

CHAPTER 1: INTRODUCTION

1.1. CHARACTERIZATION OF INDIAN AGRICULTURE

Agriculture has been and continues to be the single most important livelihood of the masses in India. Despite its relatively diminishing contribution to national Gross Domestic Product (GDP), which had dropped to 13.9 percent during 2011-12 (valued by FAO at US \$282 billion in 2010), agriculture accounted for 52 percent of employment, and sustained 72 percent of the population (State of Indian Agriculture 2011, Ministry of Agriculture, GoI). In addition to meeting the food and nutritional requirements of the nation, agriculture provides essential raw materials to several key industries and accounted for about 14 percent of the total Indian exports valued at about US \$ 23.2 billion with a 1.7 percent share of world trade in agriculture in 2010 (International Trade Statistics 2011).

India is a land of many climates and soil varieties providing scope for a wide diversity to its agriculture. Climate is the single most decisive factor influencing crop production, determining the appropriate timings for key agricultural operations like sowing, transplanting, irrigation, fertilizer application and pesticides use. Another feature of the Indian agriculture is the large number of small-size farm-holdings. Of the estimated total of 118 million farm-holdings (Ministry of Agriculture, GoI, 2011), nearly 85 percent are of less than two hectares (small and marginal holdings), with an average operational holding-size¹ of merely 1.16 hectares (Agriculture census 2010-11). Moreover, the average holding-size of over 60 percent of the farms is just about 0.4 hectares (ha). As a consequence, the performance of agriculture in the near future will be crucial not only for farmers and agribusiness entities, but also for the national economy as a whole.

Agriculture is prone to several risks in India. The major risks to which crops are exposed during growth are adverse climatic occurrences like drought, dry-spell, flood, untimely / inadequate / excessive rainfall, thunderstorm, hailstorm, cyclone, cold wave, frost, pests, plant diseases, weeds and wild animals. It has been estimated that, on an average, 20 percent of the annual crop production is

¹All land which is used wholly or partly for agricultural production and is operated as one technical unit by one person alone or with others without regard to the title, legal form, size or location.

lost due to incidence of pests, plant diseases and weeds. On an average, every year crops on nearly 11.6 million hectares, on average, are damaged every year by natural calamities and adverse seasonal conditions and 33.46 million hectares of the area is prone to flood damage (Met Monograph No. Environment Meteorology-01/2010, India Meteorological Department, GoI)

Out of the total gross cultivated area of nearly 195 million hectares, only 44 percent has perennial irrigation facility, and the remaining is dependent on rainfall. On the other hand, barely 20 percent of the rainfall is utilized in the country because of the short duration in which the monsoons are active and rest of the rain goes away as run-off. A majority of the Indian farmers suffer crop losses when rain fails or is inadequate.

On the positive side, the Government of India has stipulated that the banking institutions should lend credit liberally to the agriculture sector. The total agricultural credit made available by the Rural Financial Institutions (RFIs) during 2011-12 was INR 4,750 trillion (approx.US\$90 billion). The credit delivery services in agriculture are driven by nearly 95,000 Primary Agricultural Cooperative Societies (PACS), over 36,500 rural and semi-urban branches of Scheduled Commercial Banks (SCBs) and 14,400 branches of Regional Rural Banks (RRBs). About 108 million Kisan Credit Cards (KCCs) had been issued up to October 2011 (Annual Report 2011-12, Ministry of Agriculture, GoI).

India holds a pride position in the production of many agricultural commodities. If the past achievements in the form of the Green, White, Silver, Yellow and Blue Revolutions are recalled, there is a feeling of pride, satisfaction and confidence. Irrigation, technology, credit, price-support and marketing infrastructure are all areas where impressive growth is registered. A proportional increase of value addition by agriculture to GDP, the Gross Capital Formation (GCF) in agriculture and allied sectors to 20.1 percent in 2011-12 reflects a positive trend. Other milestones over the past half a century include: Foodgrains production rose from 52 million tonnes (Mt) in 1951-52 to 257.4 Mt in 2010-11; foodgrain output growth (2.5%) was ahead of population growth (2.1%); per capita availability of foodgrains rose from 395 grams to 530 grams per day; wheat output increased from 6 Mt to 93.9 Mt; rice output increased from 21 Mt to 104.3 Mt; cotton and sugarcane production rose five-fold and seven-fold, respectively; fruit production increased from 12 Mt to 57 Mt, vegetable production increased from 10 Mt to 87 Mt, milk production increased from 21.2 Mt to 121.8 Mt and

per capita availability of milk increased from 112 grams (1968) to 281 grams per day. Thanks to the advent of technologies and entry of corporate farming, agriculture in India is slowly moving towards semi-commercial and commercial farming.

1.2. RISKS IN AGRICULTURE²

An estimated 56 per cent of the agricultural land in the country is rain-fed, and almost 20 percent of India's total land area is perennially drought prone. The Ganges, Brahmaputra and Indus river systems are highly prone to floods, with the magnitude of land affected by floods becoming more than double in recent decades³. Agricultural sector faces many challenges from financial, institutional, personal and most importantly, from the production related risks.

Production Risks: Indian agriculture is often termed 'gamble of monsoon', and uncertainty of crop yield is one of the fundamental risks faced by farmers and this risk is particularly high in the developing countries like India (Ray, 1981). Production risks mainly arise from two principal factors: Random uncontrolled weather inputs (e.g., rains, temperature, etc.) and incidence of pests & diseases.

Price or Market Risks: Input and output price volatility is an important source of market risk in agriculture and is largely beyond farmer's control. A great majority of Indian farmers resort to distress-sale or sell soon after the harvest, resulting in low price realization. The lack of effective and efficient markets and poor storage facilities add to the problems.

Financial & Credit Risks: In India, about 70 percent of farm households have poor access to formal sources of credit (World Bank, 2005). The high dependence on the informal sources comprising intermediaries like agricultural traders, commission agents, input suppliers and moneylenders frequently binds the produce to these credit suppliers, often forcing the farmer to make sub-optimal investments in farm inputs and exercise poor bargaining power with buyers at the time of sale.

Institutional Risks: Changes in the levels of input and output support and subsidies can significantly alter the profitability of farming activities. There is another dimension to institutional risks from

²Source: Managing Agricultural Production Risk – Innovations in Developing Countries, the World Bank (2005)

³Land area affected by floods was about 19 million hectares in the 1950s, which increased to 40 million hectares in 2003. This is about 12 percent of India's geographic area.

government actions like imposing a minimum-export price, revision of export tariffs, control of commodity exchanges & derivatives trading, and restrictions on movement and purchase of agricultural commodities which hinder farmer's ability to capitalize on favorable market situations.

Technology/Information Risks: For modernizing agriculture, adoption of new technologies such as High Yielding Varieties (HYVs), new agrochemicals, nutrients etc. and genetically modified crops bring in several risks as the level of farmers' awareness, capacity and necessary infrastructure for their proper application may not be present in many regions. Furthermore, the lack of information about market, latest developments in agricultural technologies and farm practices, government policies, finance & risk management instruments, weather and pest/disease forecasts, etc. add significant risks to the farming practices in India.

Of the risks mentioned above, production risk is the most prominent one, particularly in the areas, limiting the production. It is here that the index based crop insurance is expected to be an important risk management intervention, and hence, was the motivation behind this study.

1.3. STRATEGIES TO MITIGATE RISKS

Risk management mechanisms can be classified as *ex-ante* (prior to the occurrence of risk) and *ex-post* (after the occurrence of risk). Further one can distinguish between the informal and formal risk management strategies (World Bank, 2001). Informal strategies are identified as "arrangements that involve individuals or households or such groups as communities or villages" while formal arrangements are "market-based activities and publicly provided mechanisms."

1.3.1. INFORMAL MECHANISMS

Indian farmers are known to deploy many *ex-ante* informal strategies, ranging from 'avoiding the risk' to 'adoption of risk-tolerant crops and resistant seed varieties'. Rural households resort to numerous *ex-ante* risk-mitigating strategies, but there is often a tradeoff between lower-risk-lower-yield production methods and high-risk but more profitable investments (Morduch, 1995); Rosenzweig and Binswanger, 1993; Barrett and Carter, 2008). Various other informal strategies include, crop diversification, inter / mixed-cropping, staggered planting (planting at different dates to control the supply and also to lower the adverse impact of production risks), etc. Buffer stock accumulations of crops from the previous harvest or liquid assets also function as a cushion or precautionary savings.

Crop and risk sharing arrangements in land renting / leasing and labor hiring can also provide an effective way of sharing risks between individuals. The *ex-post* informal income-smoothing mechanisms in India are typically the reduced consumption patterns, mutual insurance among family and friends via social networks (Mobarak and Rosenzweig, 2012), sale of assets, such as land or livestock, or reallocation of labor resources to off-farm activities, migration to urban areas, etc.

1.3.2. FORMAL MECHANISMS

The formal risk management mechanisms can be classified as the government-provided or market-based strategies. The *ex-ante* services provided by the government agricultural extension, supply of quality agricultural inputs, subsidies on sprinkler/drip irrigation equipment and weather forecast and weather advisories are other institutional strategies. Calamity relief, crop loan waiver / rescheduling, consumption credit, etc. are some other government initiatives aimed at helping the farmers to cope with the risks.

The most prominent and significant government interventions to assure a certain minimum price to the farmer and stabilize open market price are the Minimum Support Price (MSP) for foodgrains, oilseeds and a few commercial crops and the Market Intervention Scheme (MIS) for a few perishable crops like vegetables and fruits. The other intervention is price stabilization fund for certain plantation crops. The commodity exchanges are supposed to help indirectly through price discovery and price dissemination. Contract marketing/farming, a notable price risk mitigation tool, plays an important role in providing stable prices for specialty crops/high-value crops.

1.4. CROP INSURANCE AS RISK MITIGATION TOOL

Benjamin Franklin was probably the first person to visualize the relevance of ‘insurance’ in the agriculture sector. Based on the severe storm of 24th October 1788 in a French countryside, which destroyed crops, he observed that insurance against crop losses can mitigate much distress.

Crop insurance is a means of “protecting the farmers against uncertainties of crop yields arising out of practically all natural factors beyond their control” (Ray, 1981). It is a financial mechanism in which the uncertainty of loss in crop yields is minimized by pooling a large number of uncertainties that affect crop yields so that the burden of loss can be distributed.

The principal characteristic, which distinguishes crop production from any other activity, is its massive dependence on nature. Uncertainty of crop yield is thus one of the basic risks, which every farmer has to face, more or less, all over the world. However, these risks are particularly high in the developing countries where the majority of farmers are poor, have extremely limited means and resources and are, therefore, unable to bear the risks of crop failure, especially when these are of a disastrous nature.

With growing population's constant pressing for land, no part of it could be given up for cultivation simply because it is subject to periodical risks of failure. It is in the interest of both nation and individual owners that land should be kept under plough even if there were occasional risks of crop failure. Therefore, crop production risks have to be faced. A severe crop failure has a cascading effect leading to serious repercussions for the entire society. Various methods are adopted to help the farmers to compensate, at least partially, for the loss of their crops through natural calamities. These include reduction or suspension of land rent, taxes, cancellation of accumulated agricultural debts, etc. However, the farmers cannot expect these benefits as a matter of right. Secondly, the continued prospects of relief are liable to 'soften' its recipients and are also likely to be questioned by the non-farming community. An important measure that is largely free from these difficulties is the 'crop insurance' against all natural and unavoidable hazards (Ray, 1981).

Crop insurance has many potential advantages in mitigating agricultural risks: it cushions the shock of disastrous crop loss by assuring a minimum of protection to farmers; spreads the crop losses over space and time; provides farmers greater confidence in making higher investments in agriculture; improves the position of farmers in relation to agricultural credit; relieves the government from the existing irregular financial burden of providing relief; helps to normalize the availability of supplies and stabilize prices; helps to maintain the dignity of farmers and enables the maintenance of systematic records of crop production. At the same time, crop insurance is not a panacea, particularly in the Indian context where a large number of small holdings with a low per unit value output are prevalent. This necessitated proxy insurance in the form of index insurance.

1.5. EMERGENCE OF CROP INSURANCE IN INDIA

Agricultural risks, being systemic and co-variant in nature, do not easily lend themselves to insurance. Lack of historical yield data, prevalence of small farm holdings, low-value of crops and relatively high

cost of crop insurance, have made the designing of a workable crop insurance scheme more difficult (Rao, 2007). Despite these constraints, India began implementing the Comprehensive Crop Insurance Scheme in 1985.

J S Chakravarthi is credited for conceptualizing the first 'index-based insurance' in India in, as early as, 1912, as a mechanism to compensate crop losses. Using the rainfall data of Chitradurga (Karnataka) from 1870 to 1914 (from the India Meteorological Department (IMD)), he explained how a rainfall index could be used to guarantee the payouts to farmers due to adverse deviations (Mishra, 1996). He took due care on considering the extent of indemnification and the role of state in promoting and supporting index based crop insurance. The basic frame conceptualized in the innovative rainfall insurance contract, envisaged by Chakravarthi, was the forerunner of the structure of insurance contracts to be introduced eight decades later. It may be noted that the World Bank suggested a similar scheme in 1992. The World Bank scheme aimed to cover all rural households by selling insurance in the form of 'rainfall lotteries', while Chakravarti's scheme favoured coverage of only crop producers. The path breaking framework suggested by Chakravarti has definitely not received the recognition it deserves.

Index based crop insurance prevalent in India has two unique features: (i) the credit-insurance linkage and (ii) element of compulsion in the insurance cover for borrowing (loanee) farmers. Both these features are inevitable in designing a crop insurance system for India. The preponderance and geographical spread of a vast number of small dispersed holdings producing low value of output per holding implies that the insurer cannot viably approach individual farmers to solicit business, collect premiums, collect claim reports, conduct individual loss survey assessments and pay individual claims. The costs would be prohibitive. Equally, the farmers are so poor and their needs for cash are so acute, especially at the start of the cropping seasons, that they would not voluntarily pay premiums.

The Indian crop insurance system is widely acknowledged as an ingenious solution to this problem. By adopting the index based area-yield approach to insurance and by requiring the payment of insurance premium and indemnities in and out of the crop loan account, it has markedly reduced transaction and administration costs of insurance selling and claims administration. The system also ensures that every rupee spent by the government on paying claims reaches the farmer for whom it is

intended. It is not far from truth to say that ‘Bancassurance⁴’ was invented in India as a solution to the problem in administering the crop insurance scheme! Bancassurance model used in India has multiple facets - credit linkage, credit collateral, cost effective distribution & claims release, banks financing the premium of loanee farmers, etc.

Despite the pioneering efforts of J S Chakravarthi, the first programme on crop insurance could commence only in 1972. The evolution of crop insurance in India is briefly discussed below:

(i) Program based on ‘Individual’ Approach (1972-1978):

The first crop insurance program was started in 1972 on H-4 cotton in Gujarat; it was later extended to a few other crops and states. The program covered merely 3,110 farmers for a premium of INR 0.454 million and paid indemnities of INR 3.790 million.

(ii) Pilot Crop Insurance Scheme (PCIS) (1979-1984):

The PCIS was based on ‘Homogeneous Area’ approach and it covered food crops (cereals, millets & pulses), oilseeds, cotton and potato, but was confined to borrowing farmers on a voluntary basis. The scheme was implemented in 13 states of the country and covered about 627 thousand farmers for a premium of INR 19.7 million and paid indemnities of INR 15.7 million.

(iii) Comprehensive Crop Insurance Scheme (CCIS) (1985-1999):

This scheme was made compulsory for borrowing farmers and the sum insured lowered to a maximum of INR 10,000 per farmer. The premium rate was two percent of the sum insured for cereals/millets and one percent for pulses/oilseeds. The Centre and the States in 2:1 ratio shared the premiums and claims. The scheme was implemented in 16 states and two Union Territories in 1999 and cumulatively covered 76.3 million farmers for a premium of INR 4.04 billion and paid indemnities of INR 23.19 billion.

⁴ ‘Bancassurance’ is an arrangement between an insurance company and a bank wherein the insurance company uses the bank sale channel in order to sell insurance products

(iv) National Agricultural Insurance Scheme (NAIS) (1999 onwards):

NAIS replaced CCIS from *Rabi*⁵ 1999-2000 season. The scheme is presently administered by Agriculture Insurance Company of India Limited (AIC) and provides coverage to nearly 35 different types of crops during the *Kharif*⁶ season and 30 crops during the *Rabi* season, and is mandatory for the borrowing farmers and voluntary for non-borrowing farmers. From *Rabi* 1999-2000 to *Kharif* 2011-12, NAIS cumulatively covered 291.41 million hectares of crops grown by 192.78 million farmers, covering a risk of INR 2.554 trillion for a premium of INR 75.56 billion and paid or finalized indemnities of INR 248.39 billion. The overall loss cost (indemnities to sum insured) is 9.73 percent. NAIS is the world's largest area yield index insurance programme in terms of the number of farmers insured.

NAIS, despite being best-suited for Indian conditions, has some shortcomings. The most noticeable one is the mismatch between the crop loss suffered, and the loss payment received, called 'basis risk' as the insurance unit is rarely homogenous. Presently, efforts are made to lower the size of the area in order to minimize the basis risk. Though NAIS is an "all risk insurance" cover, pre-sowing and post-harvest losses are not reflected in the yield index. The lack of infrastructure and manpower required to conduct millions of crop cutting experiments across the country to estimate the yields of crops delays settlement of claims.

(v) Modified National Agricultural Insurance Scheme (MNAIS) (2010 onwards):

The government announced a pilot scheme on the improved version of NAIS, called Modified National Agricultural Insurance Scheme (MNAIS) with effect from *Rabi* 2010-11 season for experimentation in 50 districts. The upgrade version has, to a large extent, taken care of the shortcomings in the existing NAIS. Some salient features of MNAIS are: village panchayat or other equivalent area being insurance unit for major crops; claims up to 25 percent of the sum insured in the case of prevented/failed sowing; coverage of post-harvest losses; individual farm level assessment of losses for localized calamities; on-account payment up to 25 percent of likely claim as advance for

⁵*Rabi* season refers to agricultural crops sown in winter and harvested in the summer season. The term *Rabi* means "spring" in Arabic, and the *Rabi* crops are grown between the months November to April.

⁶*Kharif* season refers to the planting, cultivation and harvesting of crops sown in the rainy season. These crops are usually sown with the beginning of the first rains in June / July, during the south-west monsoon season.

providing immediate relief to farmers in the case of severe calamities; minimum indemnity level of 70 percent; and actuarial premium rates and up-front subsidy in premium, which ranges from 25 percent to 75 percent.

1.6. INTRODUCTION OF WEATHER INSURANCE AND ITS RATIONALE FOR INDIA

Despite the enormous efforts of the government on providing crop insurance to protect farmers against agricultural risks, a significant majority of farmers have not opted for insurance cover largely due to issues in insurance product designing, particularly the long delays in claims settlement (Hazell 1992, Mahul *et al.* 2011) and basis risk. The combination of high vulnerability of India's farm households and low penetration of NAIS has induced several innovations in the provisions of agricultural insurance products. Weather index based insurance sparked interest among policymakers in the beginning of 21st century. The international financial institutions like the World Bank played a prominent role in encouraging weather insurance pilots in the low income countries, where traditional crop insurance products were not effective for various reasons.

The basic purpose of 'weather index' (WI) insurance is to estimate the payout by interpreting adverse deviations in weather conditions in terms of loss or shortfall in crop output. The crop modeling and statistical techniques are used to work out the relationships between crop output and weather parameters and, this establishes the linkage between the financial losses suffered by the farmers due to weather variations. The key advantages of the WI insurance products are that the payouts can be made faster; the insurance contract is more transparent, and the transaction costs are lower. Since index insurance uses objective, publicly available data, it is less susceptible to moral hazard (Hellmuth *et al.*, 2009). Most importantly, there are many low-income countries where no historical yield data are available, except the weather data. This provides an opportunity to try out WI insurance in these countries.

The first weather insurance product in India, and indeed in the developing world, was a rainfall insurance contract underwritten in 2003 by ICICI-Lombard General Insurance Company for groundnut and castor farmers of BASIX's water user associations in the Mahabubnagar district of Andhra Pradesh. This pilot spurred rainfall insurance product consists of offerings from other insurers, such as the public insurer Agriculture Insurance Company of India Limited (AIC), and subsequently

IFFCO-Tokio General Insurance Company, therefore led to a high growth in the number of farmers insured between 2003 and 2007.

Recognizing the need for encouraging WI insurance, the government started supporting the “Weather Based Crop Insurance Scheme” (WBCIS) with the up-front premium subsidy support since 2007. During 2007-08, AIC introduced a location-specific (Tehsil/Block) and a crop-specific pilot on weather risk index-based insurance product on rainfall outputs for the *Kharif* season. A composite weather risk index-based insurance product incorporating weather parameters like rise in temperature, un-seasonal rainfall, humidity, frost risks, etc. was also introduced as a substitute for NAIS. AIC availed technical assistance from Indian Agricultural Research Institute (IARI), New Delhi, to design weather risk insurance products based on INFOCROP⁷Crop Growth Simulation Modeling. During 2011-12, the market piloted weather index based crop insurance products covered over 40 crops, insuring 11.63 million farmers with acreage of more than 15.65 million hectares for an insured sum of INR 209.165 billion and premium of INR 18.53 billion. The growth and performance of weather index insurance market in India since 2003 is shown in Table 1.

TABLE 1: WEATHER INDEX INSURANCE MARKET IN INDIA

Agricultural year	Farmers insured	Crop insured (hectares)	Sum insured (INR millions)	Premium (INR millions)	Payouts (INR millions)	Claim ratios (%)
2003-04	1000			<0.1	<0.1	
2004-05	11300			9.00	4.50	50.00
2005-06	125975	98747	579.00	32.27	2.38	7.38
2006-07	181900			72.00	45.00	62.50
2007-08	711012	1135186	19910.00	1506.34	1168.02	77.54
2008-09	396870	538826	9661.00	879.33	709.21	80.65
2009-10	2438762	3513379	50161.00	4508.22	3508.02	77.81
2010-11	9391889	13351994	144848.00	13025.82	6381.47	48.99
2011-12	11630319	15648189	209165.00	18529.05	11507.85	62.11

Source: Collation from various sources, including AIC

⁷A dynamic simulation model used by IARI for the assessment of crop yields, losses due to pests, and environmental impact of agro-ecosystems in tropical environments

1.7. ISSUES AND KEY CHALLENGES IN WEATHER INSURANCE

Despite weather insurance provision of some key and distinct advantages like transparency, expeditious settlement of payouts, etc., it faces certain challenges as discussed herein.

Weather Stations Density: Considering India's territorial extension (328 million hectares of geographical area with about 140 million hectares of net cropped area), the network of 550 locations from where historical weather data (other than rainfall) are available and about 3500 stations from where historical rainfall data are available, is far too sparse. It is estimated that for weather insurance to be used as a meaningful risk mitigation tool, about 50000 automatic weather stations are needed (Planning Commission, Government of India, 2011).

Delay in Receiving Weather Data from IMD and High Cost of Data from Private Data Providers: Though the cost of IMD / government weather stations is affordable, delay of 30 – 45 days in receiving the data is not helping the contract in giving expeditious payouts and not getting the support of reinsurers.

Reference Weather Station (RWS) and Data Calibration: The poor understanding of farmers about product details such as claim settlement based on Reference Weather Station (RWS) creates several legal issues. Difference in the weather data of a government and private weather stations located at the same location creates a challenge in the selection of RWS.

Limited Scope of Weather Insurance: Based on the available experience, weather insurance seems to score better when it comes to data accuracy, transparency and quick settlement of payouts (relative to area yield index insurance). On the other hand, area-yield insurance seems to perform better in terms of scope of insurance (comprehensive insurance) and product design. There are still many weather events, such as hailstorms, thunderstorms, floods, etc. that are difficult to cover under weather insurance. Moreover, incidence of pests and diseases, largely the inter-play of weather parameters, are also challenging to cover under this modality.

Weather Insurance Design Challenges and Spatial Basis Risk: Poor designing of weather index may result in inability of the index in capturing the yield loss, while basis risk, may arise from poor density of weather stations. Both may lead to a similar problem, i.e. no payout despite the occurrence of damages/losses at the individual farm, or a payout when loss did not occur.

Weather Insurance Products Lacks Bench-marking: The multitude of weather insurance products offered by various weather insurance providers necessitates for benchmarking of various products to enable a farmer to make an informed choice. Through benchmarking, it may be ascertained whether the products offered by the different insurance providers carry at least comparable benefits.

Geographic Spread and Scaling up: Despite tremendous efforts of the insurance companies in the past five years, weather insurance product could not penetrate beyond the traditionally rain-fed agriculture areas. A proper geographical spread can also bring down the cost of insurance. The absence of geographical spread can seriously hamper the scaling-up.

Un-realistic Expectation: Some farmers tend to expect the insurance products to give them regular payouts. Weather insurance is viewed rightly or wrongly, as ‘money-back’ policy. Not giving regular payouts (maybe once in three to five years) makes it extremely challenging to sustain interest in weather insurance contracts.

Government Financial Support: Presently under NAIS, almost 95 percent of the government’s support is coming in the form of claims’ financing (*ex-post*) and many States are satisfied with the arrangement. However, in the case of government-supported weather insurance, financial support is provided as an *ex-ante* subsidy for premium, while the payouts are the responsibility of the insurer. The arrangement, though, helps the government in fiscal management; some States, however, are not pleased since during normal (good) years, the premium, including the subsidy, is retained by the insurance provider.

1.8. MOTIVATION BEHIND PRESENT STUDY

Climate change is a long term issue. It is expected to be a key factor contributing to extreme temperature, floods, droughts, intensity of tropical cyclones, and higher sea levels. While the magnitude of impact varies widely by region, the climate change is expected to impact agricultural productivity, shifting crop patterns. The policy implications are wide-reaching as changes in agriculture could affect food security, trade policy, livelihood activities and water conservation issues, affecting a large portion of Indian population. The impact of climate change on agriculture could result in problems with food security and may threaten the livelihood activities upon which much of the

population depends. Climate change can affect crop yields (both positively and negatively), as well as the types of crops that can be grown in certain areas, by impacting agricultural inputs such as water for irrigation, amounts of solar radiation that affect plant growth, as well as the prevalence of pests.

The major climate change threats are likely to manifest in terms of higher frequency droughts and floods. The frequency of droughts has been increasing over time: there were six droughts between 1900 and 1950 compared to 12 in the following 50 years, and 3 droughts have already occurred since the beginning of the 21st century. The Ganges, Brahmaputra and Indus river systems are highly prone to flooding. The magnitude of flooding has increased in recent decades, from approximately 19 million hectares affected 50 years ago to 40 million hectares in 2003, about 12 percent of India's geographic area. Floods have occurred almost every year since 1980, and their extent had substantially increased in 2003 due to the widespread rains, which affected even some of the most drought-prone areas.

Going into the future, the most widely quoted projections for climate change in India derived from the Hadley Centre Regional Climate Model (HadRM2), for the period 2041–2060 suggest that, on an average surface temperatures will increase by 2°C to 4°C south of latitude 25°, and in excess of 4°C in the northern region. Climatologists also project more variable precipitation during the monsoon season, with a possible decrease towards the west and an increase over the Indian Ocean and the Western Ghats; an overall increase in rainfall intensity by 1–4 mm per day, accompanied by an increase in the highest one-day rainfall. However, given the country's varied geography, some parts of the northwest India could also witness a decrease in extreme rainfall. There are also projections of glacial retreat caused by global warming, though the extent remains uncertain and a rise in sea level, which would threaten economic assets, coastal cities, and large coast-dwelling populations.

The climate has always presented a challenge to those whose livelihoods depend on it. Climate cannot be blamed for incidence of poverty in a country. However, where people are poor, it presents an additional risk that can critically restrict options, and limit development (IRI, 2009). Climate has thus become an urgent issue on the developmental agenda.

Crop insurance, as discussed already, is one of the scientific tools for managing weather-related production risks. Of the two types of the index based insurance programs in the country, viz., yield index and weather index, weather index is specifically designed to directly address the risks that

climate poses to agriculture. Therefore, an attempt has been made in this research work to study the trends in weather patterns and how weather index insurance can be used as an adaptation strategy to manage climatic risks in agriculture. WI insurance is not without challenges, the most notable being the basis risk, which can arise from product design, as well as poor density of weather stations. Weather index being a proxy, product design presents a challenge in designing a product with a predictive capability to capture the production risks. Weather variations with distance present another challenge requiring a large number of weather stations. The present study has examined both these dimensions of the basis risk. The perceptions of the key stakeholders, i.e. the policymakers and the farming community, are critical to understand their perceptions of climate risk, and how and to what extent the weather index insurance can incorporate their expectations. The present study has also examined this dimension through extensive surveys of the key stakeholders.

1.9. KEY RESEARCH QUESTIONS AND OBJECTIVES

The key research questions explored in this study are:

- i. Is there a trend in weather parameters, particularly rainfall and temperature?
- ii. What is the impact of climate risks on agriculture?
- iii. Is weather index insurance a tool to mitigate climate risk?
- iv. How to evaluate weather insurance products?
- v. What is basis risk? Dimensions of basis risk – product basis risk and spatial basis risk? and
- vi. How farmers, state agencies and other stakeholders view climatic risks? What is their experience and how they perceive weather insurance as a risk mitigation tool?

The study has addresses these key research questions with the following specific objectives:

Analysis of trend in weather data (rainfall, temperature, relative humidity) across different climatic zones of India;

Developing approaches for evaluating weather insurance products, benchmarking of weather insurance and evaluating weather insurance products based on the benchmark developed;

Analysis of basis risk- spatial and product basis risk and its implications for weather insurance contracts;

Collecting and analyzing the views and experiences of key stakeholders on climate risks and weather insurance as mitigating tool; and

Suggesting directions for future research, based on the research results.

1.10. ORGANIZATION OF THE THESIS

The rest of the research report is organized as follows.

Chapter 2: Literature Review

This chapter presents a review of key literature on the different aspects such as weather trends, basis risk, stakeholders and results of similar research work done on different parts of the world.

Chapter 3: Methodology

This chapter includes the methodology adopted for the analysis of the various aspects of the weather based insurance product under study viz., Weather insurance product evaluation, Basis risk (product and spatial), Weather data analysis and climate trends, Perspectives from stakeholders and their response (States and farmers). The data used for the analysis, and its sources have also been mentioned in the chapter.

Chapter 4: Results and Discussion

This chapter presents the results of the analysis undertaken for the various aspects of the Weather Insurance products viz., Weather insurance product evaluation, Basis risk (product and spatial), Weather data analysis and climate trends, Perspectives from stakeholders and their response (states, farmers and insurance providers). These results have been further discussed getting an insight into the effect of these aspects on the farmers.

Chapter 5: Conclusions and Directions for Future Research

This chapter summarizes the results of all the previous chapters and gives direction for future research.