

Deficit Rainfall Insurance Payouts in Most Vulnerable Agro Climatic Zones of Tamil Nadu, India

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Abstract

Weather based insurance is a resilience strategy adopted by farmers. It is intended to provide protection to the cultivator against declined rainfall, which is deemed to adversely affect the crop during its cultivation period. It is becoming popular nowadays in India due to high fluctuation in rainfall and other climate related parameters. The present paper provides a method to compute the initial premium for each crop based on the premium structure given by Agricultural Insurance Company of India Limited, New Delhi. For this, the duration in each stage of selected crop identified by Crop Production Guide(2005) jointly published by Tamil Nadu Agricultural University and Department of Agriculture, Government of Tamil Nadu and 30 years of rainfall data from Indian Meteorological Department (IMD) were used. The payout structure was derived for each stage of the selected crop in the respective district. The strike or upper threshold of the rainfall corresponds to the 30 year average accumulated rainfall of the district reference weather station while the exit or lower threshold is intended to equal the water requirement of the respective crop necessary to avoid complete crop failure. This way, the weather based crop insurance acts as a resilience mechanism for rainfall uncertainties.

1. Introduction

Weather insurance is a mechanism, which protects the cultivators against anticipated shortfall in crop yield arising out of adverse weather incidence within a specific location and period. Most of the poor households living in rural areas suffer from low average incomes due to high variability in rainfall in the crop season. Hence, developing simple cost-effective crop insurance programs would clearly help the farmers from the adverse weather conditions.

The aim of deficit rainfall distribution index insurance is to allow households, groups and governments to reduce their exposure to weather risk by purchasing a contract that pays an indemnity during periods of deficient rainfall. Rainfall index insurance is transparent, inexpensive to administer, enables quick payouts and minimizes moral hazard and adverse selection problems associated with other risk-coping mechanisms and insurance programs (World Bank 2005; Gine *et al.*, 2007).

The purpose of this paper is to estimate a distribution for payouts structure on rainfall insurance policies offered to farmers in the vulnerable agro climatic zones of Tamil Nadu. This

weather based crop insurance keeps the farmers to cope with the risk in rainfall pattern. Thus, this crop insurance scheme acts as a resilience mechanism for rainfall uncertainties and fluctuations and to protect the farmers from financial loss on account of anticipated crop loss resulting from incidence of adverse conditions rainfall.

2. Data Sources

The database for the current study is taken from secondary sources. The necessary secondary data were collected from the various published and unpublished records, viz., crop production guide (2005) to identify the duration in each stage of the respective crop. For rainfall variables, Indian Meteorological Department (IMD) data set is used.

3. Methodology

Rainfall based insurance is useful to protect the farmers from crop failure in most vulnerable agro climatic zones of Tamil Nadu. Palanisam *et al.* (2008) developing the composite vulnerability index relating to climate change for the different agro climatic zones of Tamil Nadu. They have concluded that Southern zone and Western zone are most vulnerable to climate change. Accordingly, the Deficit Rainfall Distribution Index (DRDI) is derived to safeguard the farmers from the adverse effect of rainfall. The deficit rainfall insurance scheme is intended to provide insurance protection to the cultivator against declined rainfall, which is deemed to adversely affect the crop during its cultivation period. Deficit rainfall insurance payouts are linked to accumulated low rainfall.

The payout structure for the phase 1 of the crop is illustrated in Figure 1. The strike or upper threshold corresponds to the 30 year average accumulated rainfall of the respective reference weather station. While the exit or lower threshold is intended to equal the water requirement of the respective crop necessary to avoid complete crop failure.

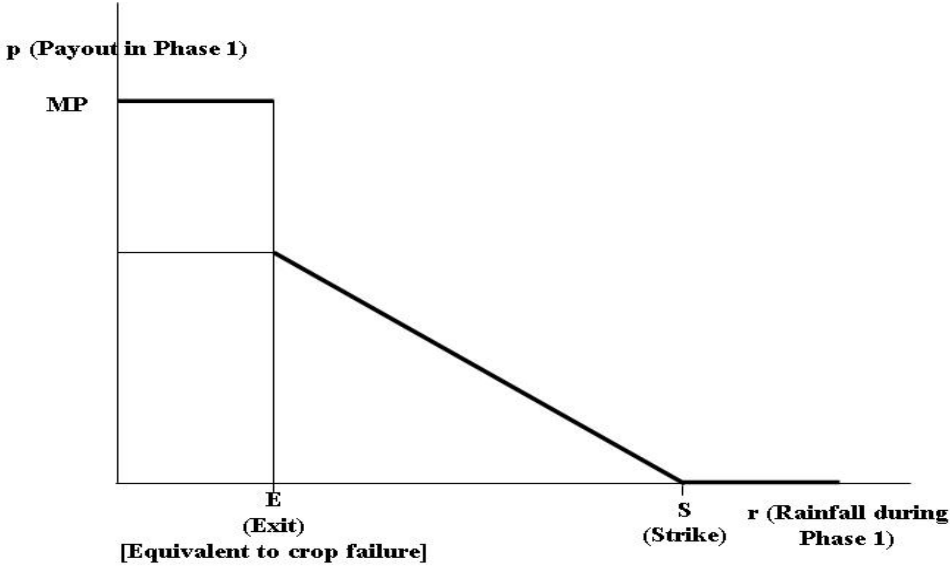


Figure1. Structure of insurance contract for the first phase of the crop

From the Figure 1, it can be observed that the rainfall insurance policy pays zero if accumulated rainfall during the phase 1 exceeds strike or upper threshold. Otherwise, the policy pays required amount for each mm of rainfall deficiency relative to the strike, until the exit or lower threshold is reached. If rainfall is below the exit value, the policy pays a fixed maximum indemnity. Mathematically, the payout for accumulated rainfall is as follows,

$$\begin{aligned} p(r) &= MP, & \text{if } r < E \\ p(r) &= (S-r) m, & \text{if } E < r < S \\ p(r) &= 0, & \text{if } r > S \end{aligned}$$

where, $p(r)$ is the actual payout for each phase with respect to rainfall, MP is the maximum payout and m is the payout per mm of deficient rainfall. The total payout for each season is then simply the sum of payouts across all the specified phases for the respective crop. In other words, the total payout p_t is given in the following formula.

$$p_t = \sum_{i=1}^n \left(I \left[r_i^{**} < r_{it} < r_i^* \right] (r_i^* - r_{it}) p_i^* + I \left[r_{it} < r_i^{**} \right] p_i^{**} \right)$$

p_t = total payout

I = is an indicator function equal to 1, if rainfall falls in the range specified and 0 otherwise

r_i^{**} = Lower strike level in each phase

r_{it}^* = Actual accumulated rainfall in phase I of year t

r_i^* = Lower strike level for each phase

p_i^* = Payout per mm of deficient accumulated rainfall

p_i^{**} = Maximum lump sum payout for each phase

Premium Calculation

The policy premium is calculated based on the premium structure given by Agriculture Insurance Company of India Limited. The premium was initially calculated to be equal to the sum of the 3.5 per cent of sum insured and 12.49 per cent of government service tax to the premium. This will declare in the notified area before commencement of the season which shall be binding on all.

4. Measuring Deficit Rainfall Distribution Index

Rainfall insurance policies are designed for the most vulnerable agro climatic zones of Tamil

Nadu to protect the farmers against adverse effects of rainfall. The most vulnerable agro climatic zones due to climatic change are high rainfall zone, southern zone and western zone (Palanisami *et al.*, 2008). Among this, high rainfall zone has minimum cultivated area and only rice is the major crop, so insurance policies are derived for the southern zone and western zone. These zones consist of many districts and Madurai and Coimbatore districts are selected to represent the southern zone and western zone respectively. In each district, two major crops are selected to construct the deficit rainfall insurance index.

The scheme will operate on the principle of 'Area Approach' in selected Reference Unit Areas (RUAs). These RUAs are linked to specific reference weather stations which are responsible for providing weather data for the purpose of assessment of compensation. RUAs are a geographical area around a reference weather station, pre-notified by State level insurance coordination committee, which is deemed to be reflective of the reference weather stations rainfall data. To the extent predictable, such RUAs will be restricted to 25 km radius around the reference weather station.

Risk period will be from sowing to maturity of the crop and this is depending on the duration of the crop. Sum insured is broadly equivalent to the cost of cultivation and this is pre-declared by the State level insurance coordination committee. The sum insured for an individual cultivator will be the product of the cultivators declared area under cultivation and the sum insured per hectare for that notified crop in the respective RUAs.

5. Payout Structure for Major Crops

Rainfall Insurance policies are designed for the two main crops viz., groundnut and cotton for the most vulnerable southern region and groundnut and maize for the western district and these crops occupy major cultivated area in this zone. Also, these two crops are more profitable than other crops, but they are more sensitive to drought. In addition, since the seeds are relatively expensive, some farmers purchase them using crop loans, but when harvest fails these loans are often difficult to repay. Hence, the payout structure for each crop is derived from using the historical weather data and different crop stages. Payout structure is a pre-defined benefit table, specific to a respective crop in a notified reference unit area. Payout structure defines the scale of payout for a given strike and exit.

The coverage is mainly for the Kharif season (South west monsoon season), which is the prime cropping season running from approximately June to October. The contract divides the entire season into three phases viz., sowing, vegetative and flowering or maturity period, and pays out if rainfall levels fall below particular strike levels. An upper and lower threshold is specified for each in all the three phases. If accumulated rainfall exceeds the strike level, the policy pays zero for that phase. Otherwise, the policy pays a fixed amount for each mm of rainfall below the strike or upper threshold level, until the exit or lower threshold level is reached. If rainfall falls below the exit level, the policy pays a fixed, maximum payout. The payout structure for each crop is given in the following tables.

Table 1. Rainfall insurance chart for groundnut crop in Madurai district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall* (Rs/mm)	Maximum lump sum payout** (Rs/ha)
1	410	Sowing and germination	1 st June to 30 th June	35	5	133.33	4000
2		Vegetative phase	1 st July to 31 st July	50	10	75	3000
3		Flowering or pod formation	1 st August to 15 th September	70	20	70	3500

Note: * $35-5=30$; $4000/30=133.33$.

** Equivalent to approximate cost incurred during particular phase

The required premium, crop stages and their corresponding calendar period, strike and exit level, payout for each mm of rainfall and maximum lump sum payout for deficit rainfall insurance of groundnut and cotton crops for Madurai district are presented in the Table 1 and 2. The calculated premium is Rs 410 and Rs 375 for the groundnut and cotton crops respectively. In the case of groundnut the first phase extends up to one month. The policy pays zero if accumulated rainfall during this phase exceeds the 35 mm, otherwise Rs 133.33 for each mm of rainfall deficiency relative to the strike until the exit (5 mm) is reached. If rainfall is below 5 mm, the policy pays a fixed maximum lump sum payout of Rs 4000. In the same way, other two phases of both the crops are shown in the same tables.

Table 2. Rainfall insurance chart for cotton crop in Madurai district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall (Rs/mm)	Maximum lump sum payout (Rs/ha)
1	375	Germination phase	1 st Sep to 15 th Sep	60	10	40	2000
2		Vegetative phase	16 th Sep to 15 th Oct	120	30	38.89	3500
3		Flowering phase	16 th Oct to 30 th Nov	200	50	26.67	4000

Payout structure for deficit rainfall insurance for groundnut and maize crops in Coimbatore district are presented in the Table 3 and 4. The calculated premium is Rs 410 and Rs 240 for the groundnut and maize crops respectively. In the case of maize the first phase of germination and

establishment stage extends only 15 days. During this period the maximum lump sum payout is fixed at Rs 1500, which is the cost incurred by the farmers during this phase. The policy pays zero if accumulated rainfall during this phase exceeds the 15 mm, otherwise Rs 150 for each mm of rainfall deficiency relative to the strike until the exit (5 mm) is reached. If rainfall is below the 5 mm, the policy pays a fixed maximum lump sum payout of Rs 1500. In the same way other two phases of both the crops are explained in the below tables.

In this way, the deficit rainfall index insurance will help the farmers to sustain their farm income against the weather shocks.

Table 3. Rainfall insurance chart for groundnut crop in Coimbatore district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall (Rs/mm)	Maximum lump sum payout (Rs/ha)
1	410	Sowing and germination	1 st June to 30 th June	30	5	160	4000
2		Vegetative phase	1 st July to 31 st July	25	5	150	3000
3		Flowering or pod formation	1 st August to 15 th September	50	10	87.50	3500

Table 4. Rainfall insurance chart for maize crop in Coimbatore district

Phase	Premium (Rs/ha)	Crop stage	Calendar period	Strike (mm)	Exit (mm)	Payout for deficient rainfall (Rs/mm)	Maximum lump sum payout (Rs/ha)
1	240	Germination and establishment phase	1 st July to 15 th July	15	5	150	1500
2		Vegetative phase	16 th July to 10 th August	20	5	133.33	2000
3		Flowering and cob formation	11 th Aug to 5 th Sep	30	10	125	2500

6. Crop Insurance, Vulnerability and Resilience

Since crop failure is often occurring due to variation in rainfall (particularly droughts). Normally, the rainfed crops are mostly affected by the drought spells. Sixty five percent of Indian agriculture is heavily dependent on natural factors, particularly rainfall. Studies have established that rainfall variations account for more than 50% of variability in crop yields (Agricultural Insurance Company of India Limited, 2005).

Government of India has already introduced the Comprehensive Crop Insurance Scheme (GCIS) in 1985 and subsequently replaced by National Agricultural Insurance Scheme (NAIS) in 1999-2000 which was based on crop cutting experiments to assess the crop yield. However due to problems in monitoring the crop yields and paying the compensation, this was not successful. Hence, the Government of India and State Governments have now following the weather based crop insurance programmes in 2007-08 which are getting popular in several regions.

This weather based crop insurance keeps the farmers to cope up with the variation in rainfall pattern. Since insurance itself is a risk mitigation strategy, the weather based crop insurance acts as a resilience mechanism for rainfall uncertainties. Since not many studies have done in assessing the premium and compensation aspects, the research study attempted to arrive the parameters so that weather based crop insurance will be solid resilience mechanism under climate variability.

7. Conclusion

Since weather based crop insurance is a resilience mechanism against rainfall uncertainties, it is important to do research on these aspects. In this connection, establishment of automatic weather station at block level at least covering about 25 km radius is needed to implement weather based insurance for protecting the farmers from adverse weather conditions. Development of knowledge based decision support system for translating weather information into operational management practices is also important. Promotion of weather based insurance among the farming community to avoid the risk related to climatic factors such as rainfall, temperature, frost etc. should be followed up regularly.

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