncertainties that impact crop yields to distribute the burden of loss [10].

In the Philippines, the government has established the Philippine Crop Insurance Corporation (PCIC) with a mandate to provide insurance protection to farmers against losses arising from natural calamities, plant diseases and pest infestations of their palay and corn crops as well as other crops (www.pcic.da.gov.ph). In the three decades of operation starting in 1981, the PCIC's performance in terms of number of farmers who availed of insurance was very low. The program had its highest coverage of 336,000 farmers in 1991. However, this has greatly decreased in the succeeding years and in 2006, the number of covered farmers was only 36,787. The use of crop insurance as a climate risk management has not been popular to farmers because PCIC is limited to formal farmer lenders (borrowing farmers). The PCIC's mandate to provide security for agricultural producers particularly subsistence farmers has been limited by its operational financial support from the national government. PCIC's main constraint is high operational and transaction cost [11].

Traditional crop insurance provides indemnity to farmers based on the assessment of damaged crop. Crop damage assessment requires time, labor and cost for the insurance provider. The classic problem of traditional crop insurance such as moral hazard can also happen when the insured farmer changes his motives to prevent losses because of availability of insurance protection. Such moral hazard increases costs to the insurance provider and ultimately increase the price of coverage [12].

Weather index-based insurance products are an alternative form of insurance that make payments based not on measures of farm yields, but rather on either area yields or some objective weather event such as temperature or rainfall. An index policy operates differently using a meteorological measurement as the trigger for indemnity payments. These damaging weather events might be: (i) a certain minimum temperature for a minimum period of time; (ii) a certain amount of rainfall in a certain time period which can be used for excess rain and also for lack of rain (drought) cover; or (iii) attainment of a certain wind speed - for hurricane insurance [13], [10].

Index insurance products have several advantages. They do not present adverse selection problems because indemnities and the premiums do not depend on the individual risk of the insured group. There are no moral hazard problems as farmers cannot influence the outcome that results in payments. Index insurance has low administrative costs (it does not require inspections of individual farms) and affordable premiums which makes it well-suited for farmers with low-income and with limited resources. It has standardized and transparent structure, so that policies can be sold in various denominations as simple certificates with a structure that is uniform across essential indices. Index insurance contracts allow the policyholder direct access to the information on which the payouts will be calculated. It allows rapid payout since payout depends on measurement of weather station data with no field loss adjustment. It can also have a reinsurance function as a mechanism to reinsure insurance company portfolios of farm-level insurance policies [13], [14], [15], [16].

On the other hand, index insurance products also have disadvantages. The main disadvantage of index insurance is the basis risk which is the difference between the loss experienced by the farmer and the payout triggered. It could result in a farmer experiencing substantial yield loss but not receiving a payout or in a payout being triggered without any experienced loss. When the correlation between the insured losses and the index is not enough, 'basis risk' becomes too severe, and index insurance fails to be an effective risk management tool. A careful design of the index insurance policy (cover period, trigger, measurement site, etc.) can help to reduce basis risk. The lack of weather data is also a problem since weather index insurance depend on the quality and availability of weather data. Another disadvantage is the absolute need of a strong reinsurance given that, in most cases, insurance companies do not have the financial resources to offer index insurance without adequate and affordable re-insurance In addition, index insurance is not a comprehensive product. It covers only the losses due to the index chosen and does not cover all losses. This has to be communicated to potential buyers by keeping contracts as simple as possible so that the farmer easily understands the limitations and capabilities of the insurance [13], [17], [15], [18], [16].

Innovations in crop insurance such as the weather index-based insurance products maybe a better alternative because of the unique characteristic of index insurance that differentiates it from traditional forms of crop insurance. The indemnity payments of index-based insurance products are based on values obtained from an index that serves as a proxy for losses rather than upon individual losses of policy holders. The underlying index is based upon an objective measure like rainfall that shows a strong correlation with the variable of interest, for example crop yield. It is practical since it does not require monitoring and on-farm verification of losses [13].

Weather-based insurance has been used in other developing countries as a climate risk management scheme but it has not been widely used in the Philippines. Research studies on this innovative insurance product are needed to determine its possibility as a climate risk management tool.

OBJECTIVES OF THE STUDY

The main objective of this study is to develop a rainfall index-based crop insurance model as drought risk management strategy for rainfed rice production in Pangasinan, Philippines. It also provides institutional and policy recommendations to enhance its use as a climate risk management scheme.

METHOD

Study area

The province of Pangasinan is located on the west central area of the island of Luzon along the Lingayen Gulf. It is 170 kilometers north of Manila and 50 kilometers south of Baguio City. It is considered as the "food basket" of Region I and the largest among the four provinces in the region both in terms of land area and population. It is the highest producer of rainfed palay which accounts for 62% of the total annual rainfed palay production in Ilocos Region, the second largest producer of rainfed palay in the Philippines next to Western Visayas Region [5].

The more frequent occurrence of severe El Niño and La Niña events in the recent years are likely local manifestations in the Philippines of global climate trends. There has not been a single year from 1994 up to present when either the cold or warm phase of El Nino Southern Oscillation (ENSO) was not present [6]. Pangasinan was not exempted from the effect of El Niño phenomenon in 1998. The total rainfed palay production in 1998 had a 30% reduction from the previous total production of 1997 [5]. The El Niño episode vulnerability map for rice in the Philippines from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) shows that Pangasinan is highly vulnerable to El Niño event (Figure 1). This implies great risk especially for rainfed rice production system. Pangasinan has a land area of 536,819 hectares, and 44 percent of which is devoted to agricultural production. Of the total hectarage revalidated physical areas for rice in the Ginintuang Masaganang Ani Rice Production Program in Pangasinan [19], 92,950.9 hectares are irrigated while 87,443.9 hectares are rainfed areas.

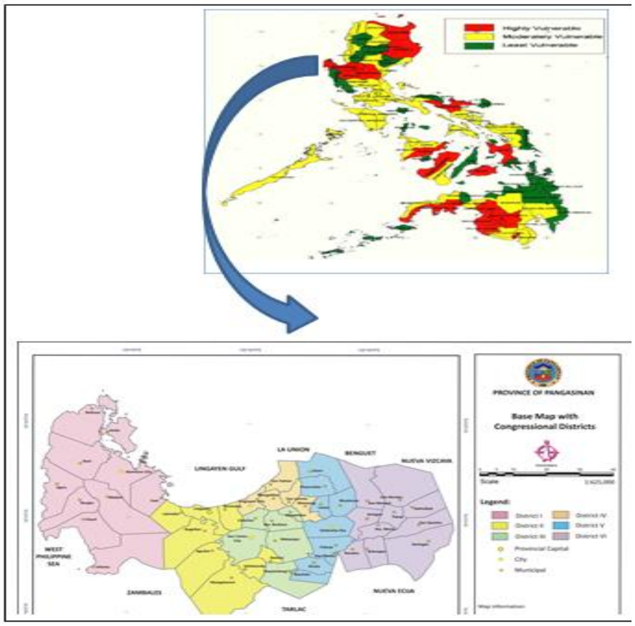

Figure 1. Location map of study area.
Source: PAGASA, 2009; Pangasinan Planning Development Office (PPDO), 2011

Drought risk analysis

In this study, the weather parameter or weather index that is closely correlated to crop yield loss in rainfed rice production system is rainfall. Drought risk is based on the amount of cumulative rainfall to meet the water requirement for the rice crop growth and development. The crop water requirement is dependent on the number of maturity days of the crop variety planted. Different varieties have different maturity days, which include the number of days during the vegetative stage, reproductive stage and maturity stage of the crop. In this study, the crop used is a typical rainfed transplanted rice variety PSB Rc 14 which has 110 maturity days. Using a 6mm/day crop water requirement [20] the cumulative crop water requirement for vegetative stage, reproductive stage and maturity stage are 270 mm, 210 mm, and 180 mm, respectively. Cumulative rainfall deficit from these threshold values indicate yield loss that serve as basis in the computation of payout. Drought risk was estimated using the probability of cumulative rainfall deficit from the threshold values of rainfall to meet the cumulative crop water requirement of the crop in its growth and development stages.

Drought risk analysis for a commercial weather index insurance and reinsurance transaction requires at least 20 years of historical daily rainfall data [16]. The data used in the drought risk analysis of this study is the historical 30-year rainfall data from PAGASA Dagupan City the only source of available historical rainfall data. Sta. Maria, Pangasinan was chosen as the area to determine the possible acceptability for the application of the rainfall-based insurance model since a comparative analysis using t-test of the available 10-year monthly mean rainfall data from Sta. Maria, Pangasinan and the corresponding 10-year monthly mean rainfall data from PAGASA Dagupan City showed that there is no difference on the average monthly mean rainfall data from these two locations.

Drought risk or the probability of cumulative water deficit in each growth stage was determined using the Gumbel relative frequency formula given as:

$$P\,(CRi < ri) = m/(n+1)$$

*w*here

P = probability

CRi<ri = cumulative amount of rainfall (CR) less than the total water requirement (r) or cumulative water deficit at ***i*** specific growth stage;

i = index for crop development stage, i.e. 1= vegetative stage, 2 = reproductive stage and 3 = maturity stage;

m = the number of historical cumulative amount of rainfall less than the water requirement when data are arranged in ascending order; and

n = the total number of observations.

On the other hand, the probability of meeting crop water requirement in each growth stage was calculated from the computed probability of cumulative rainfall deficit. This was computed for different planting periods. The formula used is:

$$P\,(CRi > ri) = 1 - P\,(CRi < ri)$$

where

P (CRi > ri) = probability of meeting cumulative water requirement at *i* specific growth stage

P (CRi < ri) = probability of cumulative rainfall deficit at *i* specific growth stage

The total probability of meeting water requirement is taken as the product of the probabilities of meeting water requirement at the vegetative stage, reproductive stage and ripening stage. The probability of meeting water requirement

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in each crop stage is considered as an independent event. The total probability of cumulative rainfall deficit is computed as one minus the total probability of meeting water requirement.

Computation of premium rate

Based on the results of the drought risk analysis, the rainfall-based insurance premium rate was calculated using the probability of drought at different planting periods. The rainfall-based insurance premium was determined using the formula of net single premium [21]. A net single premium (NSP) is a premium which is received by the insurer in a lump sum and is exactly adequate, along with the return earned thereon, to pay the amount of claim wherever it arises. It does not include the expenses of management and contingencies and other expenses of providing the insurance contract such as taxes, and operating expenses. The net single premium was obtained to determine the total amount of appropriate premium charged by the insurer given the information on the drought risk associated in the area. The formula is given as:

$$NSP = [1 / (1 + i)^{p}] \times PD$$

where

$[1 / (1 + i)^{p}]$ = monthly discount factor;

i = rate of interest per month;

p = growth period of rice in months (e.g. equal to 4 for 110-day variety); and

PD = probability of drought = probability of cumulative rainfall deficit [$P(CRi<ri)$] taken from the result of drought risk analysis

The monthly interest (i) used in the analysis was 0.792 % derived from the interest rate used for farmer loans from Landbank which is 9.5% per annum (http://www.landbank.com). A discounting factor was used to obtain the present value of the premium, discounted at the start of the contract with growth period of rice in months (p) equal to four.

The total premium is computed at different planting dates. The premium with discount rates similar to the PCIC rice crop insurance product is also computed assuming that PCIC will subsidize the premium. The contracts were structured to be purchased with corresponding amounts of premium, as percentage of sum insured, depending on the period of planting. Different planting dates have different corresponding amount of premiums.

One of the advantages of rainfall-based insurance is the rapid payment of payout. In determining the amount of payout, the threshold values of the drought index used in the payout structure of the rainfall-based insurance are the water requirement at different growth stages of rice which is 270 mm, 210 mm, and 180 mm for vegetative stage, reproductive stage and ripening stage, respectively. Payout shall be automatically calculated if there is rainfall deficit based on the water requirements of the crop during each of the three growth stages. The benefit payable is computed as:

$$Payout = (ri - CRi) \times payout\ rate \times (total\ sum\ insured/1000)$$

where:

ri = the total water requirement (r) at i specific growth stage, namely: 270 mm, 210 mm and 180 mm for vegetative stage, reproductive stage and ripening stage, respectively;

CRi = the cumulative amount of rainfall (CR) at i specific growth stage;

payout rate = amount in PhP per mm of cumulative water deficit namely: 2.50, 3.00, and 1.50 for vegetative stage, reproductive stage and ripening stage, respectively; and

total sum insured = total amount of crop insurance coverage.

There is a different payout rate in PhP per mm of cumulative water deficit for the three crop stages. The crop development stage with the highest payout rate is the reproductive stage since it is the most critical stage for drought occurrence.

Factors affecting the farmers' adoption of rainfall-based crop insurance and maximum willingness to pay (Max WTP) for the insurance premium

The factors affecting the farmers' adoption of rainfall-based insurance as a climate risk adaptation strategy were determined using the data gathered from the household survey with the use of an interview schedule. Data gathered from the respondents included the following: (1) respondents' socio-economic profile; (2) respondents' farm characteristics; and (3) farmers' willingness to adopt rainfall-based crop insurance and the maximum willingness to pay for the insurance premium using contingent valuation method

Before the conduct of the survey, information on the PCIC rice crop insurance product such as requirements, premium, and implementation procedures were gathered through literature review and from the PCIC Region I office Similarly, a brochure on the proposed rainfall-based crop insurance product developed following the above enumerated procedures was also prepared. These two crop insurance products as climate risk management strategy were explained to the farmers during the interview for the household survey.

Using the direct open-ended WTP model, the Maximum Willingness To Pay (Max WTP) of sampled farmer respondents was elicited directly by asking the respondents of whatever maximum amount they can pay for the rainfall-based insurance.

The logistic regression analysis was used in determining the factors that affect the adoption of the rainfall-based crop insurance. The likelihood of a farmer buying rainfall-based crop insurance was modeled as a function of the perceived severity of hazard; the socioeconomic characteristic of households (i.e., level of education of the household head/farmer respondent, tenure, and length of farming experience); and the physical attributes of the farm itself (i.e. size of farm area, distance to the nearest market outlet, and perceived soil quality). A logistic regression model was used to predict the farmer's adoption of the rainfall-based crop insurance given these set of variables. Using the direct open-ended WTP model, the Maximum Willingness To Pay (Max WTP) of sampled farmer respondents was elicited directly by asking the respondents of whatever maximum amount they can pay for the rainfall-based insurance.

RESULTS AND DISCUSSION

Drought risk which is expressed as the probability of cumulative rainfall deficit at different crop growth stage per weekly planting period is shown in Figure 2. The planting period with low probability of cumulative rainfall deficit during the crops' growth stage (vegetative stage, reproductive stage and ripening stage) or low drought risk is from the fourth week of May to the third week of June (May 22-June 18). Planting or sowing within these dates have the lowest probability of cumulative rainfall deficit or the highest probability of meeting water requirement at different growth stages.

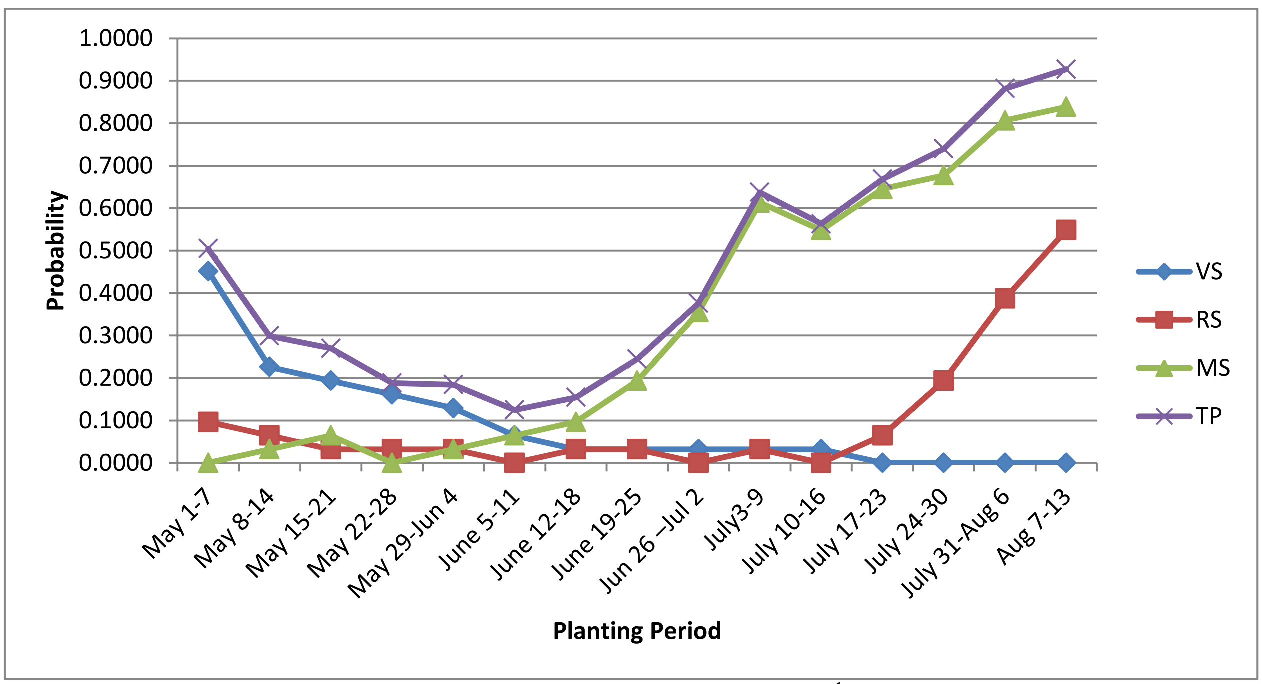

Figure 2. The probability of cumulative water deficit (6 mm day^{-1}) during the vegetative stage (VS), reproductive stage (RS), maturity stage (MS), and total probability (TP) at different periods of planting in Dagupan City, Pangasinan.

The premium rate (as percentage of sum insured) in this study varies per planting period. The computed premium rates based on the computed probability of drought at different planting periods is presented in Table 2. The lowest estimated total premium rates fall within planting periods from May 22-June 18 and ranges from 12.10% to 18.25%. The lowest amount of premium rate as percentage of sum insured is 12.10%. This is almost similar to the total premium rate for multi-risk crop insurance of PCIC for medium risk which is 12.22%.. Pangasinan is classified as medium risk area by PCIC Region I. The high premium rates fall within the late planting periods which is from third week of July to second week of August. These planting periods have high probability of drought. To avail of rainfall-based crop insurance with low premium rates, farmers should plant from May 22 to June 18.

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Table 2. Estimated premium rate for self-financed farmers (with subsidy assumed as similar to PCIC subsidy) for rice (drought-risk cover) in Dagupan City, Pangasinan (as percentage of sum insured) at different planting period based on a 30-year rainfall data.

PLANTING PERIOD	TOTAL PREMIUM RATE (TPR) WITHOUT SUBSIDY	SELF-FINANCED FARMER (51.26% OF TPR) WITH SUBSIDY	BORROWING FARMER (35.69% OF TPR) WITH SUBSIDY	GOVERN-MENT (48.74% OF TPR)	LENDING INSTITU-TION (15.57% OF TPR)
May 1-7	48.90	25.07	17.45	23.83	7.61
May 8-14	28.98	14.86	10.34	14.13	4.51
May 15-21	26.15	13.41	9.33	12.75	4.07
May 22-28	18.25	9.35	6.51	8.89	2.84
May 29-Jun 4	17.86	9.15	6.37	8.70	2.78
June 5-11	12.10	6.20	4.32	5.90	1.88
June 12-18	14.93	7.65	5.33	7.28	2.32
June 19-25	23.71	12.16	8.46	11.56	3.69
Jun 26 –Jul 2	36.40	18.66	12.99	17.74	5.67
July3-9	61.77	31.66	22.04	30.11	9.62
July 10-16	54.55	27.96	19.47	26.59	8.49
July 17-23	64.73	33.18	23.10	31.55	10.08
July 24-30	71.69	36.75	25.59	34.94	11.16
July 31-Aug 6	85.40	43.78	30.48	41.62	13.30
Aug 7-13	89.84	46.05	32.06	43.79	13.99

Table 3. Distribution of farmers willing to adopt the rainfall-based crop insurance and the farmers' maximum willingness to pay (Max WTP) for a PhP 10,000.00 amount of cover in Sta. Maria, Pangasinan, 2011.

WILLING TO ADOPT	TOTAL RESPONDENTS (N=110)	PERCENT (%)
Yes	73	66
No	37	34
Total	110	100
Max WTP		
200-500	42	38
501-1000	22	20
1001-1500	6	5
1501-2000	3	3
Total	73	66
Mean Amount = PhP 731.51		

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The distribution of farmers willing to adopt the rainfall-based crop insurance and the amount of premium they are willing to pay for a PhP 10,000.00 amount of cover is shown in Table 3. Among the total respondents, 66% are willing to adopt and 34% are not. The amount the respondents are willing to pay for the premium of rainfall-based crop insurance with a PhP 10,000 amount of cover ranges from a minimum of PhP 200 to a maximum of PhP 2000 with an overall average amount of PhP 731.51. This amount of premium is equivalent to 7.32% of sum insured which is lower than the computed lowest premium which is 12.10% of sum insured (Table 2). However, if PCIC will give similar premium subsidy of its rice crop insurance product to the rainfall-based product in this study, the amount of premium which is 7.32% of sum insured is higher than the subsidized premium which is 6.20 % of sum insured for the self-financed farmer and 4.32 % of sum insured for the borrowing farmer.

The acceptability of rainfall-based insurance as a drought risk management strategy determined through household survey with the use of a pre-tested interview schedule reveal that majority (66%) of the sample rainfed rice farmer respondents in Sta. Maria, Pangasinan are willing to adopt the rainfall based insurance. A farmer's decision to adopt the rainfall-based insurance is positively influenced by the number of family labor, and negatively affected by the farm's distance to nearest market. A farmer with more working family members and a farmer with lesser farm distance to market are likely to adopt the rainfall-based crop insurance. A farmer with more working family members would like to insure that the fruit of their labors will not be lost or wasted. On the other hand, a farmer whose farm is closer to the market can buy farm inputs as well as market his produce easily. This also implies easier access to other farm products including crop insurance products.

CONCLUSION AND RECOMMENDATION

One of the climate risk management strategies to address drought risk is crop insurance. Weather index-based insurance is an innovation in crop insurance which uses weather parameters (e.g. rainfall or temperature) to characterize crop loss or failure. The rainfall-based crop insurance model for Pangasinan was developed using the historical 30-year daily rainfall data from Dagupan PAGASA station (weather index insurance requires at least 20 years of data). Drought risk is based on the amount of cumulative rainfall to meet the cumulative crop water requirement per development stage. With rice crop water requirement of 6 mm per day (Yoshida, 1981), the PSB Rc 14, a rainfed transplanted rice variety with 110 maturity days, has a water requirement of 270 mm, 210 mm, and 180 mm for vegetative stage, reproductive stage and maturity stage, respectively. These are the threshold values for each growth stage. Cumulative rainfall values below these threshold values or cumulative rainfall deficit signify yield loss. The cumulative rainfall deficit is used in the computation of the amount of payout or indemnity payment to the insured farmer in each growth stage. The cumulative rainfall deficit as indicators of crop loss and basis in the computation of payout is to be measured through installed weather stations. Moreover, rainfall-based insurance only covers farms within 20 km radius from weather stations with accurate weather records like PAGASA.

The amount of premium rates (as percentage of sum insured) calculated based on the values of the probability of drought (i.e. cumulative rainfall deficit) varies with weekly planting period. The planting period with minimal drought risk and consequently low premium rates is from May 22 to June 18.

Farmer respondents in Sta. Maria, Pangasinan are willing to adopt the rainfall based insurance as a drought risk management strategy. A farmer's decision to adopt the rainfall-based insurance is positively influenced by the number of family labor, and negatively affected by the farm's distance to nearest market. A farmer with more working family members and a farmer with lesser farm distance to market are likely to adopt the rainfall-based crop insurance.

The institutional and policy recommendations needed to enhance the adoption of the rainfall-based crop insurance include: (a) the installation of adequate weather gauging instruments. Data from these weather gauging instruments should be made accessible to both the insurance providers and the farmers. The automated weather stations (AWS) installed in state colleges or universities (SCUs) or in LGUs should be accredited by PAGASA so that they can be used as weather gauging stations in the implementation of rainfall-based crop insurance; (b) the provision of premium subsidy by the government (PCIC), LGUs or other GOs and NGOs that could serve as funding agencies. It is also possible that farmers can form groups so that they could be given a group insurance or they can be members of cooperatives who can have cheaper or discounted premiums. The government could also give some incentives to other insurance providers by reducing taxes or offering tax exemptions on these insurance products to make them cheaper or affordable; and (c) information, dissemination, promotion and implementation of weather index-based insurance as a climate risk management strategy to all farmers especially those who are in remote areas with the collaboration of other agencies such as PAGASA, DA, LGU, Land Bank and other lending institutions and insurance providers.

The rainfall-based insurance system developed for Pangasinan could be used in developing rainfall-based insurance for other provinces in the region through the DA Regional Office. For sustainability, DA could subsidize the premium for rainfed farmers. The weather index-based insurance should be explored to be applied in other regions of the country. Weather index-based insurance products only cover a specific risk and only provide partial protection. Thus, it is recommended that research studies be conducted to develop other applications of weather index-based insurance like typhoon insurance and flooding insurance to cover other climate risks. Weather index-based insurance products for other crops such as corn and high value crops could also be developed. Its use for livestock insurance and as an early warning system in case of natural disasters should also be explored. Other studies will be on how to communicate weather index-based insurance to stakeholders.

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