Indian Journal of Science and Technology, *Vol 8(12), DOI: 10.17485/ijst/2015/v8i12/52916, June 2015*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Evaluation of Weather based Crop Insurance Products for *Kharif* Rice

S. Kokilavani*, V. Geethalakshmi and T. N. Balasubramanian

Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore-641 003, India
kokiacrc@gmail.com; geetha@tnau.ac.in; balasubramanian.tnb.tn@gmail.com

Abstract

Background/Objectives: WBCIS products proposed by three insurance providers were evaluated using historical weather data for *kharif* rice in Dharmapuri, Theni, Tirunelveli and Virudhunagar districts of Tamil Nadu. Rice is sensitive to moisture stress at reproductive stage as it consumes large amount of water during the major part of reproductive phase. **Results/Findings:** Evaluation of the strike events revealed that all the study districts are highly vulnerable to deficit rainfall risk. The soil factor and the intensity of rainfall during critical stages of the crops must be considered for excess rainfall. Water holding capacity of the soil and the daily ET must be taken into account for consecutive dry days. **Conclusion/Application:** Hypothetical analysis showed that the product designed by AIC for Virudhunagar was reliable both in terms of threshold values and compensation rate per mm of rainfall under different phases of crop growing period. This could be supported through higher monetary returns benefited by the farmer at Virudhunagar district.

Keywords: Insurance Companies, Payout, Product Design, Rice, Strike Events

1. Introduction

The greatest risk to crop yields in Indian agriculture is attributed to the variability of seasonal rainfall as well as the uncertainty in the amount and its distribution in a given season[1]. On an average 12 million hectares of crop area is affected annually by the calamities, severely impacting the yields and total agricultural production in India[2]. Rice is the most important cereal food crop of India. Ability of the rice seeds to germinate under water and capacity of the rice plant to thrive under flooded conditions of soil gives rice culture a unique status[3]. Efficient cropping zone for rice was identified[4] which help to know in depth knowledge on the districts fell under most efficient, efficient and not efficient cropping zone distributed over Tamil Nadu.

There are web enabled software tool available and developed for Meteorological Information System, with Query, Visualization and Data Reporting features for the Meteorological Network. This tool is used to generate the multilevel micrometeorological data with tower based measurements and provide the same for crop modeling studies[5].

The idea of crop insurance in India was conceptualized as far back as 1920, when S. Chakravarti proposed an agricultural insurance scheme based on rainfall approach[6]. Government of India has already introduced the Comprehensive Crop Insurance Scheme (GCIS) in 1985 and subsequently this was replaced by National Agricultural Insurance Scheme (NAIS) in 1999-2000 which was based on crop cutting experiments to assess the crop yield. Despite the large public subsidy a significant majority of India's farmers have remained uninsured largely due to issues in design, particularly the long delays in claims settlement[7]. Hence, the Government of India and State Governments now started providing the weather based crop insurance programmes from 2007-08.

*Author for correspondence

Weather Based Crop Insurance Scheme (WBCIS) is a type of Agricultural Insurance, which is a means of protecting the farmers against financial losses due to uncertainty in seasonal rainfall/unfavorable weather situations[8]. 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[9].

Tamil Nadu has a large number of agriculture-dependent farmers (8 million) who produce 75 million tonnes of food grains from 3 million ha of cultivable land[10]. Since rice is the main crop in the state and it also faces the brunt of unpredictable weather an attempt was made to compare and evaluate the WBCIS products designed by three insurance companies with respect to *kharif* rice crop in order to arrive a balanced product which would benefit the farmers and at the same time ensure viability of the insurance products.

2. Materials and Methods

Government of Tamil Nadu has notified a particular insurance company for a district in which the other insurance company can not function. The study districts, companies notified by the Government of Tamil Nadu for the year 2011-12, weather station from where the historical weather data was obtained, the data period, sum insured and farmers' premium are given in Table 1.

2.1 The Different Weather Perils Covered under the Insurance Package are as Follows

2.1.1 Deficit Rainfall Cover (DRC)/Water Deficit Index (WDI)

The deficit rainfall based insurance is intended to provide 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 DRC product given by AIC for Dharmapuri and Virudhunagar districts are described in Table 2.

AIC has suggested Strike 1 (S_1), Strike 2 (S_2) and Exit (E) for giving compensation. Other companies have proposed only S_1 and S_2. HDFC-ERGO have considered two phases and MS-Cholamanadalam have considered phase one and two as whole phase for paying compensation towards deficit rainfall which is notified as Water Deficit Index (WDI). The product is given in Table 3.

2.1.2 Excess Rainfall Cover (ERC)/Excess Rainfall Index (ERI)

Heavy and continuous rainfall within a short period has the potential to cause severe physiological damage to crops, particularly during the maturity and the harvest stages. The indices that have been designed to capture wet spells, aggregate rainfall over a period of between two and four consecutive days during the crop growth period is considered for the insurance coverage. The ERC product

Table 1. Study districts, companies notified for 2011-12, reference weather station and sum insured by different insurance companies

Sl. No	District	Insurance Company	Name of the Weather station	Data period	Sum Insured (`)	Farmers premium (`)
1	Dharmapuri	Agricultural Insurance Corporation(AIC)	Regional Research Station, Paiyur	(1981 to 2005)	10000	250
2	Virudhunagar	AIC	Regional Research Station, Arupukkottai	(1985 to 2010)	10000	250
3	Theni	HDFC-ERGO	Horticulture College and Research Institute, Periyakulam	(1981-2010)	10000	297
4	Tirunelveli	MS-Cholamandalam	Rice Research Station, Ambasamudram	(1981-2010)	10000	250

Table 2. Deficit Rainfall Cover (DRC) proposed by AIC for the Dharmapuri and Virudhunagar Districts

	P-I(15th July – 15th Aug)			P-II(16th Aug-10th Sep)		
	S_1	S_2	E	S_1	S_2	E
Dharmapuri						
DRC- ` 5000/ac	< 40 & > 15 mm	< 15 mm	0 mm	< 80 & >30 mm	< 30 mm	0 mm
Compensation	` 15/mm	` 142/mm	` 2500	` 20/mm	` 83/mm	` 3500
Virudhunagar						
DRC - ` 5000/ac	<40 & >15 mm	<15 mm	0 mm	< 50 & >20mm	<20 mm	0 mm
Compensation	` 15/mm	` 142/mm	` 2500	` 15/mm	` 153/mm	` 3500

Note: P- Phase; S_1-Strike 1; S_2-Strike 2; E- Exit

Table 3. Water Deficit Index (WDI) proposed by HDFC-ERGO for Theni District and MS-Cholamandalam for Tirunelveli District

Theni (Max. Payout – `. 4200 / ac)	PI(1st Jun- 15th Aug)		PII(16th Aug – 15th Sep)	
WDI	S_1	S_2	S_1	S_2
	< 25 & > 5 mm	< 5 mm	< 75 & > 25 mm	< 25 mm
Compensation	` 10/mm	` 60/mm	` 10/mm	` 40/mm
Tirunelveli (Max. Payout – `. 5000 / ac)	15th July – 2nd Oct			
WDI	S_1	S_2		
	< 80 &> 10 mm	< 10 mm		
Compensation	` 10/mm	` 180/mm		

Table 4. Excess Rainfall cover (ERC) proposed by AIC for the Dharmapuri and Virudhunagar Districts

ERC	PI(15th July– 10th Aug)		PII(11th Aug -15th Sep)	
Max. Payout: ` 3500/ac	Rainfall in 4 consecutive days			
	Strike	Exit	Strike	Exit
Dharmapuri	> 100 mm	> 200 mm	> 175 mm	> 275 mm
Viruthunagar	> 60 mm	> 160 mm	> 80 mm	> 180 mm
Compensation	` 10/mm	` 1000	` 15/mm	` 1500

given by AIC for Dharmapuri and Virudhunagar districts are described in Table 4.

HDFC-ERGO (Theni) and MS-Cholamanadalam (Tirunelveli) proposed Excess Rainfall Cover in the name of Excess Rainfall Index (ERI). The products of the mentioned companies are given in Table 5.

2.1.3 Consecutive Dry Days (CDD)/Dry Days Index (DDI)

It is used to construct an index equal to the maximum consecutive dry days within a specified period, where a dry day is defined as a day with total rainfall below a

Table 5. Excess rainfall cover/excess rainfall index for Theni and Tirunelveli Districts (Rainfall in any 2 consecutive days)

Theni (` 5000/ac)	PI(1st Jun- 15th Aug)	PII(16th Aug – 15th Sep)
ERI	>105 mm	>100 mm
Compensation	` 10/mm	` 10/mm
Tirunelveli (` 5000/ac)	PI(15th July-13th Aug)	PII(14th Aug – 2nd Oct)
ERI	>100 mm	>100 mm
Compensation	` 10/mm	` 10/mm

Table 6. Consecutive Dry Days (CDD)/Dry Days Index (DDI) given to study districts

AIC	**Dharmapuri & Virudhnuangar, Starting 20th July to 10th Sep, Max. Payout : ` 1500/ac**		
IF rainy day(>2.5mm) do not occur	Dharmapuri	Virudhnuangar	` (Paid)
	(for first 26 consecutive days)	(for first 30 consecutive days)	S_1 400
	(for first 31 consecutive days)	(for first 35 consecutive days)	S_2 650
	(for first 36 consecutive days)	(for first 40 consecutive days)	S_3 900
	(for first 41 consecutive days)	(for first 45 consecutive days)	S_4 1200
	(for first 46 consecutive days)	(for first 50 consecutive days)	S_5 1500
HDFC-ERGO	**Theni, starting 16th Aug to 15th Sep, Max. Payout: `. 3000 / ac**		
	If rainfall (> 2.5 mm) do not occur in the first 24 consecutive days, no money is paid(S_1) If rainfall (> 2.5 mm) do not occur from 25 to 39 consecutive days, ` 500 is paid($S_2$) If rainfall (> 2.5 mm) do not occur for 40 to 44 consecutive days, ` 1500 is paid(S_3) If rainfall (> 2.5 mm) do not occur for more than 45 consecutive days, ` 3000 is paid(S_4)		

threshold value. This cover offers protection for long dry spells during crop growth period[8].

CDD= maximum number of consecutive days with $r_{actual} < r_{threshold}$

The product offered by different insurance companies is given in Table 6.

3. Results and Discussion

3.1 Deficit Rainfall Cover/Water Deficit Index

Deficit Rainfall Cover/Water Deficit Index was considered in two phases of crop growing period by AIC (Dharmapuri and Virudhunagar districts) and HDFC-ERGO (Theni). Phase one and phase two were combined as one single phase by MS-Cholamandalam (Tirunelveli) in considering WDI. The strikes occurred during the crop growth period for the deficit rainfall cover/water deficit index are presented in the Figure 1.

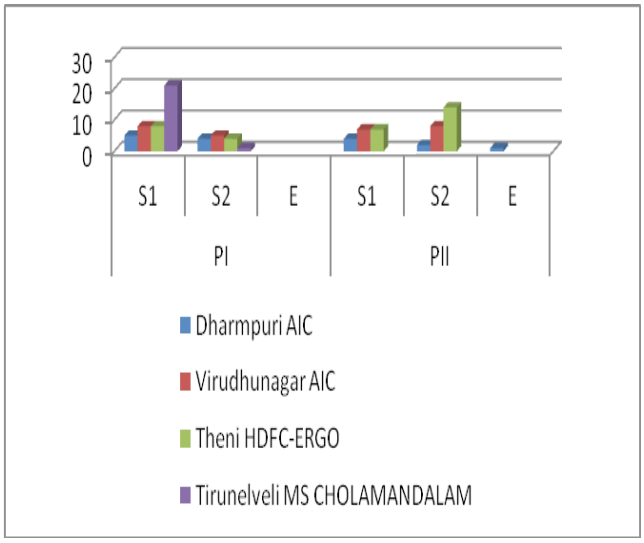

Figure 1. Comparision of strike events for Deficit Rainfall Cover/Water Deficit Index.

Dharmapuri: In phase I (15th July – 15th Aug), the S_1 (rainfall < 40 mm but > 15 mm) and S_2 (rainfall < 15 mm) occurred for five and four times respectively. In phase II (16th Aug – 10th Sep), the S_1 (rainfall < 80 mm but > 30 mm) occurred for four times, the S_2 (rainfall < 30 mm) occurred for two times and the Exit (rainfall=0mm) occurred for only one time in 25 years of evaluation period.

Virudhunagar: In phase I (15th July – 15th Aug), the S_1 (rainfall < 40 mm but > 15 mm) and S_2 (rainfall < 15 mm) occurred for eight and five times respectively. In phase II (16th Aug – 10th Sep), the S_1 (rainfall < 50 mm but > 20 mm) occurred for seven times and the S_2 (rainfall < 20 mm) occurred for eight times in 26 years of evaluation period. The analysis of the deficit rainfall weather peril revealed that the strike threshold level and compensation rate per mm fixed was similar for phase one in both the districts. It is obvious that Dharmapuri district receives bi model rainfall (both South West Monsoon and North East Monsoon) while Virudhunagar district receives only mono model rainfall (North East Monsoon). This shows the lack of scientific intervention in formulating the product. Location specific i.e. when the product is designed based on past historical rainfall data in the particular region, it would be highly reliable for the occurrence of strike events and helpful for the betterment of farmers.

Theni: In phase I (1st June – 15th Aug), the S_1 (rainfall < 25 mm but > 5 mm) and S_2 (rainfall < 5 mm) occurred for eight and four times respectively. In phase II (16th Aug – 15th Sep), the S_1 (rainfall < 75 mm but > 25 mm) occurred for seven times and the S_2 (rainfall < 25 mm) occurred for 14 times in 30 years of evaluation period.

Tirunelveli: For the phase (15th July- 2nd Oct), the S_1 (rainfall < 80 mm but > 10 mm) and S_2 (rainfall < 10 mm) occurred for 21 and one times respectively in 30 years of evaluation period.

The evaluation of the strike events revealed that all the study districts are highly vulnerable to deficit rainfall risk. The crop is sensitive to moisture stress at reproductive stage as it consumes large amount of water during the major part of reproductive phase[11]. Cruz R.[12] reported that actual cost of spikelet sterility is due to water stress given during the flowering stage and this is associated with poor panicle exsertion which can be taken as a useful indicator in assessing the yield.

3.2 Excess Rainfall Cover/Excess Rainfall Index

(In any 4 consecutive days)

In **Dharmapuri**, For phase I(15th July – 10th Aug), the strike of > 100 mm rainfall and in phase II(11th Aug – 15th Sep), the strike of > 175 mm rainfall each occurred for two times respectively in 25 years. In Virudhunagar, for phase I, the strike of >60 mm rainfall and in phase II, the strike of >80 mm rainfall each occurred for four times

respectively in 26 years of evaluation. The reduction in crop yield was attributed to cessation of panicle development and degeneration of spikelets in the crop submerged at booting stage and the reduction in tiller number and grains per panicle in the crop submerged at early and active tillering stages[13] (in any 2 consecutive days).

Theni: For phase I (1st Jun – 15th Aug), the strike of > 105 mm rainfall did not even occur once in the study period. In phase II(16th Aug – 15th Sep), the strike of >100 mm rainfall occurred for two times in 30 years of evaluation.

Tirunelveli: The strike of > 100 mm rainfall did not occur even one time in both the phases. The mean rainfall for SWM period over 30 years was 96 mm. Hence, the strike values need to modified based on the past historical rainfall pattern. The strikes occurred during the crop growth period for the excess rainfall cover/excess rainfall index is presented in the Figure 2.

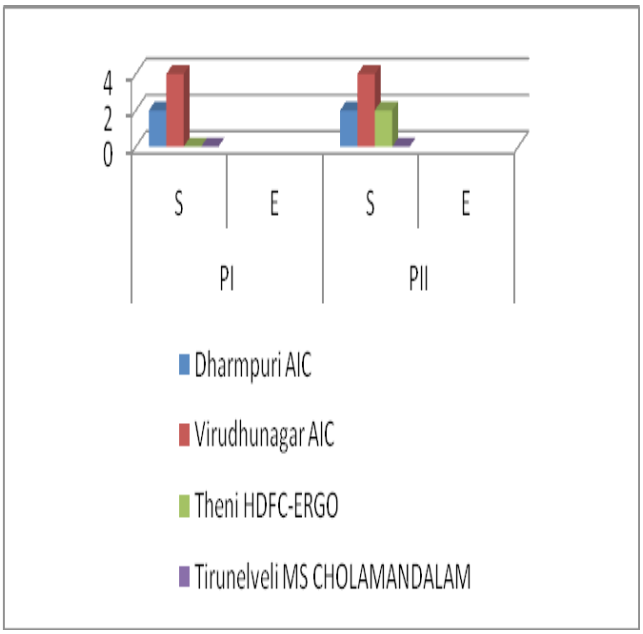

Figure 2. Comparision of strike events for Excess Rainfall Cover/Excess Rainfall Index.

As water stagnation is a cumulative result of infiltration rate of rainfall in to the soil profile, for deciding the Excess Rainfall Cover (ERC)/Excess Rainfall Index (ERI), soil factor and the intensity of rainfall during critical stages of the crops must be considered.

3.3 Consecutive Dry Days/Dry Days Index

For Dharmapuri and Virudhunagar districts, consecutive dry days were covered only from (20th July – 10th Sep) in the growing season. During that period, the strike S_1 to S_5 was considered as rainfall of > 2.5 mm do not occur consecutively for 26/30 (S_1), 31/35 (S_2), 36/40 (S_3), 41/45 (S4), 46/50 days (S_5) respectively. In the 25 years of evaluation, S_2 and S_3 each occurred for only one time respectively for Dharmapuri district. For Virudhunagar district, S_1 occurred for only one time and S_2 occurred for two times in the 26 years of evaluation.

No strike occurrence could be observed at Theni district. The strikes occurred during the crop growth period

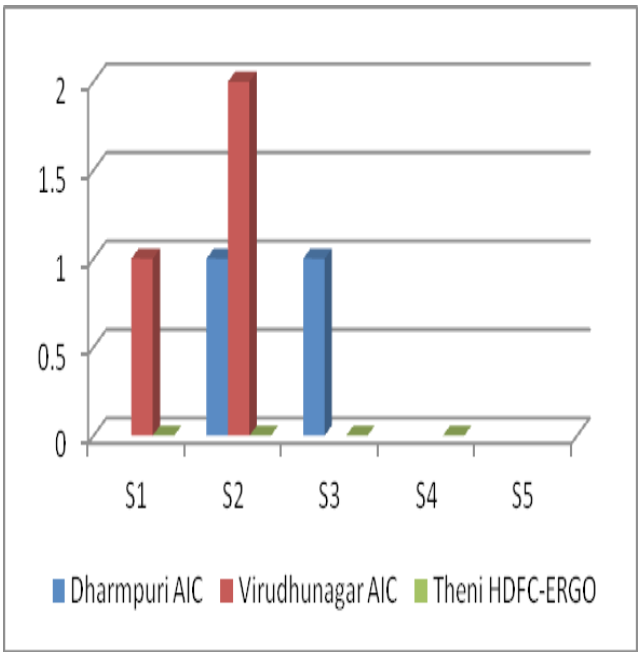

Figure 3. Comparision of strike events for Consecutive Dry Days/Dry Days Index.

for the consecutive dry days/dry are presented in the Figure 3.

For Consecutive Dry Days (CDD)/Dry Days Index (DDI), the water holding capacity of the soil and the daily ET must be taken into account for fixing the strike threshold values as well as compensation rates.

The examination of four districts covered by three agricultural insurance companies on hypothetical pre-

Table 7. Hypothetical premium payment and compensation benefit by a farmer (in `)

Weather perils	DRC/WDI	ERC/ERI	CDD/DDI	TOTAL		Limited to 25 years	
				Premium	Payout	Premium	Payout
Dharmapuri	20518	1080	1550	6250	23148	6250	23148
Virudhunagar	29391	2332	1700	6500	33423	6250	32138
Theni	23137	595	-	8922	23732	7435	19777
Tirunelveli	9064	-	-	7500	9064	6250	7553

mium payment and amount of compensation received over 25 years are given in Table 7. To arrive a good comparisons among the different companies, the period is limited uniformly to 25 years.

The hypothetical premium payment and compensation analysis showed that the Virudhunagar district was highly prone to different weather perils given by the company. The product designed by AIC for Virudhunagar district was reliable both in terms of strike threshold values and compensation rate per mm of rainfall under different phases of crop growing period. This could be supported through higher monetary returns benefited by the farmer under different weather perils. The occurrence of strike events exhibited more risk under deficit rainfall for the Tirunelveli district under Ms Cholamandalam company yet the compensation rate fixed per mm of rainfall was quite low which resulted in poor compensation benefit for the farmer.

4. Conclusion

WBCIS products proposed by three insurance providers were evaluated for *kharif* rice in Dharmapuri, Theni, Tirunelveli and Virudhunagar districts of Tamil Nadu. The evaluation of the strike events revealed that all the study districts are highly vulnerable to deficit rainfall risk. The product designed by AIC for Virudhunagar district was reliable both in terms of strike threshold values and compensation rate per mm of rainfall under different phases of crop growing period. This could be supported through higher monetary returns benefited by the farmer under different weather perils.

5. Acknowledgment

Author is thankful to Weather Based Crop Insurance Scheme (WBCIS) funded by Agricultural Insurance Company (AIC) and ClimaAdapt Scheme funded by Norwegian embassy for providing necessary funds to taken up this study.

6. References

1. Baweja PK. Rainfall variability and probability for crop planning in Solan. J of Farm Sci. 2011; 1(1):75–88.
2. Government of India. Report of the working group on risk management in agriculture for eleventh five year plan (2007-12). New Delhi: Planning Commission.
3. Venkatraman S, Krishnan A. Crops and weather publications and information division. New Delhi: ICAR; 1992. p. 355–62.
4. Sardar MP, Ponnusamy R. Web enabled real time weather data analysis. Ind J Sci & Tech. 2013; 6(11):5507–13.
5. Kokilavani S, Geethalakshmi V. Identification of efficient cropping zone for rice, maize and groundnut in Tamil Nadu. Ind J Sci & Tech. 2013; 6(10):5298–301.
6. Vyas VPS, Singh S. Crop insurance in India: Scope for improvement. Economic and political Weekly. 2006 Nov 4. p. 4585–94.
7. Mahul O, Verma N, Clarke DJ. Improving famers' access to agricultural insurance in India.World Bank, mimeo; 2011.

8. Agriculture Insurance Company of India Ltd. 2008. Available from: www.aicofindia.org
9. Senthilnathan S, Palanisami K, Ranganathan CR, Chieko U. Deficit rainfall insurance payouts in most vulnerable agro climatic zones of Tamil Nadu, India. Japan: Inter-University Research Institute Corporation, National Institutes for the Humanities, Research Institute for Humanity and Nature; 2009. p. 138–45.
10. Available from: www.tn.gov.in
11. DeDatta SK. Principles and practices of rice production. New York: John Willey and Sons; 1981. p. 9–41.
12. Cruz RT, O'Toole JC. Dry land rice responses to an irrigation gradient at flowering stage. Agron J. 1984; 76:178–83.
13. Reddy BB, Ghosh BC, Panda MM. Flood tolerance of rice at different crop growth stages as affected by fertilizer application. Plant & Soil. 1985; 83:255–63.