

## EMERGENCE OF WEATHER DERIVATIVES-FEASIBILITY IN INDIAN CONTEXT

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### ABSTRACT

Indian Economy is an agrarian economy. It has been estimated that in India, as much as 20 % of GDP is wiped out whenever there is bad monsoon. The uncertain global weather conditions particularly in 2010 have effected many businesses and industries especially commodities. Companies end up paying high prices on commodities due to rising prices and the effects of which passes on to consumers & farmers too. Traditional Tools & techniques have been unable to cope up with the unpredictable weather risk. This necessitates the need for Weather Risk Management in Indian Agriculture. The Government of India is planning to introduce a bill in the Parliament to permit introduction of weather derivatives in Indian commodities market. Our Study focuses on analyzing the emergence of weather derivatives as an alternative hedging tool. Various issues related to risk management in agriculture like failure of crop insurance in India, Feasibility of Weather derivative contracts, etc are considered.

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### I. INTRODUCTION

Every Industry faces some or the other risk. Some are controllable while some are uncontrollable. We call them systematic and unsystematic risk in context of risk management. Weather i.e Mother Nature is an uncontrollable risk.

Predictability of the amount of rainfall, snowfall, hurricanes, tsunamis and droughts is not in the hands of anyone. Small and medium segment businesses to huge conglomerates to Multi National corporations all are sailing in the same boat. No matter as different as the business and production processes of utility companies, breweries,

fashion houses, ice-cream manufacturers, building companies and sports goods manufacturers may be, they all have at least one thing in common: owing to the weather dependence of their sales, their turnover – and thus their business success – is very much

dependent on the prevailing weather conditions. According to an estimate by meteorological research institutions, more than 80% of the business activity in the world is weather dependent. Virtually every sector of the economy, however, is directly or indirectly subject to the influence of the weather in some form or other.

Any company whose revenue is affected by weather has a need for weather Derivatives.

The most usual way of reducing these risks was Insurance but not viable when the frequency is high and also high probability. (Brockett et al, 2005)

Weather trading has been in existence since 1998. The first weather derivative trade was between Enron Corporation and Koch industries. Most of the trades during that time were in the OTC market. It started trading in exchange traded market (CME) the Chicago Mercantile Exchange sometime around 1999, and it started getting mass popularity due to El Nino. Exchange trading helped the weather derivatives to get more popular in managing the risk exposure (Stulz, 2002). According to the CME the weather derivatives traded were around thirty-two billion USD in March 2008 with a high touching forty-five billion USD in 2006.

The weather market started gaining popularity beyond the US, in terms of types of risks addressed and the nationalities of firms involved in the market. Weather transactions started to name a few countries - US, the UK, Australia, France, Germany, Norway, Sweden, Mexico, and Japan. According to the latest survey on the weather derivatives market conducted by Weather Risk Management Association (WRMA), which studied the status of the weather market from April 1, 2009 to March 31, 2010, customized weather derivatives grew by nearly 30 percent in FY2010.

Major Participants in Weather Derivatives	To Protect Against
Energy Companies	Lower revenue during warm winter or cool summer
Construction Companies	Revenue loss due to adverse weather
Energy Users	Higher heating/cooling costs
Retailers	Lower sales due to weather change

Although weather risk is inherent part of many businesses but the financial risks can be hedged by use of weather derivatives (Hyman, 2001).

“The growth in the customized weather derivatives market shows increasing participation from a wide variety of end users who recognize the value of actively managing their weather risk.” As said by Bill Windle, President, Weather Risk Management Association.

## II NOTION OF WEATHER DERIVATIVES

“Everybody talks about the weather, but nobody does anything about it,” said Mark Twain. Not anymore. Now there are financial products such as weather derivatives that manage weather risk and the market is growing by leaps and bounds. The financial results of many companies depend, at least in part, on favourable weather. For example, energy utility companies, beverage manufacturers, agri-business concerns, tourism-related business and a host of other industries experience volatility in earnings because of fluctuations in weather conditions.

Growth of financial derivatives worldwide have increased drastically due to technological developments leading to development of more sophisticated risk management tools; increased volatility in asset prices in financial markets; increased integration of national financial markets with international markets and the inherent characteristic of the derivatives markets to be able to optimally combine the risks and returns over a large number of financial assets.

A derivative is a financial instrument whose value is dependent on the price of underlying asset. There are wide ranges of underlying assets available for trading-Stocks, Indexes, currencies, interest rates, commodities, bonds etc. Even electricity forwards contracts are started in June 2008 with establishment of Indian Energy Exchange by bringing power industry participants to buy and sell electricity in an auction based system. A derivative is a contract between two parties whose price changes with the change in the price of underlying asset.

Weather Derivatives are also financial instruments (Contracts) similar to equity or commodity derivatives but with a difference from other derivatives that the underlying asset (rain/temperature/snow) has no direct value to price the weather derivative. It works in the same lines of Interest Rate Derivatives where there is a notional underlying asset. The cash flows to the buyer or seller of the weather derivative contract are based on weather related measurements such as temperature, rainfall, snow fall, wind speed etc. Around 85 per cent of the weather derivatives contracts are based on temperature. Unlike other financial derivatives that are linked to the price of the underlying asset or index, weather derivative contracts are linked to weather indices. These indices are created from data readily sourced from meteorology stations. They can be used by organizations or individuals as a tool of risk management to minimize risk associated with unexpected weather conditions. Farmers can use weather derivatives to hedge against poor harvests due to floods, drought or frost. Gas and Power Companies may use heating days (HDD) or cooling degree days (CDD) contracts to improve earnings. Unlike Insurance weather derivatives cover low risk but high probability events. So precisely insurance gives protection against risk but does nothing to protect against the reduced demand as a result of weather fluctuation.

These contracts are structured based on number of Heating Degree Days (HDD) or Cooling Degree Days (CDD).

Where the day's temperature is less than the reference temperature it is taken as HDD and when the days temperature is higher than the reference temperature it is taken as Cooling Degree Days. HDD indicates how many days heating is necessary. The HDD cannot be negative.

The reference period can be one year or one month depending up on the risk exposure of the firm. Internationally the reference temperature is taken as 18 degree C or 65 degree F.

Exchange-traded weather derivatives based on temperature are now also offered on the London International Financial Futures Exchange and the Helsinki Exchange. There are no exchange-traded derivatives available for wind-or precipitation-based derivatives. Of late wind derivatives are also traded in exchanges.

Privately negotiated weather derivatives contracts are typically based on the standard International Swaps and Derivatives Association (ISDA) Master Agreement, which is the same

form of agreement used for derivative agreements involving physical commodities.

## TRADING MECHANISMS OF WEATHER DERIVATIVE CONTRACTS

A weather derivative contract typically has the following integral components:

**1. TYPE OF RISK:** This is based on a measurable index, usually temperature, precipitation, wind speed, snowfall, or combination of temperature and humidity. Of all weather derivative contracts, it is estimated that temperature-related account for about 98 percent, rain-related about 0.9 percent, snow 0.5 percent, and wind 0.2 percent. The underlying index of a weather derivative defines the measure of weather which governs when and how payouts on the contract will occur. The most common-indexes in the market are Heating Degree Days (HDDs) and Cooling Degree Days (CDDs) - these measure the cumulative variation of average daily temperature from 65 For 18 C over a season, and are standard indexes in the energy industry that correlate well with energy consumption.

There are also ranges of other indexes like event indexes which count the number of times that temperature exceeds or falls below a defined threshold over the contract period, Average temperature common index for non-energy applications, and indexes like cumulative rainfall or the number of days on which snowfall exceeds a defined level.

**2. STRUCTURE OF THE CONTRACT:** Weather derivatives are standardised contract like any other contract traded on stock exchange. All the contract details are well defined and structured in advance. Only the trader has to decide the price at which one wants to enter in the contract.

**3. TERM:** All contracts have a defined period over which the underlying index is calculated. However, volume of trading is observed higher in one month and one week contracts as the markets have grown. Some contracts also specify variable index calculation procedures within the overall term - such as exclusion of weekends or double weighting on specific days - to address individual end-user business exposures.

### 4. PREMIUM

The buyer of a weather option contract is a called holder and pays a premium to the seller. The premium is typically between 10% and 20% of the notional amount of the contract, but can vary depending on the risk profile of the contract.

**5. MECHANICS OF TRADE:** Weather derivative contracts are priced using actuarial analysis of historical payouts, factoring in recent weather trends and climatic cycles. Most temperature contracts in the US are based on Heating Degree Days (HDD) index for winter protection and Cooling Degree Days (CDD) index for summer protection. They are calculated as follows:

HDD = Max (0, 65° F minus average temperature in a day) CDD = Max (0, 65°F minus average temperature in a day)

The threshold temperature for CDD and HDD has traditionally been 65°F.

The reason is consumers tend to use more energy to heat their homes when the temperature is below 65°F and when it is above 65°F, they tend to use energy on cooling.

Pay-off is based on how the index performs relative to a trigger or strike value and not on actual loss. Pay-off is usually defined as a specific dollar amount (e.g., \$1,000 per degree day) and ‘capped’, i.e., maximum payout is indicated.

**Example: Calculation of CDD Index**

Temperature	Degrees
Maximum	83
Minimum	61
Average	72
Base Temperature	65
CDD	7

If the dollar amount per degree was agreed to be \$10,000 in the above example, the holder would have a pay-off of 10,000 times 7 or \$70,000 in the case of a CDD contract. The rationale is that the buyer of such a derivative would be compensated by the amount for which his cash flows are adversely affected by the weather.

### III. LITERATURE REVIEW

Many studies have been done in the US on weather Trading. The popular one being done by Dutton on “Opportunities and Priorities in a New Era for Weather and Climate Services” studies the sensitivity of weather to the various economic sectors and found that approximately 30 % of the US economy is affected by the vagaries of weather. Larson studied it further qualitatively using econometrics and tries to prove that different economic sectors are affected by weather risks. He used Monte Carlo Simulations, Transcendental logarithmic functions (TRANSLOG) to suggest the dependency of different economic sectors on weather. He concluded that the effect of weather was different for different economies in different regions.

Subak et al. studied the effect of weather in UK using Regression Analysis with temperature as independent variable and output as dependent variable. He did a complete analysis of sectors like tourism, insurance, energy consumption, health and real estate and used econometrics to chart a relation between the weather and these sectors.

The same sort of study was done in Amsterdam, Netherlands by ToI on tourism studying the effect of weather on tourists. According to Rob Mendelson of Yale the effects of weather and climate are regionally distributed for different regions of the world and as a result the effect is more on underdeveloped and impoverished countries than developed countries.

In Indian context weather derivatives would prove to be a blessing especially in the agricultural sector. Like any other derivative instrument traded on exchange weather derivatives will also serve its purpose with more volume and demand. With the success of these contracts in developed countries available from empirical evidences, India being an agrarian economy seems to have the potential to have a weather derivative contract supported with unprecedented growth in Equity derivative market. The currency derivatives, interest rate derivatives, derivatives on global Indices are the tip of the ice berg and now it is the time that government speeds up the process of launching weather derivatives in India.

### **TRADITIONAL AGRICULTURE RISK MANAGEMENT TOOLS AND TECHNIQUES:**

According to Harwood et al., 1999 there was existence of risk management tools in terms of usage by farmers but was restricted to rich farmers own initiative signifying deficient role of government. The agricultural loans continue to be risky and agricultural lenders are increasingly emphasizing about credit quality and management of credit risk in their loan portfolios (Miller et al., 1993). Even the only practical and widely available option-crop insurance has not proved to be a successful solution of the problem-

Crop insurance in India remained restricted to few crops in spite of India being an agrarian economy and accounts for less than 2 percent of income generated from agriculture in a year even after 25 years since the inception of agricultural insurance in India. A large part of the insurance, which is about 82 percent of the sum insured, occurs in the critical monsoon dependent khariff season (during which rice is the major crop). Most of the crop insurance schemes like Pilot Crop Insurance Scheme, Comprehensive Crop Insurance Scheme, Experimental Crop Insurance Scheme and National Agricultural Insurance Scheme have failed for one reason or another. The poor financial performance of these schemes is due to their utter failure in correctly estimating the probability of the risk covered- the total claims paid being substantially in excess of the premium amount collected. Thus, the crop insurance schemes launched so far have failed to provide a sustainable solution to the risk-hedging problem in the Indian agriculture.

There was also lack of Participation of private Players in agriculture insurance .Insurance business works on the concept of risk pooling where risk is spread among larger numbers (The law of large numbers). Also it thrives where loss occurs to a single holder at a single point of time so that loss is distributed among large number. So pooling risks on a scale that is feasible for most private insurers is difficult since many of the natural disaster risks associated with crop production affects all the crops at one time. Also it becomes unattractive for farmers when offered at market prices.

Many researchers have argued that moral hazard and adverse selection are problems that significantly affect the viability of multi-peril crop insurance (Ahsan et al., 1982; Chambers, 1989; Goodwin and Smith, 1995). Empirical research provides evidence of moral hazard in multi-peril crop insurance just and Calvin, 1993a; Coble et al., 1997), as well as adverse selection (just and Calvin, 1993b; Goodwin, 1994; Luo et al., 1994; Quiggin et al., 1994). Moreover, the traditional insurance (crop insurance), as we have seen, is expensive and unsustainable.

Thus without massive government support in the form of subsidy on insurance premium it is extremely difficult to sustain the traditional approach. To remove these demerits and come with a feasible solution in the current scenario are weather derivatives as an alternative and economical risk management tool.

## INSURANCE AND DERIVATIVES

Unlike the crop Insurance products, weather derivative contracts require no demonstration of loss. Weather derivatives contract cash flows depends on a weather index that has been carefully chosen to represent the weather conditions against which protection is being sought.

But there are some differences between weather derivatives and index-based weather insurance that may mean that one is preferable to the other in certain circumstances.

- 3 Derivative positions are revalued on regular basis called mark to market or marking to market, but this is usually not necessary for insurance;
- 3 tax liabilities and the accounting treatment may be different
- 3 Contractual specifications may be different.

According to a survey conducted by Weather Risk Management Association (WRMA) and PricewaterhouseCoopers in 2003 the annual size of global weather derivatives market was about US\$4.5 billion. An exchange Traded weather derivative can be designed to help farmers like these contracts are already in operation in some developing countries, too, for instance, Morocco, Mexico, Ukraine, Mangolia and Romania due to their numerous advantages.

Under these contracts the payout is not based on actual yield. Rather, it is linked with a predefined specific weather parameter. The chance of moral hazard and adverse selection is impossible like in Insurance. (Skees et al., 2001). Also it is cheaper due to low administrative costs in absence of any underwriting or inspection of farms. As regards the state of weather derivative contracts in India, initiatives are underway at various levels. Commodity options have started in September 2010 but weather-index-based derivatives are waiting for the approval of government. Certain amendments have to be made in the Securities Contract Regulation Act and the Forward Contract Regulation Act, as current regulations do not permit trading in instruments that cannot be delivered in physical form.

## IV OBJECTIVES FOR THE STUDY

Indian Economy is an agrarian economy. It has been estimated that in India, as much as 20 % of GDP is wiped out whenever there is bad monsoon. The inclement global weather conditions experienced during 2010 have impacted many businesses and industries especially commodities. The prices that companies pay for commodities have been rising steadily and the effects of which passes on to consumers & farmers too.

Traditional Tools & techniques have been unable to cope up with the unpredictable weather risk. This necessitates the need for Weather Risk Management in Indian Agriculture.

The Government of India is planning to introduce a bill in the Parliament to permit introduction of weather derivatives in Indian commodities market. Government of India is planning to introduce a bill in the Parliament to amend the Forward Contracts Regulations Act to permit introduction of weather derivatives in Indian commodities market.

## **OUR STUDY FOCUSES ON**

1. Analyzing the emergence of weather derivatives as an alternative hedging tool. Various issues related to risk management in agriculture like failure of crop insurance in India, Feasibility of Weather derivative contracts, etc are considered.

## **IV DISCUSSION**

Weather derivatives were an improvement over the normal crop insurance programs. Insurance solves the problem but are more suited and well structured for helping huge calamities such as tsunamis and earthquakes over a larger region, but there is no cover at smaller or individual levels. There is no answer to the question if the monsoons are a month late? Rich farmers can survive but the smaller farmers would be shattered. Insurance will also be not possible for them since it is provided for a probable and common damage. Insurance will not compensate if the monsoon is good and someone has a bad crop due to poor irrigation facilities and late monsoon. Hence with introduction of weather derivatives all farmers whether small or big, can hedge their risk due to unpredictable disturbances in the climate.

India's GDP is highly dependent on agriculture. With its high risk exposure to weather, agriculture has the biggest growth potential of all the sectors. According to a survey of Weather Risk Management Association in May 2010, weather risk for Indian farmers and banks could become a notional US\$2.2 billion market over the next two to three years. In five years, the weather risk market for agriculture is expected to rise to US\$7 billion and could reach as high as US\$20 billion. In the travel sector, airlines are often grounded due to winter fog. According to a report of FTKMC, use of weather risk tools such as fog insurance by the travel sector could grow to US\$25 million over the next five to seven years.

A bad monsoon affect production of the country, poor farmers grief leading to opt for suicide in some places of India, Country's GDP and also stock market. Taking all this into consideration along with issues of Global warming we can appreciate what crucial role weather has to play in India. If we knew how the weather was going to behave in the future, there would be absolutely no basis for the existence of tools which make it possible to improve and stabilize results against the backdrop of changeable weather conditions.

But we can lower or Hedge the risk through weather derivatives.

Hedging with weather derivatives is desirable for such businesses because it significantly reduces the year-to-year volatility of their profits. This is beneficial for a number of reasons, including:



3 low volatility in profits can often reduce the interest rate at which companies borrow money;

3 in a publicly traded company low volatility in profits usually translates into low volatility in the share price, and less volatile shares are valued more highly;

3 Low volatility in profits reduces the risk of bankruptcy.

It is not necessary that the outcome of Hedging is always better but on an average, on the hedge, it can still be very beneficial to hedge for these reasons. It is better to hedge than not to hedge.

The primary objective of weather derivatives is thus to hedge volume risks, rather than price risks, that result from a change in the demand for goods due to a change in the weather. Even though the changed demand can have an effect on the price of these goods, the price risk of goods of this kind can be hedged more effectively by means of futures or options based on the price of these commodities (classical commodity derivatives).

The notion behind a weather (volume) hedge is that the results of weather sensitive sectors can be subject to great volatility – even if prices remain unchanged – due to a change in demand or volume. Example-The ice-cream industry: it is highly unlikely, and hardly anyone will have seen it happen to date, that ice-cream is offered at lower prices in a cool, wet summer than in a comparatively hot summer. The decline in turnover of the ice-cream industry is thus exclusively due to the inadequate sales volume and not to a price reduction as a result of the market mechanisms of the national economy.

Farmers end up in mortgaging, leveraging from the moneylenders or leasing land and farming through use of old fashioned ways to reduce these risks while Rich farmers with modern infrastructure try to make optimal utilization of the favourable weather but they still follow the old diction of ‘Making hay while the sun shines’. Government is trying to support small farmers by improving the infrastructure but they still have a long way to go. The Finance ministers tend to give incentives and waiver huge loans but still farmers are facing huge problems in spite of the government efforts.

Till now, the only way for mitigating the risk from inclement weather has been crop insurance. But with uncertainties in weather increasing due to global warming even insurance policies and markets are unable to cope with the certain disasters. As a result risk of moral hazard and adverse selection rises in insurance which dampens the growth of agriculture insurance. As a result of this farmers participating in the insurance schemes have dropped sharply.

Though the losses on account of natural calamities are hedged through insurance, the market risk on account of climatic changes does not come under the purview of insurance. In such scenario taking into account all considerations weather derivatives can prove to be effective and can serve as an alternative hedging tool like any other derivative product. They are common abroad which is used for hedging the exposures in energy, crop, and plantations etc. which are weather centric. The variations in the precipitations can affect crop/plantation yields thereby affecting the income of the farmers/growers.

## UTILITY OF WEATHER DERIVATIVES

Let's consider a farmer growing paddy in a village in Andhra Pradesh. He is worried because of the expectations of unusually low rainfall in the State this year. He usually produces 50 quintals of paddy in his farm. But this year, he thinks the production will drop to 40 quintals. The Minimum Support Price (MSP) for paddy is Rs 770/quintal. This means that the farmer fears losing Rs 7,700 this season due to poor rainfall.

If the farmer had access to weather derivatives, he could have bought or sold (depending on the future outlook for rainfall) rain day futures contracts today and entered into an equal but opposite contract at a later date, making a profit on the transaction, thus offsetting the losses due to low volumes produced.

Apart from applying weather derivative as a measure of hedging risk against adverse weather conditions it can also be used as the mode of trading in derivatives. The most advantageous factor of weather derivatives is the fact that they can't be manipulated by any means like insider trading as the raining patterns are natural and beyond the scope of humans.

Current users of weather futures are primarily energy companies in energy-related businesses. However, there is growing awareness and signs of potential growth in the trading of weather futures among agricultural firms, restaurants and companies involved in tourism and travel.

The Advantage of weather derivative is that a farmer who expects high crop due to strong monsoon also faces the risk of low yield if the monsoon becomes weak, can protect himself from a potential loss. A weather index which is structured based on temperature will protect him from the loss of income from fall in yield by buying weather futures because when the temperature goes up the monsoon becomes weak. Hence he can sell the futures at a high price and make up the loss in the yield.

These hedging tools are highly useful to Rubber planters and growers of spices like cardamom, ginger, turmeric etc. Weather futures will also help electricity boards to hedge their price risk on account of lower electricity production due to low rain fall in the catchment's areas of dam sites.

Rain derivatives and precipitation derivatives also can be carved out using the rain fall and precipitation data. These hybrid hedging tools will definitely help the Indian farmers to earn a sustainable income level driving away the fear of loss from natural calamities.

A farmer can trade an option by selecting a strike price nearest to the expected price. The underlying for weather derivatives may be anything related to weather- rainfall, temperature, wind velocity, snow fall, or for that matter the occurrence of a hurricane. "A financial weather derivative contract is a weather contract whose payoff is determined by future weather events. The settlement value of these weather events is determined from a weather index, expressed as values of a weather variable measured at a stated location".(Dischel and Barrieu)

Insurance involves paying huge premium for multi calamity insurances while farmers can invest in derivatives with less amount and hedge off their risks. Derivatives are highly levered product. High Financial innovations and high technology enables creation of structured product which

will help the farmers in case of natural disasters and make it profitable for them if everything is alright. Also they will be traded in exchange traded market which will remove the hassles and credit risk in the OTC market and will also bring more reach and transparency in the market. It can be easily traded by each farmer to hedge his own risk unlike proving individual loss for getting individual claims. Many developing countries are slowly trying to incorporate weather derivatives into their systems. Romania, Mexico, Morocco, Mangolia, Ukraine are some of the fore runners who have opened up after realizing the numerous advantages of Weather derivatives.

In India NCDEX had made an attempt to introduce weather index as back as in 2004 but final approval is still awaited. The current initiative by the government will definitely help the exchanges to introduce this hybrid commodity hedging tool in Indian market.

### WEATHER DERIVATIVE BENEFICIARIES

#### Sectors

#### Uses

Agriculture	Crop yield, handling, storage, pests
Construction	Delays, incentive/disincentive clauses
Energy	Reduced and/or excessive demand
Entertainment	Postponements, reduced attendance
Governments	Budget overruns
Insurance	Increased claims, premium diversification
Manufacturing	Reduced demand, increased raw material costs
Offshore	Storm frequency/severity
Retailing	Reduced demand of weather-sensitive products
Transportation	Budget overruns, delays

### V IMPLEMENTATION CONCERNS

The growth and success of any derivative product depends on its awareness and trading volume. In the same context the fortune of weather derivatives would depend on its successful execution. It can take the learning lessons from the introduction of currency derivatives and global indices

traded on NSE. Successful execution requires the support at three levels- Institutional, Regulations and Investors.

## **INSTITUTIONAL CONCERNS**

To remove the demerits of over the counter market, trading in weather Derivatives requires infrastructure support in terms of Creation of Exchanges, Consumer Associations, Weather observatories and Clearing and Trading Members for Trading.

NSE is currently trading currency derivatives and NCDEX & MCX in commodities derivative contracts. These can be used for trading derivative contracts on underlying weather parameters. Through Exchanges a wider reach can be achieved .Also Exchanges will provide more transparency and will provide safe and secure trading platform to small farmers and power consumers. Various associations could be set up for accessing markets by farmers. The crucial factor is an organized market with timely, reliable data (on weather parameters, crop yields and power production and consumption) to all concerned parties.

## **ROLE OF REGULATORY**

Forward market Commission (FMC) and SEBI will have to join hands to permit derivative trading on underlying assets like weather parameters, electricity; etc. In the current scenario SEBI regulates cash and derivative market on exchanges of all securities (i.e. stocks and bonds) while FMC regulates Commodity forwards and futures which has a backing of the government department and has no autonomy to garner resources.

In addition Ministry of Agriculture, Ministry of Company Affairs and the Reserve Bank of India also exercise direct or indirect regulation over securities and commodity trading. These complexities in regulatory jurisdiction and multiplicity of regulators may pose regulatory challenges. These necessitate the need for establishment of an independent regulatory body acquainted with adequate resources and empowerment regulating the weather derivative market. The Forward Contract (Regulation) Amendment Bill 2006 is pending with the parliament which aims to consider such amendments and further seeks to transform the role of the Forward Markets Commission (FMC) from a government department to an independent regulator like Securities and Exchange Board of India (SEBI).

## **INVESTOR EDUCATION AND AWARENESS**

Growth and depth of weather derivative cannot be achieved without investors awareness and Trading. Like any new derivative product –currency derivatives, interest rate derivatives various awareness program me and campaigns would prove to be successful for education and training of farmers, consumers, financial intermediaries, etc.

Also designing of standardized contracts, pricing mechanism and construction of appropriate weather based Indices will require the support of strong institutional and regulatory infrastructure.

## VI CONCLUSION

Until now it seemed that weather trading in India has a long way to go. But with inception of currency futures, currency options, commodity options, global Indices Derivatives it seems that weather Trading would no more be a dream and just like future contracts proved boon to farmers for commodities, weather derivatives will also follow the trend. The big challenge is the strong regulatory and a very strong infrastructure since issues of inflation and global warming are a big concern now. Also multiple role of regulatory with FMC regulating commodities and SEBI regulating securities market the direction for weather derivatives have to be streamlined. There will be no issues as far as participation and volumes of Investors are concerned. Farmers from every nook and cranny of the country with the help of the local Gram Panchayats and e-choupals can be reached coupled with education and awareness programmes. Farmers and traders should be given exposure and educated about the benefits of weather trading. They should be taught how by using weather derivatives they can hedge their risks in an easier fashion rather than falling in the clutches of a money lender or waiting for an unknown period of time for settlement of claims. I.T as always should be the driver for disseminating real time data. Thus the huge loopholes created by the insurance companies can be reduced by the creation of derivatives.

Weather derivatives like any other exchange traded instrument can serve the purpose of its creation only if it increases in volume and is in demand. Instruments which work in one country may pass or fail in another region. But from the empirical studies conducted in other developing countries and with the success of weather derivatives there, India seems to have the potential to have a weather derivatives market. Theoretically weather derivatives seem a good hedge against the vagaries of nature which affect India and lead to a huge loss every year. In view of the significance of agriculture and power sectors in the Indian economy and their vulnerability to weather factors, the need for evolving an adequate, sustainable weather risk management system should be duly recognized. In agriculture sector the traditional crop insurance system has failed due to associated deficiencies. As an alternative, weather derivative contracts are free from these deficiencies. These contracts offer prospects of a low-cost, flexible and sustainable approach to weather risk management. Weather derivatives, like any other risk-hedging instrument, operate strictly on the basic insurance principles of law of large numbers, estimatability of probability and diversity in individual expectations. As such, the relevance of the concept is not country-specific. Its success elsewhere as revealed by various empirical studies only make a case for its adoption in any country, more particularly a country whose performance is severely constrained by highly unpredictable, erratic weather conditions. The conditions necessary for the success of weather derivative market may not be equally present in all countries. But as far as the Indian economy is concerned; it appears to be, by and large, a substantially fit case for the adoption of weather derivatives. It has an immensely weather-based and predominant agricultural sector. The huge energy sector is mostly hydro-based and occupies a pivotal position in the economic infrastructure. The extreme climatic conditions during winter and summer in most parts of the country increase the dependence of people on electricity substantially. Besides the present trend of integrating the Indian financial sector with the global market may be expected to contribute to the growth and success of the derivatives market in terms of participation of foreign players and raising the level of competition. Above all, the country's fiscal health does not warrant continuation of subsidizing the traditional crop-insurance system, any longer. The policy-makers need to make a choice between yielding to populist approach and disciplining the fiscal system.

Though there are some limitations of weather derivative contracts. They suffer from what is known as “basis risk” (Quiggin et al., 1994). Also, the non-availability of accurate weather data to the parties concerned seriously hampers the smooth functioning of these contracts. . It may not be understood by the major chunk of illiterate farmers, it may be too complex for them. The infrastructure needed to trade weather derivatives effectively may be high. But these limitations are not insurmountable. Despite these limitations, weather derivatives continue to capture increasing attention of risk managers, all over the world. Weather derivatives are undoubtedly a low-cost, flexible and sustainable option. It deserves to be tried. But we won't know whether we can succeed or not until we try. The potential is there in India for weather derivatives. We have to wait and see how the weather derivative saga unfolds once the Government passes the bill.

## REFERENCES

1. Anil K Sharma (IIT Roorkee), Weather Derivatives: Risk Hedging prospects for agriculture and power sectors in India.
2. Financial Risk Management Instruments for Renewable Energy Projects (2008).
3. John c hull- Options, Futures and Other derivatives, fifth edition, LPE
4. K. Nagarajan (2009), Weather Derivatives: A Need for Indian Farmers.
5. McDonald, R.L (2008) Fundamentals of Derivatives Markets. Addison Wesley.
6. Melanie Cao and Jason Wei (2001), The Nature and Use of Weather Derivatives.