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RESEARCH ARTICLE

Assessment of crop insurance international practices, policies and technologies as risk mitigation tools in India and Thailand

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Abstract

Crop insurance has significant potential to mitigate risks that individuals and countries are exposed to in light of rising disasters in Asia-Pacific region. The advancement of technologies has facilitated the transition of insurance industry from traditional practices to weather based and/or satellite based crop insurance schemes despite their associated challenges. However, the difference between the insured quantity and the underlying risk called basis risk remains a key challenge for the growth of index based crop insurance products. The study provides an overview of current international practices, policies and technologies relating to the use of crop insurance with case studies of India and Thailand. Both countries are at different stages of adapting index based crop insurance with varying level of support from government. Specifically, weather index insurance is continuously evolving and a combination of technology application and policy up gradation can potentially reduce reliance on subsidy and increase private sector engagement in crop insurance.

Introduction

Agriculture continues to grow as an important sector contributing to food security in the Asia Pacific region (Figure 1). In particular, India is expected to retain its position as top rice exporter with estimated rice exports of 9.5 million m/t followed by Thailand at 8.7 million m/t in 2014(FAO, 2014). Moreover, agriculture accounted for a significant percentage of GDP in 2013, for instance 18 percent in India and 12 percent in Thailand (The World Bank, 2013). While dominating the 90 percent rice production of the world (Timmer, 2010), Asia-Pacific unfortunately also accounted for 80% of the global disasters in 2011 with an estimated loss of $294 billion (UNESCAP, 2013). More importantly, the regions single year losses were also 80% of the total disaster losses from the decade 2000-2009 indicating the rising risks to agriculture. The Great East Japan Earthquake and Tsunami that led to the nuclear disaster and the South East Asian Flood, severely affected Thailand. These were listed among major global disaster(The Asia-Pacific Disaster Report, 2012).

While disasters like typhoons, floods and droughts might have small impact on the overall national agricultural production, they have significant impact on the lives of individuals associated with it at provincial, district or community level. For example, in 2011 Thailand floods, the damage and loss assessment (DaLA) estimates for agricultural sector was $1260.33 Million allocated to private ownership only(The World Bank, 2012). In addition to disaster, agriculture is also impacted by changing weather vagaries. The population living at the base of the pyramid, including farmers, are the hardest hit by these losses, often resulting in extremities such as farmer suicides (e.g. India), political unrests (e.g. Thailand) etc. causing much greater losses not only to individuals but to the entire society and economy.

In the recent years, there has been increasing interest in the use of financial instruments in order to help the developing countries cope up with their financial needs resulting from natural disaster/catastrophe. Various new instruments like contingent credits (e.g. Philippines) and catastrophe bonds (e.g. Mexico) are now available that the governments can easily access through the international and domestic financial market for better management of their budget volatility. Experience suggests that high level of debt does not allow some countries to access post disaster credits and thus limit their ability to distribute losses. Also, the budget process in many countries does not permit the government to any post disaster reallocation of their budget, thus leading to liquidity crunch.

There is an urgent need for agricultural risk mitigation measures that are more predictable from the point of view of the affected and more sustainable from the government perspective. The risk can be better managed by spreading it across entities (public and private) that have the capacity to absorb them, convert these into business opportunity, make the packaging and delivery more efficient and reduce uncertainty in terms of the level of relief compensations. In such a scenario, crop insurance can act as a risk reduction mitigation tool to build resilience.

The aim of the paper is to provide an overview of current international practices, policies and technologies of crop insurance highlighting the cases of India and Thailand where both countries were observed to be at different phases of adapting index based crop insurance with varying level of support from government. Specifically, weather index insurance is continuously evolving and an effective use of technology coupled with appropriate policy measures can create the right enabling environment for private investment in the crop insurance sector; a much needed shift from the current government based subsidy mechanism. With the top rice producing countries being in Asia, it can be very useful to the farmers but unfortunately, agriculture insurance today either has very low penetration, is unavailable or extremely expensive in developing countries.

The paper is structured as follows: It starts with discussion on agricultural insurance market, agricultural risk strategy followed by crop insurance overview with a focus on weather index insurance worldwide. Further, discussing the policy frameworks and technologies adapted by different countries highlighting and analyzing the crop insurance mechanisms in India and Thailand.

Agricultural Insurance Market

The global annual agricultural insurance premium volume was US$6.5 billion in 2001 rising to US$ 23.5 billion in 2011(Swiss Re, 2011). In 1990, about 50 countries were identified as having some form of agricultural insurance, which by 2010 increased to about 104 countries (almost half the number of countries)that either had matured or pilot insurance programs (FAO, 1991b). The **Asia and the Pacific region** has also experienced a high growth in the agriculture insurance sector in the last decade where the volume of insurance premium increased from US$1.6 Billion in 2005 to US$4.0 Billion in 2009. It represented more than 20% of the global agriculture insurance premium. The major growth has taken pace in China, which accounts for 50 percent of the regional agriculture insurance premium followed by Japan (31 percent), India (11 percent), Australia (4 percent) and the Republic of Korea (3 percent)(Food and Agriculture Organization, 2011). These five countries contributed to an overall 99 percent of premium in the region with the ASEAN member countries (the Philippines, Thailand, Vietnam, Malaysia, and Indonesia) having either comparatively new insurance or having a low penetration level. As of now, no evidence of agricultural insurance (crop or livestock) has been identified in countries like Cambodia, Lao PDR , Myanmar (The World Bank; GFDRR, 2012). Public sector agricultural insurance programs in the Asia Pacific region have generally shown poor financial performance mostly because of the premiums being lower than the required cost of implementation and administration. Many schemes running on voluntary basis (not linked to credit) also suffer from moral hazards and adverse selection leading to discontinuation with exceptions in India, the Philippines and Sri Lanka.

Agricultural Risk Strategy

Agricultural risks specifically affecting crop can be categorized in three types, i.e. production risk(due to weather, biological or labor risks), market related risk(due to price, market supply and demand volatility) and enabling environment risk(policy and political risk) which further needs prioritization based on the probability of occurrence and severity of losses (Siegel, Andrews, & Jaffee, 2010). This paper particularly focuses on the agricultural production risk where crop insurance can be used as an ex-ante strategy tool (Figure 2) to share or transfer the risk of farmers. The informal or traditional risk management practices adopted by the farmers either at farm level (like savings, storage, diversification, production techniques) or community level (like food crop sharing, common property resource management, and rotating credit) cannot protect them against low frequency high severity covariate risk like floods, droughts or tsunamis. In such scenarios, risk transfer through agricultural insurance (public, private or public-private partnerships) plays a very important role. Various global practices have been discussed and analyzed with respect to insurance in the agriculture sector including their expected premiums (Roth & McCord, 2008) and (Kahane, 1970).

An efficient formal ex-ante risk financing strategy can help in strengthening the government capacity to respond to a natural disaster while limiting pressure on the fiscal balance. Various financial instruments are available to build such a strategy, each having its own cost implications and characteristics. For example, contract marketing, traditional agriculture insurance, weather index insurance (WII) and contingent credits. Adaptation of these financing strategies can be based on the frequency and severity of catastrophe. Budget contingencies along with reserves are the cheapest source of ex-ante financing and are generally used to cover the recurrent losses. For example, governments of Indonesia, Malaysia and Philippines have allocated annual budget for potential disaster needs. Other sources of financing such as contract marketing, contingent credit and weather index insurance need to be adapted by developing countries before publically provided budget/subsidy to absorb risks are exhausted. A bottom up approach should be considered so that the government can initially secure funds for handling recurrent disasters and further increase its financing capacity to support events with low frequency and high severity. The immediate liquidity to ensure that the relief and recovery are not delayed can be managed by intermediate risk transfer mechanisms such as contingent credit, insurance, insurance linked securities etc. Financial instruments like contingent credit are being used by countries like Lao PDR, Philippines and Thailand. There are also examples of Catastrophe Bonds being issued by the Mexican government under the World Bank's MultiCat program against risks like earthquake and hurricane, use of weather derivatives in Australia and special taxes increased in Mongolia post disaster.

Various possible combinations of financial instruments to protect the fiscal balance have been analyzed (Ghesquiere, 2010) along with various options for disaster risk financing and insurance in the ASEAN region (GFDRR; The World Bank; ISDR, 2012). Financial institutions like Global Index Insurance Facility (GIIF), a world bank group is a multi donor fund working on four major challenges in developing weather index insurance in developing countries i.e., raising awareness amongst the stakeholders, conducting feasibility studies, building capacity and supporting with premium subsidies. Remote sensing-based Information and Insurance for Crops in Emerging economies (RIICE), a public private partnership is working on reducing the vulnerability of rice farmers in developing countries of Asia. The current projects at RIICE are targeted to improve rice crop information and increase efficiency and effectiveness of crop insurance solutions in developing countries.

Crop Insurance: An overview

Crop insurance is considered as a formal financial instrument to build resilient communities and guarantee food security (UNISDR, 2013). Agriculture sector is generally considered less vulnerable as compared to cities or industries in terms of economic damage. With many studies targeting the agricultural damage (Pauline, 2013), it is important to tackle the impact of damage on crops with respect to the small land farmer. The demand and willingness to pay for crop insurance is the key to determine the scalability and sustainability of unsubsidized voluntary crop insurance (Smith & Watts, 2009).

Agriculture systems are dynamics that change over time depending on the changing weather patterns and disasters, continuously present different patterns of risk. In order to cope with these risks, the insurance industry has been conducting research on new techniques for ascertaining the losses, using efficient and economical methods for measuring losses and developing new insurance products. For any risk to be insurable, two crucial requirements amongst others are a) to manage the adverse effects of asymmetric information, and b) overcoming the systemic risk as many farmers might suffer from the same loss at the same time. In case of unavailability of reinsurance, the systemic risk makes the insurance company charge for a high premium which can be unaffordable to many farmers. This indicates that agricultural insurance needs a backing from the public sector but at the same time if the government compensates the farmer for the disaster losses; it hampers the development and demand of insurance products.

The Insurance industry has come a long way transiting from the **traditional crop insurance** (Yield Index) to the weather index based crop insurance (Table 1). In traditional crop insurance schemes, the insured typically receives an indemnity from the insurer when the crops are damaged by drought, hail or frost (so called multi peril crop insurance). The farmer benefits from such information asymmetry and such insurances exist largely because of the subsidy provided by the government. Subsidies account for almost half of the premiums in the cases of FCIC in USA, FONDEN in Mexico, PROPAGRO in Brazil, CCIS in India and PCIC in Philippines. In a future with rising disasters, such levels of subsidy are clearly not sustainable.

Weather index based crop insurance is an interesting alternative being adopted by many countries where the indemnity is not based on the damage of crops but on the level of weather index, which is correlated to crop yield. Weather based indexes can include parameters such as Rainfall, Frost, Temperature, Water Stress etc. Currently, Rainfall is most commonly used weather parameter for such index insurance but has drawback of **basis risk**. This risk reflects the fact that correlation between crop yield and weather parameter (rainfall) are never perfect and there are differences between the losses experienced by the farmer and the payout triggered resulting in the possibility of underpayment or overpayment. Index insurance works best where losses are homogeneous in the defined area and highly correlated with the indexed peril.

The accuracy of index insurance is hampered by the non availability of historical data as many areas lack access to weather stations with sufficient granularity or the level of technology e.g. the use of traditional rain gauges. Basis risk may also arise from inappropriate density of weather stations or poor index design (Rao, 2010). Basis risk could be spatial, temporal or product based(World Food Program; IFAD, 2011). In order to minimize the basis risk, the industry is looking for solutions that can provide more accurate data using terrestrial and geospatial technologies.

Focus on weather index insurance and its challenges

Weather index insurance has been considered as having great potential in reducing the premiums and making insurance accessible to more farmers. Although large amount of research and pilots have been undertaken worldwide, few examples of successful scale up at farmer level have been observed (The World Bank, 2011).

Specific challenges while implementing weather index insurance in Malawi were identified as communicating insurance concept to farmers, convincing farmers, micro climatic conditions (Basis Risk), limited weather stations and interest of financial institutions in cash crops (Gommes, 2013). Apart from geographical basis risk and production basis risk (Figure 3) an additional factor called Pure Idiosyncratic Risk i.e. an individual farmers crop might be damaged by highly localized weather events or an animal or bird damage can also contribute in increasing basis risk but geographical and production basis risks shall be considered as they can be influenced by designing the contract (Carter, 2006). Reducing basis risk can play a major role in improving the scaling up of weather index insurance (Chen, 2011). Ideally, the basis risk is reduced when the area covered by the index is homogeneous both in terms of weather and in terms of farming techniques. Many studies suggest that with increase in the weather station density and satellite pixel, basis risk can be minimized.

Incorporating multiple data sources for building products can be useful in reducing the basis risks. In 2013, Kenya experienced an advantage in combining two covers: a weather station based index cover in combination with an area yield cover at county level (through the Ministry of Agriculture), providing an additional protection from geographical basis risk. In 2013, GIIF's project, the Syngenta Foundation for sustainable Agriculture (SFSA) insured 56,200 farmers under the combined cover of weather and yield index insurance (Dugger, 2014). Current index insurance schemes use simple assumptions to decide the maximum distance between the gauge and an insured farmer. Ideally, the weather based index insurance aims to captures the relationship between rainfall and crop yield, which is frequently non-linear and dependent on the spatial and temporal scales or the area. It is very important to understand the maximum distance of the gauge/weather station from the insured farm and the limit when the gauge record is considered or not considered as representative of the farm's rainfall. Traditionally, many index insurances worldwide have used an empirical distance of 20 km, a distance derived from one of the original index insurance scheme based in Mali (Osgood, 2012). But the high variability and many more features of rainfall make this assumption very challenging and inappropriate. For instance, the spatial scale of average rainstorm in Mali might be different from the spatial structure of rain in South Africa, small scale thunderstorms in the Ethiopian mountains, rainfall in the plains of India or rainfall from a squall line in Sahel. The strongest predictors of payout for a farm is payout at nearby location

It is important to know the time of the year when rainfall is most likely to affect crop yield as the spatial structure of rainfall will also change with time. Daily rainfall amounts provide the spatial scale of local weather. Similarly, the structure of monthly and seasonal totals will reflect the large scale climatic situation (Grimes and Pardo-Iguzquiza, 2010), which indicates that index insurance based on seasonal rainfall can be applied based on the daily rainfall gauge based index insurance.

It is important to understand that whether index insurance is to cover against flood or drought. Finer spatial scale would be needed in case of extreme rainfall and floods whereas larger spatial scales would be needed for monitoring rainfall occurrence in case of droughts. Again, there is no universal relationship between rainfall occurrence and intensity. The spatial structure of rainfall might not be isotropic around the rain gauge, i.e. it might be different when we look north-south or in the east-west direction as observed in case of Sahel. Normally, the rainfall intensity increases with altitude but some regions for instance in Ethiopian mountains a rain-shadow effect occurs, where rainfall amount decreases with height (Dinku et al., 2007). This is an important criterion for index insurance as most of the gauges were located in the plains along the roads and not on the mountains or agricultural areas of Ethiopia.

Considering the above challenges of spatial structure of rainfall, it is very important to estimate or quantify rainfall. Thus simply considering the assumption of farmland at a distance of 20 km away from the rain gauge would be inappropriate. Using geo-statistical techniques like variogram for measuring spatial rainfall pattern has been suggested to obtain a baseline spatial scale for index insurance design (Greatrex, 2013). Software suites like KrigeRain and Info-Map can be used to come up with climatic variogram. Also, a portfolio of index insurance based on multiple weather stations would help to offer transparent pricing that would offer a point estimate for risk at unknown locations(Norton, Turvey, & Osgood, 2013).

Weather index insurance world wide

In the United States, Rainfall and Vegetation index insurance pilot project exist for producers of forage and hay crops against late blight disease. The programs are called Pasture, Rangeland, Forage Rainfall Index (PRF-RI) and Pasture, Rangeland, Forage Vegetation Index (PRF-VI) where the indices are based on rainfall and vegetation respectively. The program is led by United States Department of Agriculture, Risk Management Agency (USDA-RMA) with Federal Crop Insurance Corporation (FCIC), USDA-RMA and other private companies as insurers. Some of the farmers insured against drought with the purchase of PRF-RI and PRF-VI insurance in Texas and Oregon complaint about the basis risk as the program did not compensate in accordance to the actual losses covered and is thus being modified in order to enhance the correlation between indemnity and actual losses. These two programs were developed to cover the same risk, but they function quite differently and also cannot be taken together in the same geographic areas. It was also observed that payoffs for two adjacent land areas varied significantly. This type of model can benefit the developing countries only if they have access to historical weather and satellite imagery.

In 2000, Forage Rainfall index insurance against drought started as a pilot with five counties in Ontario, Canada. The program was led by Agriculture and Agri-food Canada with AgriCorp as the insurer. The weather data was received from Environment Canada comprising of 350 rainfall collection stations at a distance of 15km intervals in the implementation area and the premium varied as per the plan and subsidy in the region. The model has undergone enhancements to improve the accuracy and can be implemented in developing countries having sufficient rainfall stations with available historical data.

In 2002, AGROASEMEX in Mexico piloted a weather index based insurance against drought for crops like maize and sorghum in the region of Guanajuato using five weather stations. Weather data was collected from the National Water Commission (CONAGUA). The program was scaled up further covering drought and excess rainfall for four major crops of Mexico (Maize, bean, sorghum and barley) using a total of 251 weather stations by 2008. Basis risk was identified as the main challenge in Mexico, which could be reduced by installing additional weather stations in the range of 10 to 20 kms from the area of implementation, but insufficient government resources prohibited this improvisation. A private rural producer association, Fundacion PRODUCE had come up with a network of 764 weather stations. The limitations of these stations are lack of historical weather data. In order to overcome this limitation, AGROASEMEX developed a methodology using reanalysis technique to obtain a simulated series of weather variables that was used as historical weather data for scaling up. In 2007, insurance for pasture land started using Normalized Difference Vegetation Index (NDVI) derived from satellite that measures the vigor and greenness of vegetation on the earth's surface.

Single risk insurance (mainly hail) has a long history and is available in almost all European countries. In addition, combined insurance and yield insurance (locally called Multi risk insurance) exist in many EU countries. The level of government involvement or eligibility for public funds vary from country to country for example countries like Greece, Spain, Austria, Portugal and Sweden do not support with public funds if insurance is available. In France, only those damages are covered which are not covered under insurance. In Romania, public payments are given to farmers who have insured standard risks against hail (Other risk management tools in Europe, n.d.). Studies in EU suggest low efficiency of index insurance products at farm level due to heterogeneous nature of climate and geography specifically because of the large scale of geographical area and suggest a more efficient use of index products in case of reinsurance at and aggregated level(Diaz-caneja et al., 2009). It was also observed that Maximum NDVI had a poor correlation with yield risk in the European countries which can be improved by analyzing cumulative NDVI for more sensitive crop development stages.

Ethiopia's first index insurance pilot was launched in 2006 by the government with support from World Food Program (WFP). The rainfall based insurance against drought was not triggered at the end of the coverage period and was also not renewed in 2007 due to lack of donor support though the initiative was followed by other pilot index insurance further. The second index insurance pilot was launched in 2009 by Nyala Insurance Company (NISCO) with support from WFP against drought for farmers growing haricot beans in Bofat/Sodore near Nazareth. The program was further scaled up for insuring crops like maize and teff. The third pilot was a project developed by Oxfam America and Swiss re in collaboration with IRI, the Relief Society of Tigray (REST) and others on an ongoing index insurance program in 2007 called Horn of Africa Risk Transfer for Adaptation (HARITA). The project was basically for teff growing farmers in Adi Ha village in Central Tigray district. The meteorological data was collected from National Meteorological Agency (NMA). NISCO used the second largest micro finance institution in Ethiopia, Dedebit credit and Savings Institution (DECSI) as the insurance agent to market and deliver the product.

In 2008, the first index insurance was piloted in Anhui province of China as an alternate to MPCI by the joint effort of World Food Program(WFP), IFAD and Ministry of Agriculture (World Food Program; IFAD, 2010). The policy covered the rice crops against drought and heat wave in Yanhu village in the Changfeng county. Guoyuan Agricultural Insurance Company (GAIC), a private insurer was selected to join the project taking charge of underwriting and subsidizing the product, also participating in the product design with responsibility for marketing (Balzer & Hess, 2006). The farmer paid 8.3% of the premium and the remaining 91.7% was subsidized by the insurer according to the national MPCI subsidy rules. The sum insured only covered the production cost and was not of much interest to the farmer. Though the pilot product was cheaper than MPCI, it covered fewer risks. China has more than 2200 provincial weather stations and 700 national stations having a historical 40-50 years weather data, out of which 160 station data is sharable internationally through WMO and the remaining historical and real time data is considered confidential. GAIC is interested in taking this pilot product further and seeks government support to consider weather insurance as an alternate to MPCI. China's largest insurer, PICC also has strong interest in entering this market. According to a survey in Anhui, China, most households think that losses in agriculture production over the last five years were either due to too much or too little rain and the key coping strategies were to either seek for another employment or depend on friend or relative to transfer the risk. Very few farmers use agriculture insurance to transfer risk. At the same time, farmers familiar with insurance, facing extreme losses and those who trust the accuracy of weather forecast show interest in WII(Liu, Li, Guo, & Shan, 2010). Demand of weather index insurance was also observed amongst farmers more exposed to disasters in the developed regions as they are more willing to buy crop insurance(Zhong, Qiao, Lin, Li, & Fang, 2010). Many developing countries like Honduras, Kazakhstan, Malawi, Nicaragua, Senegal, Tanzania, and Ukraine were observed to have weather index insurance based on rainfall to cover risks like drought for different range of farmers and crops.

Concepts of crop insurance framework

Traditionally, crop insurance has been implemented by public sector and heavily subsidized by governments. Since the 1990s, there has been a trend of government promoting agriculture insurance through private sector insurance as public private partnerships. Various frameworks for crop insurance were observed to be adapted by countries depending on their requirement and national policy structure (Table 2).

Apart from having different frameworks, each can vary in the level of government control and private sector engagement for any specific scheme. For instance, the national agriculture insurance scheme generally has a monopoly agriculture insurance body where the entity is responsible for loss adjustment but has high level of government premium subsidy and reinsurance support. In commercial competition with high level of control, the policy design and premium rating criteria is controlled by the government and the insurer is obligated to offer crop insurance to all farmers and regions in order to qualify for the premium subsidies where as in commercially competitive situation with low level of control, the private insurer is free to choose the crop/ region/ peril/premium rate they charge and the government role is to subsidize premiums only.

Index insurance has been implemented in various countries at micro-level where it covers individuals (e.g. Senegal and Haiti), meso-level where it covers risk aggregators like banks, MFIs, agribusinesses or national export companies (e.g. Dominican Republic) and macro-level where it covers the contingent liabilities that the government might face because of weather related disaster or event(e.g. Uruguay).In the end, an ideal situation would be to have pure private sector driven competitive agricultural industry with regulatory oversight to protect consumers and create level playing field for healthy competition.

Some of the crop insurance parameters were analyzed to better understand the range of international policies, practices and technologies in the sector (Table 3).

Case Studies for Crop Insurance Mechanisms and its Analysis

Crop Insurance in India

India's 58.2% population is sustained by agricultural sector, which contributes to 14.1% of GDP. Rice being one of the chief grains of India accounts for 20% of the world rice production. It is the staple food of the people in the eastern and southern parts of the country. With 120 million farm holdings, 62% farmers are small and marginal owning less than one hectare of land. The average farm holding size is 1.16 hectare.

The Indian agriculture sector has been performing well and has exhibited an output growth of 3.6% in the GDP from agriculture component against a target of 4% for the period 2007-2012 despite various shocks in terms of weather and price. It faces complex weather conditions as 75% of rainfall occurs within a period of four months with huge variations. Droughts and floods affect the farmers at different locations at the same time and also various perils hit the same location at different time periods. One third of the country is prone to droughts where as one sixth of the country is prone to floods.

Existence of commercial farming is quite low as compared to subsistence farming in India. Insurance schemes are more stable in case of commercial farming as subsistence farmers prefer to purchase health insurance or invest in other livelihoods rather than considering crop insurance. The two sowing seasons in the country are named Kharif (affected by rainfall deficit or excess rainfall) and Rabi (affected by low temperature and high temperature). Kharif yield is known as the summer crops where sowing is done from April to June and harvested from October and December. The Rabi yield is known as the winter crop where sowing is done from October to December and harvested from April and May. Rice flourishes comfortably in hot and humid climate, mainly grown in rain fed areas and is fundamentally a kharif crop. It demands temperature of around 25 degree Celsius and above and rainfall of more than 100cm. Rainfall is crucial as the crop thrives if the soil remains wet and is under water during its growing period.

The first pilot index yield insurance program started in 1999 through government subsidized **National Agricultural Insurance Scheme (NAIS)** based on the General Crop Estimation survey (GCS) at district level, which compensated the farmers taking crop loans from the government if the area yield for a region fell below a particular threshold. However, this MPCI program had many drawbacks like inadequate coverage, long adjustment procedures leading to delay in claim settlements (5-6 months approx.) with a high coverage cost which made the program unattractive for the reinsurers. It was more of a fund management scheme as losses higher than 95 percent were covered and settled by the government. Also after a decade of implementation only15 percent of farmers were covered under NAIS scheme(India Agricultural Finance Corporation Ltd, 2011). This led to a need of alternate crop insurance product in the market. Considering the need of further expansion and demand of insurance in the country, NAIS has been withdrawn from the market with effect from the current Rabi season in 2014 and is being replaced by **Modified National Agricultural Insurance Scheme (MNAIS)** (Table 4). It is basically improvising the ongoing NAIS to make it more farmers friendly. It has been launched as a pilot in selected states. It has additional features apart from payment of claims for yield loss on area approach basis (as under NAIS) as

- unit area of insurance is reduced to village level for major crops
- minimum indemnity level is raised from 60% to 70%
- indemnity payment for prevented sowing/ planting risk and coverage of post harvest losses due to cyclone in coastal areas
- uniform seasonality disciplines for loanee (farmers taking loan) and non loanee farmers
- premium subsidy available for loanee farmers would be up to the amount of loan sanctioned/advanced or value of threshold yield, whichever is higher and for the loanee farmer, subsidy is available up to the value of threshold yield.
- provision of ‘on account’ payment only if the estimated crop losses are more than 50% (as compared to normal/ average yield) and the maximum amount payable should not exceed 25% of the likely claims.

Agriculture Insurance Corporation of India (AICI), the public insurance company provides yield index and weather index insurance. The insurance provided is linked with credit and is mandatory for the borrowing farmers. Risk covered is based on the production cost as a safety net and acts as collateral, while the lending agencies have the first lien on claim. Initially AICI had one underwriting office in every state but after realizing the inefficiency of direct selling, in 2006 AICI started enrolling insurance intermediaries with insurance brokers followed by corporate agents and micro-insurance agents in 2008. AICI uses pamphlets, posters and radio jingles for marketing and building awareness. The index insurance products sold by AICI include Varsha Bima Rainfall Insurance, Rainfall insurance customized for ITC Ltd, Rabi weather Insurance and other weather insurance specifically for wheat, mango apple, etc.

The yield estimation was done through a traditional crop cutting experiment by the provincial government agencies, which is quite time consuming. Further enhancement on how to reduce the time span and execution cost has been continuously carried out. As a result of which, in 2003, **Weather based crop insurance scheme (WBCIS)** was introduced as pilot projects that helped to overcome some challenges of traditional insurance (specifically damage and yield assessment). Pilot projects with alternate parameters like rainfall, temperature, humidity, wind speed and consecutive dry days were launched by ICICI Lombard, a private insurance company and further in 2004 by AICI. In 2007, the private insurers were allowed to participate in the agricultural insurance schemes (only for non loanee farmers) with no subsidy from the government but later in 2009, government opened the market for private insurers for loanee farmers as well, contributing to an increase in premiums and farmers insured.

Crop growth simulation model was developed in order to capture the correlation between yield and weather and establish triggers and payout rates. A network of automatic weather stations was built for weather data. The average premium was 8% depending on the type of crop and region of which an average of 2.8% was paid by the farmers after subsidy adjustments. In 2007/08 the pilot was extended to 200 sub districts (from a total of 5000 sub districts in the country) for more than 20 crops scaling to 45 crops in 15 states by 2012 (Personal communication with the public and private insurance provider). WBCIS operates on the ‘area approach’ in notified Reference Unit Areas (RUA) and was also observed that the claim to premium ratio was 0.89 for WBCIS as compared to 2.98 of NAIS (Nagarajappa Adivappar, K. S. Aditya, 2014).

The Scheme operates on the principle of “Area Approach” in notified Reference Unit Areas (RUA). It is noticed that the claims to premium ratio is 0.89, which was lower than that of NAIS (2.98). The adoption of scheme by farmers measured in terms of growth rate in number of farmers covered under WBCIS over the years is also high.

Apart from the AICI and ICICI Lombard, some of the other private insurance providers that are offered the same level of support from the government are HDFC-ERGO GIC, TATA AIG GIC, IFFCO-TOKIO GIC and Cholamandalam MS GIC.

Coconut Palm Insurance Scheme (CPIS) is the new insurance scheme introduced in 2014 to address and protect the loss of coconut due to climatic changes and natural disasters.

Product Customization

Private insurance companies like ICICI Lombard have come up with multiple insurance products customized according to the needs of the weather risks. It allows the farmers to have the flexibility to take insurance for their crops for a particular critical stage of the crop growth or the entire crop cycle. Although it started with rainfall deficit, it now offers insurance for excess rainfall, high and low temperatures, relative humidity and their combination depending on the weather risk for the particular crop in that area.

PepsiCo contract farming is an example of such deployment. ICICI Lombard has a partnership with PepsiCo and offers index insurance for farmers involved in contract farming. The weather insurance scheme was introduced on a pilot basis for farmers in three states in 2008 primarily for potato growers who are suppliers for PepsiCo's potato chips business. A total of 2,000 acres in Karnataka, 1,800 acres in Maharashtra and 900 acres of potato crop in Punjab was insured. Following the success of trial runs in the states of Punjab, Maharashtra and Karnataka, the scheme has been rolled out for potato growers in 10 Indian states covering an area of 14,000 hectares. This customized index insurance product for PepsiCo is developed and maintained by Weather Risk Management Services (WRMS), a private consulting firm in India which also provides weather data and charges a commission of 5% of the premium as the policies are sold through ICICI Lombard.

The potatoes are insured against the risk of Late blight disease that can spread easily under high moisture caused by rain, dew, irrigation or high humidity (greater than 85%) and moderate temperatures. This insurance program is an example of a disease index, incorporating both humidity and temperature levels. The weather station is 20 km from the participating farmer and the station is placed at four corners of the grid with the farmer in the centre to minimize basis risk. The premium under this program is US$30/ acre (1 acre = 0.405 hectare), which is approximately 3-4% of the sum insured (US$500-600/ acre). PepsiCo also offers a buy back price of US$0.002/kg with the purchase of the index insurance. The product is structured to cover losses above 40% of yield. 4250 farmers were insured under this program in 2007 that increased to 4575 in 2008. Some other examples of customized products were Del Monte for baby corn cultivation in Punjab, Gujarat Heavy Chemicals Limited (GHCL) for salt pan and Air India for fog cover.

Premiums of agricultural insurance in India vary between 7-10% of the sum assured based on the risks covered. The government also provides subsidy for specific crops which helps the farmer to pay the premiums and the risk is entirely carried by the insurer.

Weather insurance settlement is simpler than traditional insurance as all farmers associated to the nearest weather station are eligible for the claim, especially if a pre defined index has been triggered. This weather data is available, can be calculated and can be the basis for payment. The sum assured is defined for every specific policy and the maximum amount can be claimed making the weather index insurance settlement simple, quick and transparent. A chain of rural retail outlets like the Hariyali Kisan Bazaar and Godrej Aadhar are used as **marketing channels** apart from partnerships with NGOs and MFIs.

The delivery channels play a very crucial role in the scalability and sustainability of the program. Various delivery channels are MFIs, IRDA, retail, bank (for loanee) and political action committees (PACs). The Insurance Regulatory and Development Authority (IRDA) stipulates that a maximum of 17.5 percent of the gross premium (2010) can be paid as a commission to the agents and channel partners which is a potential constraint for the profitability and sustainability of the sector.

The diversification of portfolio, an important requirement of insurance product, is not similar in all private insurance companies and MFIs as they tend to target large scale farmers expecting higher returns. However, ICICI Lombard and BASIX, a microfinance institution (MFIs), have been able to sustain the program, targeting lower income farmers since its start in 2003 largely by diversification of portfolio(Miranda & Farrin, 2012). The operations are extended throughout the country with many extended services offered by BASIX although the company is yet unable to recover its marketing and distribution cost (2010).

One important area of development is the need to have more reinsurance companies. They have been limited in India, which has made the reinsurance rate quite high. They are mainly interested in programs with a total premium value of more than US$1 million, with an exception of one reinsurer accepting a US$100,000 deal. On the other side the insurance companies want the minimum risks in their books and are more dependent on reinsurance companies. This again creates a vicious circle, as the reinsurance will not support unless the programs are sizable and the programs cannot expand without any reinsurance support. The reinsurer companies working with ICICI Lombard are Swiss Re and Scor and Hanover Re for micro insurance development. In case of AICI, the reinsurers are Paris Re, SCOR Re, Endurance Re and Swiss Re apart from the national reinsurer GIC Re.

Generally, in developing countries with unavailability of historical yield data at the micro level, area yield based insurance becomes a difficult option. As an alternate, weather based index insurance is considered. There still are barriers to scaling up of weather based insurance in terms of village level weather data. As estimated by WRMS, India needs 10,000 weather stations requiring an investment of US$ 5-6 million. Apart from installation cost, an additional 25% of the installation costs are estimated for the annual maintenance of these stations. Hence, having a greater access to crop production data and weather data will depend on future finances and maintenance mechanisms adopted by the country.

The demand for index insurance can be increased and appreciated by the farmers by providing

a) Incentives like higher buy back price e.g., offered by PepsiCo
b) The ability to use the loan as the premium and other production cost
c) Trust in the insurance provider and actor involved
d) History of timely payouts in the earlier seasons
e) Education needed to mitigate the risk of losing the current production cost

The challenges existing are in terms of real time weather data and accuracy of weather data as still many weather stations are manual, having one weather station per district, frequently taking 30 to 70 days for the insurer to receive data delaying the timely settlement of payouts. To address this issue many private companies have come up with the installation of automatic weather stations. They install about 3-4 weather stations per district and charge US$40-100 per month per station, thereby enhancing the private insurance products at the same time prohibiting the access of data by the public sector as the government programs do not have enough margins to accommodate expensive private data. Four major organizations providing weather data in India are IMD, WRMS, NCMSL and SKYNET. Some of the other challenges are lack of awareness amongst the target farmer population, non bankable customers with no valid documents and many remote areas still being inaccessible.

Innovations like crop and region specific agro advisory, remote sensing based yield estimation, terrestrial observation and prediction system (TOPS) are in the pipeline. Minimizing basis risk, designing products with affordable premiums and developing new indices with more accurate payouts could thus help in further enhancing the future index insurance market in the country.

Crop Insurance in Thailand

Crop insurance program has been operational in Thailand as early as 1978. During 1978 -1990, a multi peril crop insurance (MPCI) covering cotton, maize, soybeans was operated but was closed due to high administrative and loss adjustments. A weather index insurance (WII) pilot was developed in 2006 with the support from World Bank. It was expanded further in 2008 and 2010. In 2009, rice WII scheme had been pilot tested in Thailand (Jeerachaipaisarn Thanad, 2012)

Crop insurance market structure

The Thai Government has a disaster relief compensation program for the affected farmers and the government insurance scheme launched in 2011, has been designed to link and top up the disaster relief program. This helps in keeping the claim administrative cost low by using the existing loss assessment mechanism of the government. Claims are paid out to farmers whose land falls under the disaster area declared by the provincial government. The three insurance schemes currently existing in Thailand are Government Multi Peril Crop Insurance (MPCI) scheme for Rice, Weather index insurance (WII) by Sompo Japan Co for Rice (Table 5) and by Thaivivat Insurance Company for Maize. It is on voluntary basis and has not been made a pre-condition for access to loans by Bank of Agriculture and Agricultural Cooperatives (BAAC). In case of the Multi Peril Crop Insurance (MPCI) scheme by the government, there are two local insurers and a fund. Thaivivat and Dhipaya equally share the premium and claim at 0.25% and the National Catastrophe Insurance Fund (NCIF) shares 99.75% from the national portfolio. NCIF actually acts as a reinsurer and also provide financial assistance of 50 billion baht to those in the insurance business. The sum insured per area (rai = 40m X 40m) is 1111Thai Baht for flood/ excessive rain, drought, frost, windstorm/typhoon, fire and hail and 555 Thai Baht for pest and diseases. When the government declares the insured area as the national disaster area with respect to the perils defined in the policy, the indemnity/claim is processed accordingly,

$$\text{Indemnity} = \text{Sum insured per area (Rai) X } \frac{(\text{Insured Area } * \text{ Loss Area})}{\text{Total area in the rice grower registration form}}$$

The insurance premium is 129.47 baht/rai including the tax and stamp. It is a flat premium applied throughout Thailand of which 69.47 baht comes from the government compensation and 60 baht from the farmer's contribution (50 percent government subsidy). In addition, a discount of 10 baht/rai is offered to BAAC clients only.
All the weather stations are established, maintained and owned by the government through the Thai Meteorological Department (TMD) unlike many private stakeholders in India. A total of 236 rainfall stations are being used for weather index insurance of rice in the nine provinces of north east Thailand (Figure 4).

Currently, AON Benfield and Swiss Re act as the two international reinsurers for the government scheme and there are no international reinsurers existing incase of private insurance scheme. Although, the WII program (2006-2010) was underwritten by a co-insurance pool of 9 insurance companies and the Thai Reinsurance Public Company Ltd.

The Bank of Agriculture and Agricultural Cooperatives (BAAC) acts as the distribution channel for weather index insurance and is also involved in many extension activities to educate and enroll farmers on the weather index program. Since 2009, the Japanese Bank for International Cooperation (JBIC), in conjunction with Sompo Japan Insurance (Thailand) Company Ltd. (SJIT) has been pilot testing a separate cumulative season rainfall deficit WII product for rice. BAAC has been acting as the distributer and the main implementing agency for this pilot rice WII program in Thailand (Figure 5).

Insurance Penetration Rate

The pilot maize weather index insurance program has been operating for four years in Thailand. Yet the penetration rate of only about 1 percent of the national maize crop area has been achieved (FAO, Publication, 20011/12). There is not much take up of the index insurance by the farmers. Lack of awareness and low confidence in the scheme as the payouts are based on proxy index rather than farmer's actual yield are possibly the reasons of low uptake in the country. Table 6, provides the details of farmers, premium and claim details of Sompo Japan offering WII in nine province of Northeastern Thailand in 2013.

Government Support

A system of financial compensation is operated by the Ministry of Agriculture in Thailand for losses caused by drought and floods. This compensation operates in parallel with the weather index insurance. The government also has a price support program (Farmer's income guarantee scheme) for rice, maize and cassava under which the government would purchase large quantities of rice at above market prices and then store the rice. This practice has led to major over supply and high cost of holding surplus rice stock.

The Ministry of Finance is reconsidering the crop insurance model in order to reduce the cost of compensation. It is more economical to pay the premium subsidies, if sustainable, rather than paying off as compensation. The rice pledging scheme has been heavily criticized as the government guaranteed to buy white paddy at 15,000 baht a ton in October 2011 which is 40-50% above global market prices reducing to 13,000 baht a ton in 2014 for second crop paddy, capped at 300,000 baht per household.

BAAC suggested to stop growing rice for the current second crop as this would help in reducing the supply and improving the already falling market prices. The failed scheme has created a crisis in Thailand and was one of the major items for protests against the government.

In the current scenario, the farmer has the privilege to choose the nearest neighbor weather stations while applying for the purchase of the insurance policy. There is no standard distance up to which a weather station is considered as representative. A general assumption of the farm being at 20 km distance from the weather station is not considered as a criterion for insurance i.e., farms at a greater distance from the weather station are also eligible for the insurance policy with the same level of premium for farmers at a smaller distance from the weather station. This indicates there is possibility of huge basis risk. There is a need to analyze the maximum distance to which a weather station is representative and what could be the ideal station density for the insurance scheme to be sustainable. Also as the weather index insurance is based on rainfall, understanding the spatial variation of rainfall would help in building enhanced insurance product, further reducing the basis risk and scaling up weather index based crop insurance in the country.

Conclusion and way forward

Globally, index based crop insurance has been acknowledged as one of the critical risk mitigating tool in the agriculture sector and is being adapted by most of the agricultural based countries. This study on trends and practices suggested that the indexes used for the purpose, which is continuously evolving, needs further refinement and accuracy. While Weather Based Index was seen to be most widely used worldwide, a number of pilot projects are ongoing using a combination of weather index as well as satellite index insurance.

India and Thailand are both at different phases of adapting index based crop insurance with varying level of government support and private sector engagement. India and Thailand have been using Index based crop insurance since 2003 and 2006 respectively. The role of private sector was more visible in the case of India where the industry manages the entire product with financial subsidy from the government and private sector products compete with those of the public sector. In Thailand, the model revolves around private sector supplementing the existing compensation mechanism of the Government. While weather based index insurance remains most popular, pilot projects on satellite based index insurance was also seen in India. In terms of weather stations, in Thailand these are entirely managed by the government while in India it is a combination of government and third party. In Thailand, the scheme remains voluntary with no linkage with credit while in India it is compulsory for farmers taking loans to be insured.

Amongst challenges, access to accurate data still remains a key bottleneck for private sector entry and growth of commercial products. Technically, the data for index based crop insurance can be either collected from ground based weather stations or satellite based ones. In general, weather index insurance requires at least 30 years of historical weather data collected from an official meteorological weather station within a distance of 20kms (the range is further reducing for instance, 12 km in case of India). The risk is then calculated based on the specified parameter (mostly rainfall) of a particular meteorological weather station and payouts are determined based on the events recorded there. Challenges like non availability of granular weather data, missing data, large distance from the weather station can contribute to a larger basis risk. For greater accuracy, additional weather stations would be required based on the terrain in order to effectively implement weather index insurance at a larger scale. Satellite based index insurance, which has larger coverage is a possible option. However, it has its own limitations of lower resolution. In terms of costs involved, the tradeoff is between establishing high number of weather stations and using expensive satellite data. The appropriate solution would be based on techno-economic considerations in the specific area.

For the success of this sector, open access to data is critical. Disaster related risk maps exist at country level, but detailed risk maps at province level needs to be generated and made available to insurance providers in order to estimate the premiums more accurately. More advanced and comprehensive agriculture insurance models tailored to each agricultural region would be useful. Possible research like rainfall modeling and simulation to improve index design, geo-statistics, seasonal forecasting, techniques for modeling risk over time and space or modeling long term processes and trends have high potential and would be useful in reducing the basis risk currently faced by the index insurance industry. Further research and development of satellite based index insurance would help both India and Thailand to mitigate disaster risk combined with climate risk. The larger the spatial scale, the more efficient the insurance will be in terms of reducing basis risk. It will enhance the take up of index insurance especially in the developing countries.

At national and industry level, the availability of infrastructure to provide this data is critical to reduce risk and avoid duplication. The government and the private sector could share responsibilities in making accurate data available by deploying common infrastructure or look at creating a common fund to install and operate this infrastructure. Competition can then be enhanced at the service level. It would reduce private sector risks making commercial entry more attractive and also the costs, thereby making the premiums and products more affordable and with greater choice. As more private players will enter, it would bring greater economies of scale reducing the costs further. Such enhancement of competition in crop insurance sector amongst companies, public and private, would likely reduce the areas in need of real subsidy from the government. The very high cost areas that would still remain due to even higher costs can be supported through market based mechanisms such as minimum subsidy auctions. A competitive crop insurance service market is required for the success of market based mechanisms to be effective.

Index based crop insurance was observed to have high growth potential and scope for efficiency enhancement that would increase crop insurance penetration and reduce government's financial burden in developing countries.

Table 1: Comparison of traditional and weather index based crop insurance

Traditional crop insurance	Weather index based crop insurance	
Named Peril Multi Peril Crop Insurance (MPCI)	Rainfall based, Temperature based	
Disadvantages	**Advantages**	**Disadvantages**
Adverse selection	Transparent	Basis risk
Moral Hazard	Lack of adverse selection	Limited perils
High underwriting cost	Lack of moral hazard	Replication
High loss assessment cost	Addresses correlated risks	Lack of weather data
Large errors in damage assessment	Low operational and transaction cost	
Low efficiency of indemnity post disaster	No loss assessment required Rapid payout	

Table 2: Examples of countries adapting different frameworks for crop insurance

Framework	Characteristics	Countries
Public Sector	▪ Government has monopoly and intervenes to provide heavy subsidy and assumes the role of reinsurer ▪ High penetration as it is generally compulsory ▪ Well diversified portfolios ▪ High fiscal cost	Bangladesh (Sadhurin Beema Corporation), Canada (10 provincial government crop insurance corporations), Cyprus (Agricultural Insurance Organization of the Ministry of Agriculture), Democratic People's Republic of Korea (Korea National Insurance Corporation), Greece (Hellenic Agricultural Insurance Organization (ELGA), India (Agriculture Insurance Cooperation of India (AIC)), Iran (Government owned Agriculture Insurance Fund), Philippines (PCI), Sri Lanka (Agricultural and Agrarian Insurance Board)
Private Sector	▪ Insurance companies compete for business and purchase the reinsurance from international commercial reinsurers. ▪ Low to moderate penetration ▪ Low risk diversification ▪ No fiscal cost	Argentina, Australia, Germany, Hungary, India, Malaysia, New Zealand, Philippines, South Africa, Sri Lanka, Sweden, Thailand, The Netherlands, United States, Vietnam
Public Private Partnerships	▪ Different forms varying on the level of government involvement. ▪ High Penetration ▪ Well diversified portfolios ▪ Reasonable fiscal cost	China, Indonesia, Japan, Mongolia, Pakistan, Republic of Korea, Thailand, United States, Vietnam
Coinsurance Pool Arrangements	▪ Managed by the lead insurer or by any other agency appointed by the pool ▪ Major cost advantage	Argentina, Austria, China, Malawi and Spain (crop based)

Table 3: Crop insurance characteristics: International practices

Countries	China	India	Indonesia	Vietnam	Thailand	Australia	Bangladesh	Austria	Canada
Government	Yes	Yes	Yes	n/a	Yes	No	No	Yes	n/a
Government Premium Subsidy	40% by Govt, 25% by provincial govt, 35% by farmer	75% by Centre & State Govt on 50:50 basis(MNAIS)		(2011-2013); Poor rural farmers (90-100 %), other farmers 60%), Agriculture Production Organization (20%)	50%	No	No	50% of commercial premium, (25% central govt, 25% regional govt)	60% federal govt and 40% provincial govt
Public Insurer	No	Yes(AIC)	No	No	Yes (BAAC)	No	Yes(SBC)	n/a	Yes
Private	Yes	Yes	No	Yes	Yes	Yes	No	n/a	Yes
Public Private	Yes	No	Yes	Yes	Yes	No	No	n/a	n/a
Agriculture Insurance Started	3 Phases (1982-2003-2006)	Traditional (1965), Index (2003)	2010	1982	1978-1990; index (2007)	1918, but expanded in 1960	(1977-1995) SBC, Individual yield based MPCI		1938 (hail insurance) 1964 (crops insurance)
Index	Yes	Yes	Yes (flood index and crop WII (R&D phase))	awaiting since 2008	Yes	No	No	No	Yes
Area Yield		Yes		Yes	Yes				
Weather Index		Yes	Yes		Yes				
Satellite Index		Pilot			No				
MPCI	Yes	No	Yes	No	Yes	No	No	Yes	Yes

Countries	China	India	Indonesia	Vietnam	Thailand	Australia	Bangladesh	Austria	Canada
Named Peril	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes
Revenue Based	Yes	No	No	No	No	No	No	No	Yes
Voluntary (V)/ Compulsory (C)	V	C(AIC), V(Private)	C(Planned)	V	V	V	C (Livestock)	V	V
Reinsurance {Quota share(QS), surplus(S), stop loss(SL)}	QS, SL	QS	Unknown(too small to be reinsured)		QS(Maize only)	QS,S,SL		QS, SL	SL
Reinsurers	China Re (National reinsurer), private and international reinsurer exist but unknown	GIC Re, Paris Re, SCOR Re, Endurance Re, Swiss Re			AON Benfield and Swiss Re (Government Schemes only)			Munich Re, SCOR, Hannover Re, Swiss Re, Sirius Re	
Crops	Maize, soya bean, wheat, rice, cotton		Rice(MPCI), Maize(WII, in R&D phase)	Rice	Rice, Maize	Cereal, grain legumes, oilseeds		Field crops, fruits	

Table 4: Comparison of four crop insurance programs (NAIS, WBCIS, MNAIS and CPIS) in India

	NAIS (Withdrawn in 2014, Rabi season)*	WBCIS	MNAIS	CPIS
Year Started	1999	2007	2010	2014
Index	Area yield	Weather	Area yield & weather	
	Crop cutting experiments (CCE)	Weather data	Crop cutting experiments (CCE)	
Program nature	Administered	Actuarial		
		Premiums calculated by the insurer		
Insurance unit	Not uniform (gram panchayat, mandal)	Reference unit area(RUA)	Village panchayat level for major crops	Minimum of 5 healthy nut bearing palms in contiguous area
Premium subsidy	Only for small and marginal farmers	Shared 50:50 between state and central government		50% by CDB, 25% by state government and 25% by farmer
Claims	Beyond 95%,shared by state and central government	Insurance company responsible for all claims		Shared by CDB and concerned state
Government financing	Ex-post	Upfront premium subsidy		Ex-post
Open to private sector	No (Only AIC)	Yes		AIC
Transparency	Low	Higher		
Cost	High (CCE)	Low (80$/month by the insurer)	High (CCE)	Moderate (certify loss)
Duration of claim settlement	6 - 24 months	45 days from data release	On account settlement of 25% of likely claims immediately	1 months from all the certified details received
		During 2012-2013		**Total**
Farmers (Millions)	15.45	13.23	2.98	**31.66**
Hectare (Millions)	29.92	18.39	2.97	**51.28**
Sum Insured (US$ Millions)	5892.35	4038.47	1149.20	**11080.02**
Premium (US $ Millions)	195.67	379.45	125.10	**700.22**
The sum insured and premium size is expected to be US$ 15 billion and US$ 1.30 billion respectively in 2014-15.				

*NAIS is being withdrawn from those area(s)/ crop(s) where MNAIS is implemented.
Source: Government of India, NAIS figures were provisional (AIC)

Table 5: Trends of crop insurance in Thailand

Indicators	Sompo Japan (WII Rice)			Thaivivat and Dhipaya (MPCI Rice)		
Year	2011	2012	2013	2011	2012	2013
No of farmers insured	6173	849	2863	55228	45722	7
Gross premium(thousand baht)	3319.92	466.32	1528.88	136564.53	112492.61	43.19
Area Insured (rai)	35775.00	5250.00	16475.00	1059131.00	872440.00	120.00
Claims(thousand baht)	141.00	1583.00	343.50	756487.97	249497.38	31.10

Table 6: Sompo Japan was offering WII in nine provinces of Northeastern Thailand in 2013

Province			Early Drought 1st Period (1 Jan-31 Jan)		Early Drought 2nd Period (1Aug-30Sept)		Total	
	Farmers	**Premium**	**Farmers**	**Claim**	**Farmers**	**Claim**	**Farmers**	**Claim**
Khon Khen	1665	929856	204	205000	16	24000	220	229000
Maha sarakham	187	101152	0	0				
Roi Et								
Kalasin	222	103472			1	1500	1	1500
Nakhon Ratchasima	69	38976	0	0				
Buri Ram	191	97904	2	2000			2	2000
Surin	251	122960	0	0	0	0	0	
Sisaket			0	0	0	0	0	
Ubon Ratchathani	278	134560	0	0	74	111000	74	111000
Total	**2863**	**1528880**	**206**	**207000**	**91**	**136500**	**297**	**343500**

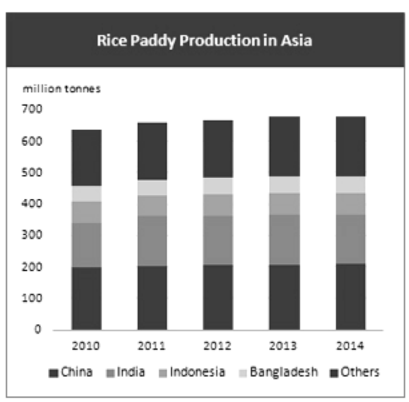

Figure 1: Rice Paddy Production in Asia Source: Food and Agriculture Organization, 2014

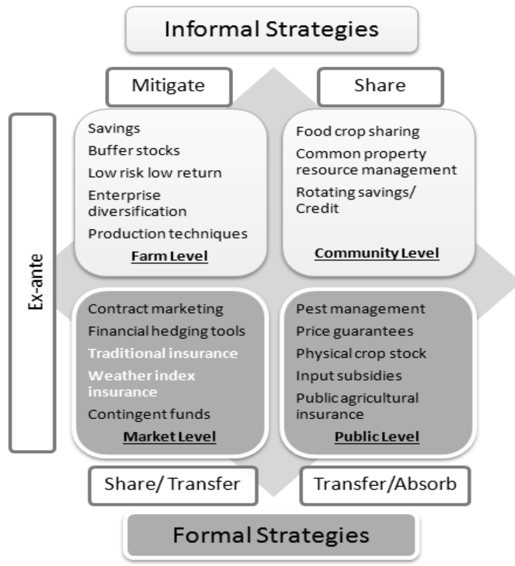

Figure 2: Ex-ante informal and formal risk management strategies Source: Author (based on information from The World Bank, 2010)

Yield Index Insurance	Weather Index Insurance	Satellite Index Insurance
Parameters Yield	**Parameters** Rainfall, Temperature	**Parameters** NDVI, Relative Evapotranspiration (RE), Rainfall estimation (RFE)
Advantages Useful for small sized farmers where historical yield data does not exist Can reduce issues regarding asymmetric information	**Advantages** No historical yield data required Transparency is relatively high at the same time being accurate and tamper proof No yield assessment cost as indemnity is based on weather data Faster claim settlements	**Advantages** Data are independent and tamperproof and available via internet Available across large areas in near real time Spatially detailed TRMM data since 1997
Challenges Delay in indemnity payments as it depends on the yield estimation Basis risk as the insurance area is generally heterogeneous High yield assessment cost	**Challenges** Basis risk (particularly high for rainfall) due to lack of weather data and weather stations density Complex and varying weather pattern Challenges in contract design and actuarial modeling Need at least 25 years historical weather data	**Challenges** Not direct measures but proxy, TRMM does not measure rainfall directly, but infers rainfall from atmospheric humidity Satellite passes a pixel every 10 days approx with interpolated daily estimates Low resolution
Basically two types of Basis risk		
Geographic Basis Risk	Production Basis Risk	

Figure 3: Summary and comparison of existing index insurance products

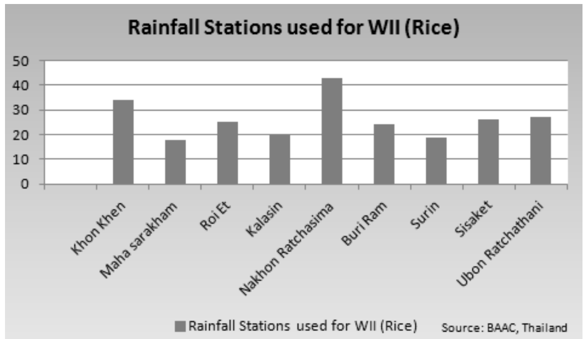

Figure 4: Rainfall stations used for WII (Rice) in nine provinces of north east Thailand

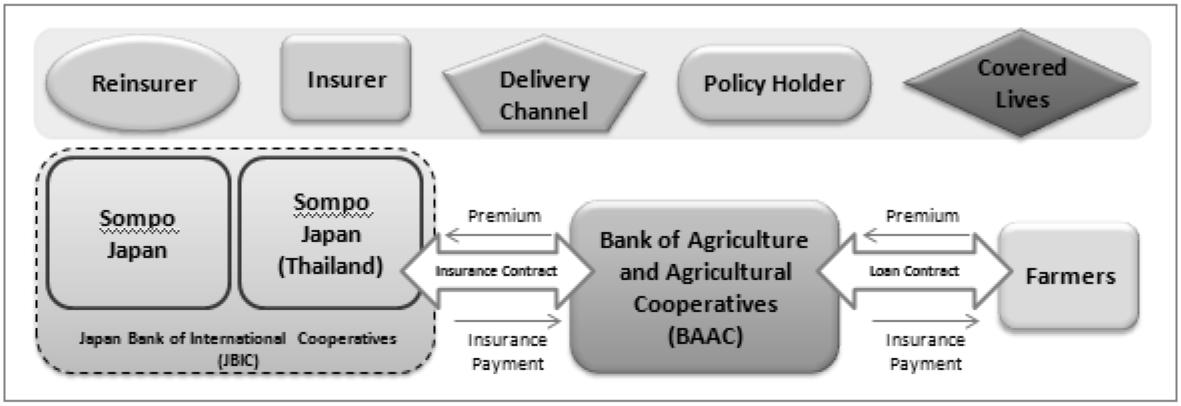

Figure 5: Weather Index Insurance launched for drought risk in northeast Thailand
Source: Sompo Japan Insurance Inc. (Personal Communication)

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