

EVALUATION OF WEATHER INDEX INSURANCE AS AN  
ADAPTATION STRATEGY TO MITIGATE CLIMATE RISKS IN  
AGRICULTURE

A THESIS

SUBMITTED IN FULFILLMENT  
OF THE REQUIREMENTS FOR THE DEGREE  
OF  
DOCTORATE OF PHILOSOPHY

IN

AGRICULTURAL ECONOMICS

AT  
GOKHALE INSTITUTE OF POLITICS AND ECONOMICS  
(University U/S 3 of UGC Act, 1956)

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MARCH 2013

## **Evaluation of Weather Index Insurance As An Adaptation Strategy To Mitigate Climate Risks In Agriculture**

Number of volumes : Thesis (one)

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CERTIFICATE (FORM 'A')

CERTIFIED that the work incorporated in this thesis entitled "Evaluation of Weather Index Insurance as an Adaptation Strategy to Mitigate Climate Risks in Agriculture" submitted by Kolli N Rao was carried out by the candidate under my supervision. It is an original contribution and has not been submitted elsewhere for the award of any other degree. Such information as has been obtained from other document has been duly acknowledged in this thesis. I recommend that the thesis should be considered for the award of the degree of 'Doctorate of Philosophy'

Date: 19<sup>th</sup> March 2013  
Place: Pune

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## DECLARATION BY THE CANDIDATE

I, Kolli N Rao, hereby declare that this thesis on the topic entitled, "*Evaluation of Weather Index Insurance as an Adaptation Strategy to Mitigate Climate Risks in Agriculture*" is submitted for the award of Degree of Doctorate of Philosophy in Agricultural Economics to the Gokhale Institute of Politics and Economics, Pune - 411004.

It is an original contribution and has been completed during my tenure as a research scholar at Gokhale Institute of Politics and Economics, Pune.

This thesis has not been submitted by me elsewhere for the award of any degree or diploma-part or full. The information gathered by me elsewhere for the thesis is original, true and factual. Such information as has been obtained from other document has been duly acknowledged in the thesis. I hereby request, to consider the thesis for the award of the degree of 'Doctorate of Philosophy' to me.

Date: 19<sup>th</sup> March 2013

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Place: Pune

## Abstract

For Indians, agriculture is not a profession; it is a way of life. With increasing fragmentation and scattering of landholdings, producing yields low in volume and value, climate poses a big challenge. To mitigate the problems of farmers, it is necessary to provide them safety-net to prepare them to face the calamities of nature. The Government of India has taken several initiatives to provide relief in case of crop losses. Among these initiatives, crop insurance has emerged as an effective measure in helping the distressed farmers. The weather being the major cause of crop losses, both weather and yield have been used as basis for developing crop insurance schemes. One of them, viz. Weather Index (WI) insurance is being used in India over the past six years as a key risk management strategy to tackle the climate related risks. Given the large scaling-up and scaling-out, this study has tried to evaluate the efficacy of WI insurance products vis-à-vis yield index insurance products, and has compared different product designs currently used in the market and the products of different insurance providers.

To begin with, the study looks at the various weather based insurance products provided by different insurance providers. The WI products analyzed between the competing insurance providers have shown significant differences in product design, pricing approach, and the benefits offered, making it difficult for the less informed states in the country to understand the nuances. The thesis, therefore, examined four different WI insurance product designs for *Kharif* and three for *Rabi season*. The study found that ‘Key factor index’ based product for *Kharif* and ‘INFOCROP’ modeling based product for *Rabi* perform better than other WI product designs. Weather – Yield correlation for select locations and crops has revealed that it performs better for *Kharif* products where rainfall is the key component compared to *Rabi* products covering high temperature. The study has observed that *Kharif* products tend to underpay while the *Rabi* products overpay. The current WI insurance products in the market appear to be poorly designed with almost 40 percent probability of giving a payout with no visible yield loss. On the other hand, the probability of payout is only about 70 percent when the yield loss is as high as 100 percent. Further the average claim payments conditional on total crop loss as a percentage of the historical average claim payment is just about 175 percent, shows that there are likely to be huge under pay-outs when there is a total crop loss. Evidence has also been found in this study to suggest that WI product providers should focus on the relative strengths of WI products, viz. capturing rainfall deficiencies. Particularly for *Kharif*, the study reveals that the basis risk would have

been lower if products had only the volume deficit rainfall element of cover, instead of many different covers.

The product basis risk as highlighted above in terms of lack of uniform standards in product design, risk margins, and weak correlation between yield index and weather index pay-outs needs immediate attention of the policy makers and the insurance providers. As the government looking to double the crop insurance penetration during the XII Plan period, setting-up Technical Support Unit (TSU) to encourage and promote further research in product design, product-benchmarking standards, service norms, etc. could be very timely and useful.

The spatial basis risk arising out of lack of adequate density of weather stations appears significant for rainfall, and tends to be high for a shorter span of the weather contingency covered, and gradually decreases with the increase in the span, necessitating higher density of weather stations for covering rainfall events of shorter span (daily and weekly events). To minimize the spatial basis risk the weather station density has to increase many times. While it may take many years and a huge investment by the government, there is a strong case for 'public - private partnership' and investment in this area. It's also worthwhile to encourage research on use of technologies to generate weather data from the meteorological satellites.

The study has also explored the various approaches that can reduce the shortcomings of the WI product design, and one such way is to understand the behavior of the weather parameters over a period of time. This study has looked at the time series weather data of the past 25 years period for 21 well distributed locations, to study the trends in the data with particular reference to the weather dimensions used in WI products. The analysis has revealed definite trends at some locations for certain parameters. The relative humidity particularly exhibited an increasing trend at most locations, while the length of dry-spell has shown a decreasing trend for almost three-fourth of the locations. 12 of the 21 locations reported increasing trend in south-west monsoon rains, and in equal number of locations the single-day rainfall has shown increasing trend. 13 of the 21 locations reported increasing trend in day's maximum temperature, while 11 of the 21 locations have shown increasing trend in day's minimum temperature. These trends highlight the new risks that climate can bring to the existing risk

profile of Indian agriculture, as also the need for developing appropriate index insurance solutions to effectively mitigate the new risks.

Another way is to understand the perspective of the stakeholders: states, farmers and insurance providers. The majority of the states have considered that operationally and structurally NAIS is a better product than WBCIS and MNAIS products, which appears to be driven by the considerations of lower workload on yield estimation surveys, rather than product benefits. States do understand the strong and weak aspects of yield index and weather index insurance products, and are mostly in favour of a 'hybrid' like a 'double trigger' product. The double trigger product envisaged has 'weather index' as the first trigger and 'yield index' as the second trigger. Proportion of weather index trigger depends on to what extent weather explains the yield variability, and gives early payout, while the yield index accounts for the balance, and gives the residual payout. Almost all the states have indicated the need for setting up a TSU for hand-holding and guiding in evaluating the products being offered by multiple insurance providers, to enhance the insurance value for the farming community. As briefly mentioned earlier, setting up TSU assumes additional significance in the light of the 'poor' performance of the current WI products (vis-à-vis the yield losses), requiring vast technical inputs in WI product design, as well as the lack of expertise and confidence on the part of the States. The government allowing a larger participation of private insurance providers in agriculture space is another strong case for setting up TSU.

Farmers practicing crop production under irrigated conditions have shown higher interest in crop insurance than the farmers' growing crops under rain-fed conditions. Awareness of the crop insurance among the farmers is primarily driven by the level of education, size of landholding and type of farming (irrigated or rain-fed). Insurance providers are seeking standard market practices, like product benchmarking, transparency in competition and weather data standardization, to grow the market.

Finally, the study has highlighted the need for research in quantifying basis risk (both product and spatial) in order to improve the product designing, and the need for scientific research in developing the crop modeled inputs in WI insurance product design.

## ACKNOWLEDGEMENTS

This thesis would not have been possible without the generous support of many people and friends. Most importantly, I must thank my supervisor, Prof. Rajas K Parchure, whose advice, suggestions and feedback have shaped the way I think and write. It has been a pleasure to work with him.

Many others and well-wishers have provided valuable feedback and suggestions. I would like to generously thank Dr. Olivier Mahul, Dr. Daniel J Clarke, Dr. Mushfiq A Mobarak, Dr. Tetyana Zelenska, Dr. Pramod K Aggarwal, Dr. S. S. Raju, Dr. G S Rao, Dr. GHSLV Prasad Rao, and Mr. Raghavendra.

It gives me immense pleasure in acknowledging the support and assistance extended by my Colleagues Mr. Vibhuti Srivastava, Mrs. Jeyanthi Hariharan and Ms. Aishwarya Agarwal in data analysis.

I owe my deepest gratitude to the Central Research Institute for Dryland Agriculture (CRIDA), Hyderabad, for providing the weather data used for studying the trend. I am especially grateful to Agriculture Insurance Company of India limited (AIC) for granting me permission to pursue this research, and also allowing me to use the macro level data. I am hugely appreciative of the assistance of these institutions.

I must thank my wife and my two daughters for their support, encouragement and patience during this research period.

Finally, I thank the Almighty for motivating me to take up this research and supporting me all through.

Kolli N Rao



## Abbreviations and Acronyms

AIC	:	Agriculture Insurance Company of India Limited
AMSL	:	Above Mean Sea Level
ANOVA	:	Analysis of Variance
ARFI	:	Aggregate Rainfall Index
CCEs	:	Crop Cutting Experiments
CCIS	:	Comprehensive Crop Insurance Scheme
CDD	:	Consecutive Dry Days
CEI	:	Certain Equivalent Income
CERs	:	Certainty-Equivalent Revenues
CRIDA	:	Central Research Institute for Dryland Agriculture
CRRA	:	Constant Relative Risk Aversion
DSSAT	:	Decision Support System for Agrotechnology Transfer
ENSO	:	El Niño Southern Oscillation
ET <sub>c</sub>	:	Crop Evapo-Transpiration Estimate
ET <sub>o</sub>	:	Evapo-Transpiration for Grass
FAO	:	Food and Agriculture Organization
GCF	:	Gross Capital Formation
GDP	:	Gross Domestic Product
GIS	:	Geographic Information System
GoI	:	Government of India
HadRM2	:	Hadley Centre Regional Climate Model
HYV	:	High Yielding Variety
IARI	:	Indian Agricultural Research Institute
IDW	:	Inverse Distance Weighted Estimator
IMD	:	India Meteorological Department
INR	:	Indian Rupee
IPCC	:	Intergovernmental Panel on Climate Change

IRI	:	International Research Institute for Climate and Society
Kc	:	Crop coefficients
KCC	:	Kisan Credit Card
KeyFI	:	Key Factor Rainfall Index
MIS	:	Market Intervention Scheme
MNAIS	:	Modified National Agricultural Insurance Scheme
MRS�	:	Mean Root Square Loss
MSP	:	Minimum Support Price
Mt	:	Million Tonnes
NAIS	:	National Agricultural Insurance Scheme
NSSO	:	National Sample Survey Organization
PACS	:	Primary Agricultural Cooperative Societies
PCIS	:	Pilot Crop Insurance Scheme
PML	:	Probable Maximum Loss
PPR	:	Pure Premium Rate (also called Burn Cost)
RFIs	:	Rural Financial Institutions
RWS	:	Reference Weather Station
SMA	:	Simple Moving Average
TOPS	:	Terrestrial Observation and Prediction System (TOPS)
TSU	:	Technical Support Unit
VaR	:	Value-at-Risk
WBCIS	:	Weather Based Crop Insurance Scheme
WI	:	Weather Index
WIBI	:	Weather Index Based Insurance
WII	:	Weather Index Insurance
WRSI	:	Water Requirement Satisfaction Index

*'I have sometimes thought that it might be well to establish an office of insurance for farms against the damage that may occur to them by storms, blight, insects etc. A small sum paid by a number of farms would repair such losses and prevent much distress'*

*Benjamin Franklin*

*October 1788*

