LSE Asia Research Centre

WORKING PAPERS

Crop Insurance for Adaptation to Climate Change in India

Mamata Swain

ASIA RESEARCH CENTRE WORKING PAPER 61

Crop Insurance for Adaptation to Climate Change in India

July 2014

Dr Mamata Swain was a Commonwealth Fellow 2013 at the Asia Research Centre, LSE.

For further information, please contact:

Asia Research Centre (ARC)
London School of Economics & Political Science
Houghton Street
London
WC2A 2AE
United Kingdom

E-mail: arc@lse.ac.uk
www.lse.ac.uk/asiaResearchCentre

ASIA RESEARCH CENTRE WORKING PAPER 61

Crop Insurance for Adaptation to Climate Change in India

Mamata Swain*

Abstract

In India, agriculture is inherently a risky venture due to uncertainty in production and volatility in price, and more so in the context of increased climatic aberrations and globalisation. Therefore, there is a great need for crop insurance to provide economic support to farmers, stabilise farm income, induce farmers to invest in agriculture, reduce indebtedness and decrease the need for relief measures in the event of crop failure. This paper assesses the performance of the National Agricultural Insurance Scheme, NAIS (area based crop yield insurance) and the pilot Weather Based Crop Insurance Scheme, WBCIS (area based rainfall insurance) under implementation in the state of Odisha, the climate change hot spot of India. Analysing secondary time series data on performance of these two schemes and information gathered through focussed group discussion with insurance users, the paper concludes that WBCIS seems to perform better than NAIS because of higher coverage, larger percentage of farmers benefited, lower premium, faster and more frequent compensation payment and more transparency. But WBCIS covers only weather related risk and the sum assured and the compensation amount are lower. Therefore, instead of having two schemes, a hybrid product combining the advantages of both the schemes should be offered. To increase the penetration of insurance in rural areas, insurance companies may be asked to provide priority insurance services to farmers just like priority lending to agriculture sector. The public sector may address catastrophic risk and provide multi-peril insurance where subsidy requirement is high, but allow private sector to provide insurance products for less severe events and for individual independent idiosyncratic and localized risk. In the context of climate change with increasing agricultural risk, there is a need to redesign insurance products not merely as a risk transfer mechanism but as a potent device to reduce risk and crop loss by inducing desirable proactive and reactive responses in insurance users.

Key Words: Climate Change, Agricultural risk, Adaptation, Crop insurance, Odisha, India

*Professor of Economics, Ravenshaw University, Cuttack, Odisha, India-753003,
E-mail: mama_swain@hotmail.com

1. Introduction

Climate change is a global environmental challenge that is threatening sustainable development around the world. It is a continuing long-term process manifesting itself with gradual increase in temperature, greater variability in rainfall, rise in sea level and increased frequency, intensity and duration of extreme weather events, such as drought, flood, cyclone and storm surge (IPCC, 2007). However, the impact of climate change is not uniform across all sectors or all regions of the world. The low-latitude tropical countries in South Asia and Africa are the worst sufferers because of their heavy dependence on agriculture, which is the most climate sensitive sector. Agriculture dependent economies are invariably the low-income countries and are thus most vulnerable to climate change due to their high exposure with least adaptive capacity. Their high levels of susceptibility and low coping capacity have been linked to a range of factors that include a high reliance on natural resources, low per capita GDP and high poverty, limited ability to adapt financially and institutionally, and a lack of safety nets (David and Twyman, 2005). Moreover, the poorest and most vulnerable groups within the developing world will disproportionately experience the negative effects of 21st century climate change owing to their least coping capacity.

India being located in the low latitude region of South Asia is extremely vulnerable to climate change because of its tropical climate, monsoon rain, long coast line, greater dependence on agriculture, high incidence of poverty, low irrigation coverage and inadequate resources and technology to combat climate change. Agriculture is the dominant sector in Indian economy. Agriculture contributes 22 percent of GDP, provides 58 percent of employment, sustains 69 percent of population, produces all the food and nutritional requirements of the nation, important raw materials for some major industries, and accounts for about 14 percent of exports. However, agricultural production is beset with various risk factors due to occurrence of natural calamities like flood, drought, cyclone and storm surge, infestation of plant diseases and pest attack, technology failure, irregularity in input supply etc. Apart from production risk, there is also market/price risk owing to fluctuations in input and output prices. Agriculture is inherently a risky venture due to its dependence on climatic factors such as rainfall, humidity, sunshine and temperature which are difficult to predict and beyond human control.

Risk in agriculture can thus be considered as an interaction of production risk and price risk. Indian agriculture is now confronting two major threats: climate change and economic globalization (O Brien et al, 2004). While climate change is accentuating the production risk, globalisation has raised the price fluctuations. The combined effect of these two stressors has created a crisis situation in Indian agriculture; as a result farmers' suicides are reported in most of the states indicating the failure of public action in handling the aggravated risk situation. However, of all the risk factors in agriculture, weather variables are considered to be the most important (Miranda and Vedenov, 2001).

Climate change has affected production risk in various ways such as: (i) increasing the frequency of loss events, (ii) changing absolute and relative variability of losses, (iii) shifting spatial distribution of losses, (iv) damage function increasing exponentially with weather intensity, (v) abrupt and non-linear changes in losses, (vi) widespread geographical simultaneity of losses, (vii) more single events with multiple correlated consequences, (viii) more hybrid events with multiple consequences. Thus with climate change, the agricultural risk will not only accentuate but also will become very complex and cumbersome process necessitating devising new mechanisms and measures to address such risks.

Government takes many steps such as flood proofing, drought proofing, watershed management, extension of irrigation facility, technology development, provision of insurance, relief measures etc. to reduce production risk. At the same time farmers take a wide variety of adaptive measures including ex-ante measures before the event of crop loss and ex-post measures after the crop loss to cope with the production risk associated with climatic aberrations. The ex-ante measures mostly aim at smoothing income, whereas the ex-post measures are mostly consumption smoothing (Morduch, 1995). The income smoothing measures include changes in cropping pattern, intercropping, mixed farming and sowing drought/flood resistant seeds, increasing irrigation efficiency and income diversification. The ex-post measures usually adopted by the farmers after the occurrence of the crop loss are drawing down of savings, borrowing, sale of assets and migration. Crop insurance is a coping mechanism and ex-ante adaptation measure by which risk is transferred from the insured to the insurer. Crop insurance indemnifies the farmer if there is ultimate crop failure in spite of all the precautionary measures taken by him. Insurance is a mechanism in which payment of a certain small amount of premium ensures the receipt of a larger amount of compensation contingent upon the occurrence of an uncertain loss event. Thus, insurance involves the substitution of a small known cost (premium rate) for the possibility of a larger but uncertain loss which will be compensated through indemnification. The basic principle underlying crop insurance is that the loss incurred by a few is shared by many in an area. Also, losses incurred in bad years are compensated from resources accumulated in good years (Dandekar, 1976).

Most of the Indian farmers are having small size of land holding and resource-poor. Therefore, they are usually risk averse and in the face of production risk and absence of insurance, they manage their farms so as to minimise loss rather than maximising profit. Whereas specialisation may lead to efficiency in resource use due to economies of scale, the Indian farmers diversify the cropping pattern and occupation to spread risk. This results in inefficient allocation of resources and sub-optimal output. Once there is an extreme weather event like drought and flood, which are catastrophic and covariate risk affecting all the households in the region at same time, the informal risk sharing mechanisms mediated through patron-client relationship become inoperative. On the other hand, in many developing countries, formal credit and insurance markets are not adequately developed due to asymmetric information, moral hazard, adverse selection problems which give rise to high transaction and contract enforcement costs. In the absence of any dependable formal credit and insurance facility, farmers borrow from informal moneylenders at exorbitant interest rates; sell livestock, land and other durable assets and fall into the poverty trap (Barnett et al. 2008). In such a situation, there is a great need for crop insurance to provide economic support to farmers, stabilise their farm income, induce them to invest in agriculture, reduce indebtedness and decrease the need for relief measures. It is a better option for a farmer to insure his crop and transfer the risk to the insurer rather than waiting for government relief after the occurrence of the loss event, which is uncertain.

Realising the need for crop insurance as a safety net to farmers, Government of India has implemented various crop insurance schemes from time to time (AICI, 2007). To ameliorate the problems of information asymmetry, adverse selection and moral hazard endemic in insurance markets (Goodwin, 2001), India has implemented area based index insurance schemes. Since 1999, National Agricultural Insurance Scheme (NAIS) has been implemented, which is an area based crop yield insurance scheme. However, the performance of NAIS is not satisfactory due to its low coverage, poor financial performance and delay in indemnity payment (Raju and Chand, 2008). Since 2007, the weather based crop insurance scheme (WBCIS) has been launched on pilot basis in several states of India. If there is a deficit or surplus in rainfall, the farmers insuring their crop in the defined area get compensation. In comparison to crop yield, rainfall as an index is more objective, readily available, easily verifiable and reliable. Thus, WBCIS is considered as an improvement over NAIS due to its less administrative cost, more transparency and quicker payment of compensation (Gine et al. 2008). The major drawback of WBCIS is the basis risk i.e. the mismatch between the actual crop loss suffered by the insurance buyer and the indemnity received on the basis of the weather index (Binswanger and Mkhize, 2012). Internationally India covers the largest number of farmers under insurance which include more than 22 million farmers under NAIS and more than 3 million under pilot WBCIS during 2010. However, the penetration of insurance is less than 20 per cent of total farming households, which is a major concern for the government.

In the context of climate change, with increase in agricultural risk, the risk averse crop producers will require more of insurance coverage at lower cost, while the insurers will have a tendency to increase premium rate and reduce coverage. Innovative insurance products need to be designed so as to balance the interests of both the insurer and the insured. The insurer’s interest lies in the economic viability or profitability of the insurance product, whereas the insured is concerned with his ability to pay the premium and the affordability of the product. Therefore, both affordability and economic viability criterion need to be synergised to offer new insurance products in the climate change scenario. Thus, there is a need to redesign insurance products not only as a risk transfer mechanism but more importantly as a risk reducing and mitigation measure by inducing desirable proactive and reactive responses in the insurance users.

This paper attempts to compare the area based yield insurance scheme NAIS and the rainfall insurance scheme WBCIS under implementation in Odisha, located in Eastern coast of India and known as the climate change hot spot for its extreme vulnerability to climate induced natural disasters. The paper examines the performance of these two schemes with respect to their coverage, operational efficiency and financial performance and above all their efficacy and effectiveness in managing risk in the climate change context. The paper uses time series, district and region wise data on scheme performance collected from the office of the regional office of the Agriculture Insurance Company of India, Bhubaneswar. Also, information was collected from insurance users through focussed discussion in the field. The objective of the paper is to suggest appropriate insurance policy and schemes for mitigating and adapting to climate change risk. The paper is divided into six sections. Section 1 is the introductory section emphasizing the increasing role of insurance in the context of climate change in India and contains the objectives of the paper. Section 2 reviews existing literature on implications of climate change for insurance industry. Section 3 delineates the climate change scenario in Odisha and how does it affect agriculture. Section 4 explains the operational mechanism of crop insurance schemes under implementation in Odisha. Section 5 compares the performance of NAIS with WBCIS. Section 6 contains some policy recommendations for revamping the existing insurance schemes in the increasing risky environment of changing climate.

2. Climate Change and Insurance: A Review

Many studies have been undertaken to examine the implications of climate change for insurance industry. Climate change increases agricultural risk by increasing variability in rainfall, causing water stress, enhancing susceptibility to plant diseases and pest attack and more importantly raising frequency, intensity and duration of extreme weather events like drought, flood, cyclone and storm surge. These risks are catastrophic and covariate in nature and affect the whole population in the affected area at the same time. Therefore, these correlated risks cannot be pooled and pose potential threats to insurance industry. Thus, climate change may erode the insurability of many catastrophic risks. Climate change stands as a stress test for insurance, the world's largest industry with U.S. $4.6 trillion in revenues (Mills, 2012). While climate change undermines the viability of the insurance industry, it also offers enormous opportunities to innovate new insurance products to minimize the causes and effects of climate change (Mills, 2007, 2012). Historically the insurance industry had played a key role in the establishment of first fire department, enforcement of building construction codes and vehicle safety testing.

With increase in exposure to risk, the insurance company may respond by increasing premium, insisting greater deductibles, refusing to insure unless the insureds take risk reducing measures, limiting maximum coverage, transferring risks to governments and global reinsurers, withdrawing from certain exposures or abandoning the market altogether (Tucker, 1997; Mills, 2007). Duncan and Myres (2000) in their insurance model show that catastrophic risk increases premium, reduces farmer coverage levels, and, under some conditions, lead to a complete breakdown of the crop insurance market. Under such circumstances, reinsurance can increase participation and it needs to be subsidized. The most effective step is to forge public-private partnership and couple insurance schemes with explicit measures to prevent disasters. The private sector can play a vital role in climate insurance systems for developing countries.

The major objective of the insurance company is reducing risk to the insurance company, i.e. the variability in its income from insurance business. The most effective way to reduce risk would be to take action to limit the probability of global warming or reduce its impact. Thus, where insurers tend to retreat in the face of climate change, insurance users will encounter acute affordability issues restricting their access to this societal safety net. The strategy should be to develop innovative products and systems for delivering insurance and use of new technologies and practices that both reduce vulnerability to disaster-related losses and support sustainable development (Mills, 2012).

With increase in the frequency and severity of natural disasters, the need for disaster relief will increase manifold. The low-income countries find it difficult to finance economic losses in the aftermath of natural disasters out of government budget revenues, due to the limited tax base and considerable indebtedness of many of these nations. On the other hand, international aid has not been able to keep pace with the growth in demand for natural disaster relief. There is clear evidence that over-reliance on these traditional post-disaster funding models may no longer be sustainable. There is a need for market based solution for addressing such risks. Insurance has to play both adaptive and mitigative role. Mitigation i.e. reduction in Green House Gas emission and reducing exposure to risk are more important than adaptation. Insurance industry can do this by rewarding those who adopt risk-reducing technologies and practices, using financial incentives in the form of lower premiums, deductibles and higher sum assured etc. There are other methods as well, such as channelling information to insurance customers and promoting improved building codes and land-use planning (Mills, 2007). In the long term, insufficient adaptation in areas of rising risk could threaten the concept of insurability itself, by limiting the availability and affordability of private insurance coverage. Activities that incentivise and enable adaptation not only give rise to commercial opportunities, but are increasingly necessary for the sustainability of the insurance industry (Herweijer et al, 2009). The insurance industry is likely to face increased regulatory scrutiny and action if it does not respond appropriately to the threat of rising uninsurability. Forty leading international insurance companies have launched a Climate Wise initiative to incorporate climate change in their investment strategy and they have agreed to adopt the following activities (Kunreuther et al., 2013).

- Promote risk awareness and risk-reducing behaviour through risk-based pricing
- Develop insurance products and/or terms and conditions that incentivise risk reduction
- Finance risk reduction/adaptation measures
- Risk education
- Fostering disaster resilience practices and technologies

- Establishing relationships with policy-makers, regulators, and the private sector.

However, many economists (Bayer and Mechler, 2006) are of the view that without donor support, insurance is hardly affordable in highly exposed developing countries, which helps to explain why only 1% of households and businesses in low-income countries, and only 3% in middle-income countries, have catastrophe coverage, compared with 30% in high-income countries. Climate change is a global phenomenon. The history of high carbon growth and high emissions of developed countries has been major contributor to global warming. Developing countries are most vulnerable to environmental hazards due to climate change and have a low capacity to cope. Therefore, international support for climate risk management, including proactive support for insurance instruments, is emerging on the climate change adaptation agenda. Article 4.8 of the United Nations Framework Convention on Climate Change (UNFCCC) calls upon Convention Parties to consider actions, *including insurance*, to meet the specific needs and concerns of developing countries arising from the adverse impacts of climate change (United Nations, 1992), and Article 3.14 of the Kyoto Protocol explicitly calls for consideration of the establishment of insurance policies (United Nations, 1997). These interventions include the provision of technical assistance, financial subsidies and reinsurance. The Earth system, the global economy and the insurance systems constitute a connected complex adaptive system (Phelan et al., 2011). Therefore, for using insurance systems for adaptation to and mitigation of climate change risk which is a global phenomenon, international collaboration and commitment are necessary.

Many vouch for increased government subsidy for agricultural insurance in the context of increased agricultural risk due to climate change. However, Mcleman and Smit (2006) show that government subsidization of insurance against risks associated with adverse climatic conditions and extreme weather events such as flood damage, may lead to individual decisions that actually increase the susceptibility of people, property and economic activities to these risks. With examples from New Zealand they illustrate how the removal of subsidy in crop insurance reduced the moral hazard and farmers took adaptive actions to reduce the likelihood of crop losses. Also, removal of subsidy reduced physical hazard, as farmers stopped cultivating marginal lands where production risk is more. However, in low-income countries, where agriculture is the major source of livelihood of the small farming community, subsidy is a requirement to increase the take up of insurance products. Many studies on determinants of participation in insurance market reveal that mostly large, wealthy and high income farmers buy insurance, whereas small and resource-poor farmers refrain from buying due to their inability to pay the premium (Sherrick et al. 2003; Gine et al. 2008). Therefore, in low-income countries, insurance premiums are usually subsidised for marginal and small farmers to induce them to busy insurance, which they need most to stabilise their income in the event of crop loss.

3. Climate Change Scenario and Agriculture in Odisha

Climate change is affecting the global commons adversely. During the past 100 years the global mean temperature has increased by 0.74 ^{0} C (IPCC, 2007) and is expected to rise between 2^{0} to 4^{0} C during the twenty first century. There are also regional estimations. The all-India annual mean surface temperature has increased by 0.51^{0} C in the past 106 years (Srinivasan, 2012). There is evidence that extreme rainfall events have increased. During the past 100 years, global sea level has increased by around 170 mm. An increase of one metre in sea level will inundate almost 6000 km^2 land in India. Agricultural production in India will be hampered by the rise in temperature, increase in heavy rainfall events, heat waves and coastal inundation.

Kumar and Parikh (2001) have estimated the possible impacts of climate change by using climate response function in the 'best' guess climate change scenario of a 2^{0} C temperature increase and a 7% increase in precipitation. They forecast that for the country as a whole, the impacts due to the above scenario are adverse with a loss of about 8.4 per cent of the total net-revenue from agriculture. Sanghi and Mendelsohn (2008) estimate that if temperatures rise by 2^{0} C with an 8% increase in precipitation, agricultural net revenue may fall 12% in India. By using ORYZA1 and INFOCROP rice model, Krishnan et al. (2007) predict that for every 1.8 ^{0} C increase in temperature average yield decline will be 6.7% to 7.2% respectively, at the current level of CO^2 (380 ppm) emission. There will be serious consequences for food security in India (Fisher et al. 2001). IPCC predicts that crop yields could increase up to 20 per cent in East and Southeast Asia while they could decrease up to 30 per cent in Central and South Asia by 2050. In tropical countries like India mainly kharif rice, sugarcane and wheat yield could decrease due to decline in water availability and rise in temperature.

Climate change is expected to negatively impact agriculture in warmer and lower latitude regions including Africa and South Asia. Odisha spreads over geographical area of 1,55,707 km^2, and extends from 17° 49` N to 22° 34`N latitude and from 81° 27` E to 87° 29` longitude at the eastern coast of India in South Asia. The state has 480 km long coastline along the Bay of Bengal. The state has tropical climate, characterized by high temperature, high humidity, medium to high rainfall and short and mild winters. The temperature remains high from March to May and rainfall is high from June to September. Major source of rainfall is the south-west monsoon. Besides, the state also receives a small amount of rain from the retreating monsoon in the month of October–November, when occasionally cyclone and storms are experienced. The annual average rainfall of the state is 1482 mm. Nearly 80 per cent of rainfall is received from June to September. There is wide variation in quantum of rainfall temporally and spatially. Odisha state as a whole comes under the "Sub humid" category, implying deficient winter rains.

The state is broadly divided into 4 physiographic zones namely Coastal Plains, Central Table Land, Northern Plateau and Eastern Ghats. These are further sub-divided into 10 Agroclimatic Zones. Agricultural Development Indices computed for different districts of Odisha indicate that the coastal plain districts are agriculturally more advanced followed by the central table land area, eastern ghat and northern plateau in that order (Swain, 2002).

Agriculture is the backbone of the state contributing to 26 per cent of Net State Domestic Product. Nearly 65 per cent of the total work force depends on agriculture to earn their livelihood either as cultivators or agricultural labourers. Odisha is the poorest state in India having 48 per cent of its population languishing below poverty line. In addition to this, due to frequent occurrence of extreme weather events like flood, drought and cyclone the incidence of transient poverty is also remarkably high.

A significant majority of farmers in Odisha mainly depend on rainfall for crop cultivation. Irrigation facility has been provided to only 41 per cent of cultivable land. Thus 59 per cent of cultivable land is rainfed and exposed to the vagaries of monsoon, which cause wide variations in crop output. On the whole, the state's economy is extremely vulnerable to climate change and catastrophic loss because of its tropical climate, monsoon rain, long coast line, high dependence on agriculture, mass poverty and low irrigation coverage.

Going by the key parameters of climate like temperature and rainfall, the climate has worsened in Odisha. The manifestations of climate change as observed in Odisha are drier weather conditions, extended dry season, early end of rainy season, weak monsoon activity, above normal air temperatures (Mujumdar and Ghosh, 2007). The mean maximum temperature and the mean minimum temperature of Odisha show an increasing trend. It is predicted that for the next two decades there will be warming of about 0.2° C. During dry period i.e. September to February rainfall has been decreasing whereas during wet period i.e. March to August rainfall has been increasing. As a result there has been an increase in occurrence of drought and flood (Gulati et al., 2009). The average annual normal rainfall shows a declining trend. This has decreased from 1502 mm during 1961-2000 to 1482 mm after 2000. The variability of rainfall has increased (Table 1).

Natural calamities like drought, flood and cyclone occur in the state very frequently. During the period 1961-2011, out of a total of 51 years only 11 years were normal years and the rest 40 years were abnormal years with occurrence of natural disasters like drought, flood and cyclone of varying intensity (Table 1). Coastal districts are prone to floods and cyclones, while drought is particularly frequent and severe in the western districts of the state.

In recent years, an increase in the variability of precipitation, coupled with increase in temperature due to global warming, has impacted the hydrological cycle in Odisha. This has affected the timing and magnitude of floods, droughts, sediment discharge, and drainage of river systems (Mujumdar and Ghosh, 2007); Patra et al., 2012). Global warming has increased both coastal and inland flooding. Further it is predicted that lower rainfall and more evaporation due to rise in temperature would cause less runoff, which would lead to substantial decline in the availability of freshwater in the watersheds, decline of soil moisture and increase in aridity level of hydrological zones. These will cause water stress and accentuate drought conditions. The increased occurrence of these extreme weather events will increase agricultural production risk making the sustenance of farming population quite unstable.

According to Greenpeace (2008), the state's fluctuating weather conditions observed during the last two decades suggest that it is already grappling with climatic chaos. For more than a decade now, it has experienced contrasting extreme weather conditions: from heat waves to cyclones, from droughts to floods (CSE, 2008). Earlier Western Odisha was a known calamity hotspot but now the coastal areas are also experiencing heat waves. A heat wave in 1998 killed around 1500 people, mostly in coastal Odisha, a region otherwise known for its moderate temperature. Bhubaneswar, the state capital of Odisha now has a mean maximum temperature above 40˚ C which is comparable to Sambalpur located in the interior. The 2001 flood was the worst ever flood recorded in Odisha in the past century, as 25 of the 30 districts were inundated affecting one-third of the state's 30 million residents. Areas with no history of floods such as districts in western Odisha were submerged. Ironically, Odisha suffered one of its worst droughts in the same year. Due to climate change, the severity of cyclone has also increased on the Odisha coast (Swain et al., 2006). In 1999, two cyclones hit the state in quick succession. The second one was unparalleled in Indian history and named as Super Cyclone because of amazingly high wind speed of 270-300 km per hour. The super cyclone ravaged 12 coastal districts out of total 30 districts of Odisha. Recently, **d**uring 11 October 2013, a severe cyclonic storm named as Phailin created havoc in the state.

During the last two decades the natural calamities have not only become more frequent and severe, but have hit areas that were never considered vulnerable. The state's economy has been ransacked by nature's fury. The increased frequency, intensity and duration of natural calamities have halted the development momentum of the state government and the state has been pushed to reverse gear. Particularly the agriculture sector has been the worst sufferer.

Foodgrain production trend in Odisha reveals that large variations in annual rainfall and increased frequency of extreme weather events have caused significant instability in crop yield and production. Table 2 shows the year wise data on area, yield and production of food grains in Odisha for the period from 1970 to 2011. The co-efficient of variation for area, yield and production is computed to be 6.9 per cent, 20.2 per cent and 23.9 per cent respectively. Thus, the inter-temporal variations in yield and production are considerable. It may be seen that in abnormal years the yield has been reduced substantially. During normal years, the food grain production hovers around 8 million metric tonne. In the year 1999, when the super cyclone had devastated twelve fertile coastal districts of the state, the food grain production was only 5.6 million tonne. Likewise in the severe drought year 2002 the food grain production declined to an alarmingly low level of 4 million tonne.

The impacts of climate change on agriculture are largely determined by the ability of producers to access irrigation, alternate crop varieties, agronomic practices, explore marketing opportunity, insurance and technology, or to discard agriculture for alternate livelihoods. If farmers do not take adequate adaptive measures to combat climatic risk, there may be substantial decline in crop production, farm income and greater production instability and food insecurity.

4. Modality of Crop Insurance Schemes

Realising the importance of insurance as a risk management strategy, the Government of Odisha has implemented different crop insurance schemes from time to time to stabilize farm income and stimulate investment in agriculture (Swain, 2008). To start with Odisha experimented by implementing some pilot crop insurance schemes during 1980-85. After the launching of Comprehensive Crop Insurance Scheme (CCIS) by the Government of India in

1985, Odisha immediately implemented the scheme across the state in the same year kharif season following guidelines of the Central Government. To reduce administrative costs the scheme had a built-in crop insurance to cover farmers who have taken crop loans from commercial banks, regional rural banks and the cooperatives. The basic objectives of the scheme were (i) to provide a measure of financial support to farmers in the event of crop failure as a result of drought, flood etc.; (ii) to restore the credit eligibility of farmers, after a crop failure, for the next crop season; and (iii) to support and stimulate production of cereals, pulses and oilseeds.

In this scheme the indemnification was on area basis and if there was a shortfall in actual average yield per hectare of insured crop from the threshold yield, each of the insured farmers growing that crop in the defined area was eligible for indemnity. This scheme was a credit linked insurance scheme and is criticised as a loan insurance scheme as the scheme was compulsory for loanee farmers and not available to non-loanee farmers, who self finance the cultivation expenses. Also, the financial performance of the scheme was very poor, as premium rates were highly subsidised and the claim-premium ratio was greater than one i.e. unfavourable in most of the seasons (Swain, 2008). To improve the scheme performance, a broad based National Agricultural Insurance Scheme (NAIS) has been implemented since1999 rabi season. NAIS covered all food crops (cereals, millets and pulses), cotton, sugarcane and potato in the 1st year and other annual commercial/horticultural crops in a period of three years. All loanee farmers are compulsorily covered under the scheme. The non-loanee farmers growing insurable crops can also opt for the scheme. The scheme provides comprehensive risk insurance against yield losses due to natural fire, lightening, storm, hailstorm, cyclone, typhoon, tempest, hurricane, tornado, flood, inundation and landslide, drought, dry spells, pests, diseases etc. The sum insured extends to the value of the threshold yield of the crop, with an option to cover up to 150 per cent of average yield of the crop on payment of extra premium. The premium rate for kharif crops bajra and oilseeds is 3.5 per cent of sum insured and 2.0 per cent for other food crops. In the rabi season the premium rate is 1.5 per cent for wheat and 2.0 per cent for other food crops and oilseeds. Also, 50 per cent subsidy in premium is allowed to small and marginal farmers which will be shared equally by the Government of India and State Government/Union Territory. The subsidy shall be phased out in a period of 5 years. In Odisha during 2009, the subsidy has been reduced to only 10 per cent. Like CCIS, NAIS operates on the basis of area approach. However, there is provision that the scheme would operate on individual basis for localized calamities such as hailstorm, landslides, cyclone and flood. NAIS is considered as an improvement over CCIS for extending insurance facility to non-loanee farmers, setting higher premium and including horticultural and commercial crops. However, NAIS failed to achieve its objectives owing to its low coverage, poor financial performance and less effectiveness (Sinha, 2004; Vyas and Singh, 2006; Kalavakonda and Mahul, 2005; Raju and Chand, 2008). The major drawback of NAIS is delay in payment of compensation as the collection of crop yield data through crop cutting experiment is a time consuming process. Moreover, as the claims are equally shared by the central and state government on 50:50 basis, the insurance company can disburse the compensation only after receiving from the central and state government, which cause significant delay in settlement of claims (Mahul et al. 2012).

To reduce administrative cost of collecting data on yield and to make faster claim payment in a transparent manner, during 2007 the Central Government launched Weather Based Crop Insurance Scheme (WBCIS) on pilot basis. Following the guidelines of the Central Government, since 2008 Odisha has been implementing WBCIS in few drought prone blocks in western Odisha on pilot basis. Initially during 2008, WBCIS was available only to non-loanee farmers. Since Kharif 2009, the scheme has been extended to both loanee and non-loanee farmers for paddy crop. In the pilot areas, for the loanee farmers, WBCIS is compulsory and NAIS is not available to them. But for the non-loanee farmers both NAIS and WBCIS are available.

WBCIS as implemented in Odisha is nothing but rainfall insurance and under this scheme the insured farmers shall be compensated against the likelihood of financial loss on account of anticipated loss in crop yield resulting from adverse rainfall incidence such as deficit rainfall and excess rainfall. In case of adverse weather incidence (AWI), all the insured farmers in the reference unit area shall be deemed to have suffered the same level of AWI and crop loss, and become eligible for the same level of pay-outs. Thus, in case of WBCIS, if there is deficient or excess rainfall in the defined area, all the farmers cultivating the notified crop within the defined area will be eligible for compensation at the same rate. The premium rate for kharif paddy is 2.5 per cent of sum insured. WBCIS is considered an improvement over NAIS because, in comparison to crop yield, rainfall as an index is easier to measure objectively and process of data collection is more transparent and less time consuming. As a result the administrative cost is low and this facilitates quicker payment of indemnity to the buyers of insurance. WBCIS eradicates the problems of moral hazard and adverse selection, as the insured farmer cannot influence the rainfall data to claim higher compensation. WBCIS allows reinsurance by the primary insurer as it is based on standardized/well defined internationally verifiable data. Major drawback of WBCIS is that it covers only the weather related risk and if there is crop loss due to any other reason such as plant disease and pest attack, the insured does not get any compensation. The most challenging disadvantage of WBCIS is basis risk, which is the variability between the value of losses as measured by the weather index and the value of actual losses experienced on the farm (Hess, 2003; Collier et al., 2009). Basis risk results in mismatch between actual loss and payout. In WBCIS, the start-up cost is high as, time series and historical data on rainfall and yield are required to define the trigger events that necessitate indemnity payment. A comparison of the modality of NAIS and WBCIS is given in the following table.

Comparison between NAIS and WBCIS

National Agricultural Insurance Scheme (NAIS)	**Weather Based Crop Insurance Scheme (WBCIS)**
Practically all risks covered (drought, excess rainfall, flood, hail, pest infestation, plant disease etc.)	Weather related risks like rainfall, frost, temperature, humidity etc. are covered.
Easy-to-design if historical yield data up to 10 years is available	Technical challenges in designing weather indices and also correlating weather indices with yield losses. Needs up to 25 years historical weather data
High basis risk [difference between the yield of the Area (Block / Tehsil) and the individual farmers]	Basis risk with regard to weather could be high for rainfall and moderate for others like frost, heat, humidity etc.
Objectivity and transparency are relatively less.	Objectivity and transparency are relatively high
Quality losses are beyond consideration.	Quality losses to some extent gets reflected through weather index
High loss assessment costs (crop cutting experiments)	No loss assessment costs
Delays in claims settlement	Faster claims settlement
Government’s financial liabilities are open ended, as it supports the claims subsidy.	Government’s financial liabilities could be budgeted up-front and close ended, as it supports the premium subsidy.

During 2010 the Government of India also launched a modified National Agricultural Insurance Scheme (MNAIS) on pilot basis in some selected districts across the country. The MNAIS tried to correct the loopholes in the existing NAIS. The novel features of MNAIS are coverage of prevented sowing/planting risk and post harvest loss, provision of higher level of indemnity, provision for mid-season on-account payment of compensation on the basis of expected crop loss, allowing private sector participation. In case of adverse seasonal conditions during crop season, claim amount up to 25 percent of likely claims would be released in advance subject to adjustment against the claims assessed on yield basis.

Recently during November 2013, in order to insulate farmers from farming risks, the Ministry of Agriculture and Cooperation, Government of India has directed the state governments to implement the new National Crop Insurance Programme (NCIP) with immediate effect from the ongoing rabi season. This central scheme has been formulated by merging the Pilot Weather Based Crop Insurance Scheme (WBCIS), Pilot Modified National Agricultural Insurance Scheme (MNAIS) and Pilot Coconut Palm Insurance Scheme (CPIS) to make it more farmer friendly.

Loanee farmers will be covered compulsorily under component scheme of NCIP notified by the concerned state, while non-loanee farmers will choose either MNAIS or WBCIS component. MNAIS and WBCIS will be extended to all the districts from rabi 2013-14 and NAIS will be rolled back simultaneously. Private sector insurers with adequate infrastructure and experience will be permitted to implement NCIP besides Agriculture Insurance Company of India (AIC).

Unlike earlier, all farmers even including sharecroppers, tenant farmers, farmers enrolled in contract farming, group of farmers serviced by fertilizer companies, pesticide firms, crop growers, and self help groups are eligible for insurance cover. There will be three indemnity levels instead of two- 70 per cent, 80 per cent and 90 per cent. The Threshold yield (TY) or guaranteed yield for a crop in a Insurance Unit shall be the average yield of the preceding 7 years excluding the year(s) in which a natural calamity such as drought, floods etc. may have been declared by the concerned Government authority, multiplied by level of indemnity. However, it may be ensured that at least 5 years' yield data is available for calculating the threshold yield.

The insurance companies will be liable to make claim payment from their own resources. Only the premium subsidy will be shared by state and central government on 50:50 basis. Besides, a catastrophic fund at the national level will be set up for providing reinsurance cover to the insurance companies implementing the scheme. However this fund, set up with equal contribution from the state and centre, can be used only in the event of failure to procure reinsurance cover at competitive rates and if premium to claims ratio exceeds 1:5. The novelty of the NCIS is that it incentivises risk reducing measures by farmers by lowering the premium for the farmers who undertake soil and water conservation measures. Premium structure would be worked out with a discount provision on the premium in respect of a unit area where all farmers have adopted better water conservation and sustainable farming practices for better risk mitigation.

In the National Action Plan on Climate Change (2008), under the national mission for sustainable agriculture, emphasis has been laid on strengthening agricultural and weather based insurance schemes to make agriculture resilient to climatic risk. Odisha is one of the first states to formulate its Climate Change Action Plan for 2010-2015. However, in the Action Plan, there is no mention about the role of insurance as a risk management strategy.

5. Performance of Crop Insurance Schemes

To evaluate the performance of NAIS and WBCIS under implementation in Odisha, I have analysed district-wise and state time series data on area and number of farmers covered, sum assured, premium collected, claims paid and farmers benefited, which have been collected from the regional office of Agriculture Insurance Company of India Limited, Bhubaneswar regional office. Also, I have used the information gathered through focussed group discussion with insurance users, while undertaking a research project on crop insurance with technical and financial support of South Asian Network for Development and Environmental Economics (SANDEE).

Adoption of NAIS as risk management strategy

I have tried to examine to what extent the farmers in Odisha have adopted the crop insurance schemes as a risk management tool. As NAIS is a universal scheme and under implementation in all the districts of Odisha, to examine the extent of farmers' participation, I have considered the trend in area and number of farmers covered under this scheme. Over the period 2000-2010, area under NAIS during both the kharif and rabi seasons show more or less an increasing trend. This is shown in Table 3 and Figure 1. The total area under NAIS has steadily increased from 0.86 million ha in 2000 to 1.06 million ha in 2010. However, percentage of Gross Cropped Area under NAIS has marginally increased from 10.1 per cent in 2000 to 11.7 per cent during 2010 (Table 3). Thus, the penetration of NAIS is abysmally low and slow, as nearly 90 per cent of gross cropped area in Odisha is not yet covered under NAIS.

For loanee farmers, i.e. for the farmers taking loans from institutional sources such as commercial banks, cooperatives and regional rural banks, NAIS is compulsory, but for non-loanee farmers, it is voluntary. Therefore, a break-up analysis of area and farmers covered according to loanee and non-loanee categories has been made to examine the farmers' adoption rate of NAIS voluntarily (Table 4). During 2010 kharif season, it is observed that only one per cent of farmers are non-loanees and they account for 1.9 per cent of total area under NAIS, which is really worrisome. On the top of it, the trend analysis reveals that over the period 2000-2010 kharif seasons, the percentage of non-loanee farmers availing NAIS has declined substantially from 11.9 per cent in 2000 to only one per cent in 2010 (Table 3). Likewise the percentage of area covered by non-loanee farmers has declined from 10.5 per cent in 2000 to only 1.9 per cent in 2010. Thus the insurance scheme has received scant acceptance by the non-loanee farmers, for whom insurance is voluntary. I tried to explore the reasons for such non-adoption of NAIS through focussed group discussion with the farmers and implementing agency personnel. It was discerned that the cooperatives, regional rural banks and commercial banks extend insurance facility to loanee farmers, for whom insurance is compulsory. But they are reluctant to provide insurance service to non-loanee farmers due to additional work burden and shortage of manpower. In spite of the provision for payment of service charges to the banks for providing crop insurance (4% of the premium collected), the bankers complained that they do not get any service charges from the Agriculture Insurance Company of India, and also the service charge is quite nominal in comparison to the extra work burden of processing insurance applications and providing insurance service..

Thus the insurance scheme has not received wide acceptance by the non-loanee farmers, for whom insurance is voluntary. In the case of rabi season the participation of non-loanee farmers is quite negligible and during 2010 it was nil (Table 5). Over the period 2000-2010 the percentage of non-loanee farmers and percentage of area show a decline from 0.7 per cent in 2000 to zero per cent in 2010.

Thus the adoption rate of NAIS by non-loanee farmers is abysmally low and a matter for great concern. A regionwise analysis reveals that the participation of non-loanee farmers in NAIS is higher for agriculturally backward regions such as northern plateau and central table land area, where agricultural risk is high. The percentage of area covered by non-loanee farmers is only 0.3 in the most agriculturally advanced coastal region, whereas it is as high as 12 per cent for the most agriculturally backward region of northern plateau.

This indicates that in risky areas, the non-loanee farmers are coming forward to insure their crops (Table 6).

Categorywise analysis of adoption of NAIS scheme reveals that marginal and small farmers owning land less than two hectares constitute 91% of total loanee farmers and 75 % of non-loanee farmers (Table 7). Thus the percentage of other farmers that include the medium and large farmers is higher for non-loanee farmers (25%) than that of loanee farmers (9%), which indicate that more of big farmers voluntarily insure their crop.

NAIS covers various crops during both kharif and rabi season. In Odisha, during 2009-10 kharif season, out of total insured area of 0.98 million ha, paddy coverage was as high as 0.95 million ha, accounting for nearly 97 percent of total cropped area. Other crops covered were maize (15276 ha), cotton (8457 ha), ginger (1039 ha), turmeric (767ha) and groundnut (140 ha). During rabi season also paddy is the most important insured crop (1,12953 ha) followed by groundnut (13611 ha) and potato (8467ha). However, WBCIS covers only paddy during kharif season and does not cover any crop during rabi season. WBCIS has been designed only for paddy as paddy production crucially depends on rainfall. NAIS covers all types of production risk including various natural calamities, pest attack and plant diseases, WBCIS covers only crop loss due to rainfall deficit or excess.

Farmers Benefited under NAIS

During 2000-2010 kharif seasons, it is observed that the percentage of farmers benefited from crop insurance in terms of receiving compensation varies substantially ranging from 1.7 per cent in 2001 to 69.7 per cent in 2002 (Table 8). During abnormal years of flood and drought the number of farmers benefited is very large. During rabi seasons the percentage of farmers benefited ranges from zero per cent in the year 2000 to 27.4 per cent in 2009.

A region wise analysis of percentage of farmers benefited from NAIS during 2009 kharif season in the case of loanee farmers reveals that it is the highest i.e. 31.3 per cent for the agriculturally most backward region of Northern Plateau and the least i.e.0.07 per cent for the agriculturally advanced coastal region (Table 9). Similar finding is obtained in the case of non-loanee farmers. However, in the case of non-loanee farmers the percentage of farmers benefited is higher than that of loanee farmers for the state as a whole and also in northern plateau and central table land area. This shows that more of risky farmers voluntarily come forward to insure their crops and thereby get compensation in the event of crop failure.

Financial Performance of NAIS

To assess the financial performance of NAIS in Odisha, the claim-premium ratio was computed by dividing the indemnity claim or compensation payment by insurance premium collected. If the claim-premium ratio exceeds one, it indicates financial loss on the part of the insurer in insurance business. During the 2000-2009 kharif seasons, it is observed that the claim-premium ratio is unfavourable i.e. greater than one for 6 years and favourable for only 4 years (Table 10). The claim-premium ratio ranges from 0.15 in 2005 kharif season to 9.4 in 2000 kharif season. But for 2000-2009 rabi seasons, claim premium is favourable for 9 years and unfavourable only for one year.

A region wise analysis of claim-premium ratio unfolds that it is higher in the case of agriculturally backward region and for non-loanee farmers (Table 11). There is negative association between extent of agricultural development of the region and claim-premium ratio.

Comparison of NAIS and WBCIS Performance

WBCIS has been implemented in Odisha on pilot basis since 2008 and covers only kharif paddy crop. A comparison of performance of NAIS and WBCIS reveals that percentage of non-loanee farmers and area covered by non-loanee farmers are higher in case of WBCIS, which implies that WBCIS is more popular than NAIS (Table 12). In the case of WBCIS, during 2008 the scheme was available to only non-loanee farmers, therefore, all the farmers buying insurance were non-loanees. During 2009 and 2010 kharif season, the percentage of non-loanee farmers was 8.8 per cent and 2.9 per cent respectively (Table 12). Thus the percentage of non-loanees is higher in both the years compared to NAIS, which was only 3 per cent and 1 per cent respectively. Likewise percentage area covered by non-loanees was higher in both the years in comparison to NAIS. Thus the adoption rate is higher in WBCIS than NAIS, because of its transparency and quicker payment of indemnity**.** The claim-premium ratio is also higher in case of WBCIS indicating more compensation payment to insurance users in comparison to their premium payment.

Percentage of farmers benefited was quite higher for WBCIS than that of NAIS. For NAIS, it ranged from only 9.1 per cent in 2008 to 19.3 in 2010. In case of WBCIS it ranged from 18.6 per cent in 2010 to cent per cent in 2008 (Table 13). The premium paid per hectare was higher in case of NAIS in comparison to WBCIS. It is observed that insured area per farmer was higher in case of WBCIS in comparison to NAIS for all the kharif seasons. However, the sum assured per hectare was more in the case of NAIS.

Thus, WBCIS seems to perform better than NAIS because of more coverage, higher percentage of non-loanee farmers, higher percentage of farmers benefited, less premium and higher claim-premium ratio (Table 13). However, as we have analysed data only for three years, the findings are not conclusive and may be considered as indicative. To further investigate the matter; during field survey we have examined the farmers' views on the efficacy of both the schemes. While discussing with the insurance users, they articulated that the frequency of getting compensation is more in the case of WBCIS but the compensation amount is greater in the case of NAIS. The farmers expressed that since last 8 years, most of the farmers in the region did not get any indemnity under NAIS, whereas most of the farmers under WBCIS, received compensation twice since 2009.

6. Revamping Crop Insurance Schemes

On the basis of the foregoing discussion in the preceding sections, the followings suggestions are made to revamp the existing crop insurance schemes in Odisha in Eastern India to increase its operational efficiency and effectiveness as a risk management strategy in the context of increasing agricultural risk due to climate change.

Promotion of Crop Insurance as a Merit Good

To increase the adoption rate of crop insurance the government has a major role to play. Insurance may be considered as a merit good as it stabilises farm income and provides economic support to farmers in the event of crop loss due to occurrence of unforeseen contingencies such as natural calamities, pest attack and plant diseases, which are non-preventable risks. Recently, widespread suicides by farmers in India speak of the disastrous consequences of agricultural risks on farmers' lives and well being. The government has to rise to the occasion and find a market based solution to this socio-economic problem by developing credit and insurance markets. Various insurance products catering to the need of different crops, locations and varied risk factors may be provided. Government is required to promote crop insurance by various methods such as creating awareness about the merits of insurance, linking credit with insurance, tying up insurance with other input supply services (seed, fertiliser, irrigation), subsidising insurance and providing reinsurance facility and technical assistance. Also data system on rainfall and yield should be developed to help in designing insurance products. Research on agro-meteorological issues such as correlation between various weather parameters and crop yield in different agro-climatic regions should be encouraged, which will help in designing appropriate weather based crop insurance products. An enabling regulatory and legal environment should be created to promote crop insurance.

Participatory design of Insurance Products

In case of WBCIS, the design of insurance product is a very difficult and cumbersome process. For defining the trigger events for crop loss, local knowledge and experience are very much necessary. The product will vary according to crop, seed variety, soil-climatic condition and micro-environment. In such case the design of the product should be done in a participatory manner by taking into account the views of the progressive or contact farmers in the area. So that farmers will not resist the schemes, if the indemnity payment does not match their crop loss.

The main drawback of NAIS is delay in compensation payment, because collection of data on area yield rate on the basis of which compensation will be calculated is a time consuming process. Government is required to streamline the procedure and make it transparent to reduce the scope for manipulation. The farmers' representatives should remain present during the crop-cutting experiments and estimation of crop yield to win the trust of the farmers in the yield data on the basis of which the indemnity will be paid to them in case of crop failure.

Integration of NAIS and WBCIS

NAIS is a multi-peril area based crop yield insurance scheme and it covers not only weather related risk such as drought, flood, storm etc. but also plant diseases and pest attack. Compensation is paid on the basis of actual crop loss in the defined area. The major drawback of this scheme is delay in claim settlement due to time consuming process of collection of yield data.

On the other hand, WBCIS covers only rainfall related risk and the compensation is paid on the basis of deficit or excess rainfall which is considered as a correlate or proxy of crop loss. The indemnity is paid quickly after receiving the rainfall data from meteorological stations. However, in the case of WBCIS, the basis risk is high if there are factors other than rainfall that affect crop yield, faulty design of the product in defining the trigger event and inaccurate measurement of local rainfall due to distant location of the weather measuring device.

Therefore, both the schemes have advantages and disadvantages. The better option may be to integrate both the schemes to take advantage of merits of both. To remove the basis risk, the indemnity may be calculated on the basis of actual crop loss data. However, to save delay in payment to wait for yield data after harvest, payout may be made on the basis of indemnity calculated by using rainfall data and the remaining amount may be released on the basis of actual crop loss data. Recently launched National Crop Insurance Programme (NCIP) includes both the schemes as alternatives, but what I am suggesting is to blend both the schemes and provide a hybrid insurance product to improve its operational efficiency. This insight was gained during my field survey, when most of the NAIS users in the study area showed their preference for WBCIS and the WBCIS users revealed their liking for NAIS.

Public and Private Participation

The new NCIP has allowed private insurance companies to participate in NAIS as well as WBCIS. In the context of climate change with increased covariate catastrophic risk, the private companies may not show their interest in offering crop insurance. Therefore, it is necessary to make it mandatory for all private and public insurance companies to extend certain percentage of their insurance business to cover crop insurance. Like priority lending to agriculture sector, insurance companies may be asked to provide priority insurance services to agriculture sector and this may be considered as social responsibility of the insurance sector. The public sector may address catastrophic risk and provide multi-peril insurance where subsidy requirement is high, but allow private sector to provide insurance products for less severe events and for individual independent idiosyncratic and localized risk. Government should provide technical guidance, subsidy, guarantee and reinsurance facility to attract the private insurers to this important sector (Marcel et al. 2002). Regulation and strict scrutiny of activities of private insurance companies may be done by the regulatory authority. There should be proper mechanism for redressal of grievances of insurance users/buyers/adopters.

Financing of Insurance and Reinsurance

Many argue that in the face of limited resources, government has to allocate resources to productive and income raising activities like irrigation, rural infrastructure, instead of pumping money to insurance which is so to say an income transfer mechanism. However, insurance induces farmers to adopt modern method of production, apply fertiliser, cultivate HYV seeds and more importantly makes agriculture dependable. To make agriculture viable and a cherished occupation, actions on all fronts and an integrated approach is necessary. Moreover, to make insurance business viable, reinsurance facility may be provided at state, country and international level. In the NCIP, there is a provision for creation of Insurance Fund at the centre with 50:50 contributions from centre and state. However, the international reinsurance companies have a larger role to play. In the climate change scenario, they also face resource constraint and insolvency. Therefore, there is a need for common commitment at the international level to meet such eventualities. This has already been accepted by UNFCCC and Kyoto protocol.

Role of Insurance in Climate Change Mitigation and Adaptation

The insurance industry can help both in mitigation and adaptation to climate change by inducing proper proactive and reactive responses in insurance users. The mitigation responses include incentivising use of clean technology, climate friendly cropping pattern, promoting organic farming and less energy intensive agriculture. Proactive adaptation responses include encouraging cultivation of drought resistant variety crops and seed variety, pest management, seed treatment, using efficient irrigation method etc. Discount in premium may be given for taking risk reducing action such as water conservation and sustainable farming practices. The insurance industry can induce desirable reactive responses after the occurrence of crop loss by making quick payment of indemnity, so that insurance buyers do not deplete their productive assets and fall into poverty trap. Also mid-season payment may be made if there is clear indication of ultimate crop loss due to severe drought condition or excess rainfall at crucial growth stage of crop.

Integration of Microfinance and Microinsurance

When formal financial institutions like commercial banks, regional rural banks and cooperatives did not come forward to meet the credit needs of the poor in rural areas due to high transaction cost, the microfinance institutions (MFIs) through the formation of self-help groups and group lending came forward to provide credit to the rural poor. Likewise, now there is a need to create awareness about the benefits of insurance in rural areas and the MFIs can play a major role in this due to their easy access to farmers through their grass-root level developmental activities. The micro-enterprise activities financed through MFIs can be insured, and will help in proactively managing enterprise loss. Integration of micro-finance, micro-insurance and micro-enterprise will go a long way in solving the problem of unemployment and poverty in rural areas.

ACKNOWLEDGEMENTS

I am extremely grateful to Ruth Kattumuri for her supervision and constant encouragement that helped me to improve the paper. I thank the Commonwealth Scholarship Commission, UK for awarding the Commonwealth Academic Fellowship that enabled me to pursue my research work in London. I duly acknowledge the technical and financial support provided by the South Asian Network for Development and Environmental Economics (SANDEE) for completing a research project on Crop Insurance. Some of the research findings of this project have been used in this paper. I thank Jean-Marie Baland, SANDEE advisor for his guidance and intellectual support.

REFERENCES

Agricultural Insurance Company of India Limited (AICI). (2007). *Crop Insurance in India*.

Barnett, B.J., C.B. Barrett, and J.R. Skees. (2008). 'Poverty Traps and Index-based Risk Transfer Products', *World Development* 36:1766-1785.

Bayer Joanne Linnerooth and Reinhard Mechler. (2006). 'Insurance for assisting adaptation to climate change in developing countries: a proposed strategy', Climate Policy, Vol. 6, pp. 621–636.

Binswanger Hans P. –Mkhize. (2012).Is There Too Much Hype about Indexbased Agricultural Insurance?, *The Journal of Development Studies*, Vol.48, No.2, pp. 187-200.

Centre for Science and Environment (CSE). 2008. Climate Change and Orissa, Orissa Factsheet.

Collier Benjamin, Jerry Skees and Barry Barnett. (2009). 'Weather Index Insurance and Climate Change: Opportunities and Challenges in Lower Income Countries', Geneva Papers, No.34, pp. 401-424.

Dandekar, V.M. (1976). 'Crop Insurance in India', Economic and Political Weekly, Vol. 11, No. 26.

David S.G. Thomas and Chasca Twyman. (2005). 'Equity and justice in climate change adaptation amongst natural-resource-dependent societies', Global Environmental Change, Vol. 15, pp. 115–124.

Duncan, John and Robert J.Myers (2000). 'Crop Insurance under Catastrophic Risk', *American Journal of Agricultural Economics*, Vol.82, No.4, pp842-855.

Fisher, Gunther, M. Shah, Harrij van Velthuizen and Freddy O Nachtergaele. (2001). *Global Agro-ecological Assessment for Agriculture in the 21st Century,* International Institute for Applied Systems Analysis, Austria.

Gine Xavier, Roberts Townsend and James Vickery. (2008). *Patterns of Rainfall Insurance Participation in Rural India*, *The World Bank Economic Review,* pp.1-28, October 22.

Goodwin, Barry K. (2001). Problems with Market Insurance in Agriculture, *American Journal of Agricultural Economics,* 83(3), 643-649.

Greenpeace (2008). Climate change: A Case Study of Orissa.

Gulati Aastha, Palak Gupta, Meenakshi Jha, P. Parth Sarthi and Kumar Vishal. (2009). 'Impact of Climate Change, Variability, and Extreme Rainfall Events on Agricultural Production and Food Insecurity in Odisha', ISPRS Archives XXXVIII-8/W3 Workshop Proceedings: Impact of Climate Change on Agriculture, in Sushma Panigrahy, Shibendu Shankar Ray and Jai Singh Parihar (eds.), pp. 371-75.

Herweijer Celine, Nicola Ranger and Robert E.T. Ward. (2009). 'Adaptation to Climate Change: Threats and Opportunities for the Insurance Industry', The Geneva Papers, 34, pp.360-380.

Hess, Ulrich. (2003). *Innovative Financial Services for Rural India: Monsoon-Indexed lending and Insurance for Smallholders,* Agricultural & Rural Development Working Paper 9,World bank.

IPCC. (2007). *Climate Change, Impacts, Adaptation and Vulnerability,* Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.

Kalavakonda Vijay and Olivier Mahul (2005). *Crop Insurance in Karnataka*, World Bank Policy Research Working Paper 3654.

Krishnan P., D.K. Swain, Chandra Bhaskar, S.K. Nayak and R.N. Dash. (2007). 'Impact of elevated CO2 and temperature on rice yield and methods of adaptation as evaluated by crop simulation studies', Agriculture, Ecosystems and Environment, Vol. 122, pp. 233–242

Kumar, K.S.Kavi and Jyoti Parikh. (2001). 'Indian agriculture and climate sensitivity', Global Environmental Change, Vol. 11, pp. 147–154.

Kunreuther Howard, Erwann Michel-Kerjan and Nicola Ranger (2013). 'Insuring future climate catastrophes'**,** *Climatic Change,* 118:339–354.

Marcel A.P.M., Van Asseldonk, Miranda P.M. Meuwissen, and Ruud B.M. Huirne (2002). 'Belief in Disaster Relief and the Demand for a Public-Private Insurance Program', *Review of Agricultural Economics*, Vol.24, No.1, pp.196-207.

Mcleman, Robert and Barry Smit. (2006). 'Vulnerability to Climate Change Hazards and Risks: Crop and Flood Insurance', *The Canadian Geographer*, Vol. 50, No.2, pp.217-226.

Mills Evan. (2007). 'Synergisms between climate change mitigation and adaptation: an insurance perspective', *Mitigation and Adaptation Strategy for Gloal Change*, Vol.12, pp. 809–842.

Mills Evan. (2012). 'The Greening if Insurance', *Science: Policy Forum*, Vol. 338, 14 December, pp. 1424-25.

Morduch, J. (1995). 'Income Smoothing and Consumption Smoothing'. *Journal of Economic Perspectives*, 9 (summer), 103–14.

Miranda, Mario and Dmitry V. Vedenov. (2001). 'Innovations in Agricultural and Natural Disaster Insurance', *American Journal of Agricultural Economics*, 83(3), pp.650-655.

Mujumdar, P. P. and S. Ghosh. (2007). 'Assessment of Impact of Climate Change on Precipitation at Regional Scale', *Jalvigyan Sameeksha*, Vol.22, pp.21-36.

O'Brien Karen, Robin Leichenko, Ulka Kelkar, Henry Venema, Guro Aandahl, Heather Tompkins, Akram Javed, Suruchi Bhadwal,Stephan Barg, Lynn Nygaard, Jennifer West (2004). 'Mapping vulnerability to multiple stressors: climate change and globalization in India', Global Environmental Change, Vol.14, pp. 303–313.

Patra Jagadish P., A. Mishra, R. Singh and N. S. Raghuwanshi. (2012). 'Detecting rainfall trends in twentieth century (1871–2006) over Odisha State, India', *Climatic Change*, 111, pp. 801–17.

Phelan Liam, Ros Taplin, Ann Henderson Sellers and Glenn Albrecht. (2011). 'Ecological Viability or Liability? Insurance System Responses to Climate Risk', Environmental Policy and Governance, Published online in Wiley Online Library.

Raju, S.S. and Ramesh Chand. (2008), Agricultural Insurance in India: Problems and Prospects, National Centre for Agricultural Economics and Policy Research, Working Paper No.8.

Raju, S.S. and Ramesh Chand. (2008). 'A Study on the Performance of National Agricultural Insurance Scheme and Suggestions to Make it More Effective', *Agricultural Economics Research Review*, Vol. 2, January-June, pp 11-19.

Sanghi Apurva and Robert Mendelsohn. (2008).'The impacts of global warming on farmers in Brazil and India' Global Environmental Change, Vol. 18, pp. 655–665.

Sherrick, Bruce J., Peter J.Barry, Gary D.Schnitkey, Paul N.Ellinger and Brian Wansink (2003). 'Farmers' Preferences for Crop Insurance Attributes', *Review of Agricultural Economics*, Vol.25, pp.415-429.

Sinha Sidharth. (2004). 'Agriculture Insurance in India: Scope for Participation of Private Insurers', *Economic and Political Weekly,* 39(25), 2605-11.

Srinivasan, J. (2012).'Impact of Climate Change on India', in Navroz K. Dubash (ed) (2012) *Handbook of Climate Change and India: Development, Politics and Governance*, Earthscan: London and New York.

Swain Mamata. (2002). 'Performance of Agriculture in Orissa: Intertemporal and Spatial Variaton', Chapter IV in *Orissa State Development Report*, Planning Commission**,** New Delhi.

Swain Mamata, M. Swain and R.H. Sahoo. (2006). *Disaster and Gender: Impact of Super Cyclone on Life and Livelihood of Women*, New Delhi: Serials Publisher.

Swain Mamata. (2008). Agricultural Risk and Crop Insurance in a Globalised Economy, *Man & Development*, Vol. 30, No.3, pp. 107-28.

Swain Mamata (2009). 'Impact of Climate Change on Agriculture in Odisha: Adaptation and Mitigation', in R.K.Panda (ed.) Odisha's *Economic Development: Experiences and Expectations*, New Delhi: Serials Publisher.

Tucker Michael. (1997). 'Climate change and the insurance industry: the cost of increased risk and the impetus for action', Ecological Economics, Vol. 22, pp. 85–96

Vyas, V.S. and S. Singh. (2006). Crop Insurance in India: Scope for Improvement, Economic and Political Weekly, Vol.41(43&44), 4585-94.

Table 1
Rainfall and Natural Calamities in Odisha

(in mm)

Year	Normal Rainfall	Actual Rainfall	Deviation from normal		Natural Calamity
			in mm	in %	
1961	1482.2	1262.8	-219.4	-14.8	
1962	1482.2	1269.9	-212.3	-14.3	
1963	1482.2	1467.0	-15.2	-1.0	
1964	1482.2	1414.1	-68.1	-4.6	
1965	1482.2	997.1	-485.1	-32.7	Severe Drought
1966	1482.2	1134.9	-347.3	-23.4	Drought
1967	1482.2	1326.7	-155.5	-10.5	Cyclone, Flood
1968	1482.2	1296.1	-186.1	-12.6	Cyclone, Flood
1969	1482.2	1802.1	319.9	21.6	Flood
1970	1482.2	1660.2	178.0	12.0	Flood
1971	1482.2	1791.5	309.3	20.9	Severe Cyclone, Flood
1972	1482.2	1177.1	-305.1	-20.6	Flood, Drought
1973	1482.2	1360.1	-122.1	-8.2	Flood
1974	1482.2	951.2	-531.0	-35.8	Severe Drought, Flood
1975	1482.2	1325.6	-156.6	-10.6	Flood
1976	1482.2	1012.5	-469.7	-31.7	Severe Drought
1977	1482.2	1327.5	-154.7	-10.4	Flood
1978	1482.2	1333.2	-149.0	-10.1	Hailstorm, Tornados
1979	1482.2	951.2	-531.0	-35.8	Severe Drought
1980	1482.2	1318.2	-164.0	-11.1	Flood, Drought
1981	1482.2	1185.1	-297.1	-20.0	Severe Flood, Drought & Cyclone
1982	1482.2	1178.3	-303.9	-20.5	Severe Flood, Drought & Cyclone
1983	1482.2	1374.1	-108.1	-7.3	
1984	1482.2	1303.1	-179.1	-12.1	Drought
1985	1482.2	1606.8	124.6	8.4	Flood
1986	1482.2	1547.9	65.7	4.4	
1987	1482.2	1040.4	-441.8	-29.8	Severe Drought
1988	1482.2	1270.5	-211.7	-14.3	
1989	1482.2	1283.9	-198.3	-13.4	
1990	1482.2	1865.8	383.6	25.9	Flood
1991	1482.2	1462.2	-20.0	-1.3	
1992	1482.2	1344.1	-138.1	-9.3	Flood & Drought
1993	1482.2	1417.6	-64.6	-4.4	
1994	1482.2	1700.3	218.1	14.7	
1995	1482.2	1600.4	118.2	8.0	Flood & Cyclone
1996	1482.2	988.9	-493.3	-33.3	Drought
1997	1482.2	1463.0	-19.2	-1.3	Drought
1998	1482.2	1279.6	-202.6	-13.7	Drought, Heat Wave
1999	1482.2	1433.8	-48.4	-3.3	Super Cyclone
2000	1482.2	1022.9	-459.3	-31.0	Drought
2001	1482.2	1616.2	134.0	9.0	Flood
2002	1482.2	1005.5	-476.7	-32.2	Severe Drought
2003	1482.2	1667.1	184.9	12.5	Flood
2004	1482.2	1273.6	-208.6	-14.1	Flood
2005	1451.2	1515.8	64.6	4.5	Flood
2006	1451.2	1682.8	231.6	16.0	Flood
2007	1451.2	1591.6	140.4	9.7	Flood
2008	1451.2	1523.6	72.4	5.0	Flood
2009	1451.2	1362.6	-88.6	-6.1	Flood & Drought
2010	1451.2	1293.1	-158.1	-10.9	Flood & Drought
2011	1451.2	1338.1	-113.1	-7.8	Flood
Mean		**1361.1**			
SD		**231.9**			
CV(in %)		**17.0**			

Source: Climatological Data of Orissa, Various Issues, Directorate of Economics and Statistics, Orissa, Bhubaneswar.
Orissa Agriculture Statistics, Various Issues, Directorate of Agriculture and Food Production, Orissa, Bhubaneswar.
Annual Report on Natural Calamity 2009-10, Revenue & Disaster Management Department, Orissa.

Table 2: Area, Yield and Production of Foodgrains in Odisha

Year	Area (000Ha)	Yield (Kg/Ha)	Production (000MT)	Natural Calamity
1970-71	5781	847	5104	Flood
1971-72	5950	732	4354	Severe Cyclone, Flood
1972-73	5915	822	4860	Flood, Drought
1973-74	6218	84 8	5480	Flood
1974-75	5992	663	3971	Severe Drought, Flood
1975-76	6484	859	5500	Flood
1976-77	6038	675	4075	Severe Drought
1977-78	6519	853	5561	Flood
1978-79	6680	863	5765	Hailstorm, Tornados
1979-80	6455	600	3872	Severe Drought
1980-81	6909	865	5977	Flood, Drought
1981-82	6738	822	5538	Severe Flood, Drought & Cyclone
1982-83	6417	731	4688	Severe Flood & Drought, Cyclone
1983-84	7323	956	7001	
1984-85	6652	843	5609	Drought
1985-86	7043	989	6968	Flood
1986-87	7010	910	6378	
1987-88	6728	751	5058	Severe Drought
1988-89	6856	1021	7002	
1989-90	6972	1144	7974	
1990-91	7089	992	7031	Flood
1991-92	7252	1141	8273	
1992-93	6946	993	6898	Flood & Drought
1993-94	7208	1140	8216	
1994-95	7120	1122	7986	
1995-96	7194	1101	7923	Flood & Cyclone
1996-97	6360	841	5347	Drought
1997-98	6616	1105	7311	Drought
1998-99	6516	989	6288	Drought, Heat Wave
1999-00	6075	937	5602	Super Cyclone
2000-01	5192	884	4976	Drought
2001-02	6683	1232	8233	Flood
2002-03	5992	675	4045	Severe Drought
2003-04	6568	1178	7737	Flood
2004-05	6576	1154	7588	Flood
2005-06	6790	1211	8221	Flood
2006-07	6840	1213	8298	Flood
2007-08	6884	1344	9254	Flood
2008-09	6912	1249	8634	Flood
2009-10	6920	1258	8707	Flood & Drought
2010-11	6783	1293	8770	Flood & Drought
2011-12	6483	1175	7616	Flood
S.D	**457.8**	**197.1**	**1557.1**	
C.V. (%)	**6.9**	**20.2**	**23.9**	

Source: Orissa Agriculture Statistics, Various Issues, Directorate of Agriculture and Food Production, Orissa, Bhubaneswar.
Annual Report on Natural Calamity 2009-10, Revenue & Disaster Management Department, Orissa.

Table 3

Percentage of Gross Cropped Area under NAIS in Odisha

Kharif and Rabi 2000-2010

(Area in Ha)

Year	G.C.A.	Area under NAIS			% of G.C.A. under NAIS
		Kharif Area	Rabi Area	Total Area	
2000	8526000	751595	164703	916298	10.1
2001	7877000	625098	108810	733908	10.2
2002	8798000	1377756	174899	1552655	17.1
2003	7852000	633977	123475	757452	10.3
2004	8638000	943212	178181	1121393	13.2
2005	8718000	922854	198026	1120880	13.1
2006	8928000	890122	216780	1106902	12.2
2007	8960000	905934	199725	1105659	11.7
2008	9014000	590932	138534	729466	8.2
2009	9071000	981287	144564	1125851	12.3
2010	9075000	1031185	31705	1062890	11.7

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha.
Orissa Agricultural Statistics, Various issues and Directorate of Agriculture and Food Production, Odisha, Bhubaneswar.

Table 4
Percentage Distribution of Farmers and Area Covered according to Loanee and Non-Loanee category
NAIS Kharif 2000-2010

Season	% of Farmers			% of Area		
	Loanee Farmers	Non-Loanee Farmers	Total	Loanee Farmers	Non-Loanee Farmers	Total
Kharif-2000	88.1	11.9	100	89.5	10.5	100
Kharif-2001	89.6	10.4	100	90.6	9.4	100
Kharif-2002	54.4	45.6	100	53.2	46.8	100
Kharif-2003	96.2	3.8	100	94.8	5.2	100
Kharif-2004	88.7	11.3	100	85.3	14.7	100
Kharif-2005	99.1	0.9	100	98.4	1.6	100
Kharif-2006	98.4	1.6	100	97.4	2.6	100
Kharif-2007	99.5	0.5	100	99.2	0.8	100
Kharif-2008	97.4	2.6	100	95.5	4.5	100
Kharif-2009	97.0	3.0	100	94.6	5.4	100
Kharif-2010	99.0	1.0	100	98.1	1.9	100

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 5
Percentage Distribution of Farmers and Area Covered
according to Loanee and Non-Loanee category
NAIS Rabi 2000-2010

Season	% of Farmers			% of Area		
	Loanee Farmers	Non-Loanee Farmers	Total	Loanee Farmers	Non-Loanee Farmers	Total
Rabi-2000	99.3	0.7	100	99.3	0.7	100
Rabi-2001	99.7	0.3	100	99.8	0.2	100
Rabi-2002	99.7	0.3	100	99.9	0.1	100
Rabi-2003	100	0.0	100	100	0.0	100
Rabi-2004	100	0.0	100	100	0.0	100
Rabi-2005	100	0.0	100	100	0.0	100
Rabi-2006	100	0.0	100	100	0.0	100
Rabi-2007	99.9	0.1	100	100	0.0	100
Rabi-2008	99.9	0.1	100	99.8	0.2	100
Rabi-2009	100	0.0	100	100	0.0	100
Rabi-2010	100	0.0	100	100	0.0	100

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 6

Percentage Distribution of Farmers and Area Covered according to Loanee and Non-Loanee category Region and District-wise NAIS Kharif 2009-2010

Region	% of Farmers			% of Area		
	Loanee Farmers	Non-Loanee Farmers	Total	Loanee Farmers	Non-Loanee Farmers	Total
Northern Plateau						
Mayurbhanj	99.7	0.3	100.0	99.8	0.2	100.0
Keonjhar	96.4	3.6	100.0	94.0	6.0	100.0
Sundargarh	84.8	15.2	100.0	74.5	25.5	100.0
Jharsuguda	94.6	5.4	100.0	90.1	9.9	100.0
Deogarh	97.1	2.9	100.0	92.6	7.4	100.0
Total	92.1	7.9	100.0	87.2	12.8	100.0
Central Table Land						
Bolangir	95.1	4.9	100.0	92.2	7.8	100.0
Sambalpur	92.8	7.2	100.0	86.5	13.5	100.0
Bargarh	86.0	14.0	100.0	74.5	25.5	100.0
Dhenkanal	99.0	1.0	100.0	98.9	1.1	100.0
Sonepur	88.3	11.7	100.0	85.0	15.0	100.0
Angul	94.7	5.3	100.0	95.1	4.9	100.0
Boudh	99.3	0.7	100.0	98.5	1.5	100.0
Nawapara	0.0	100.0	100.0	0.0	100.0	100.0
Total	93.5	6.5	100.0	89.5	10.5	100.0
Eastern Ghat						
Koraput	99.4	0.6	100.0	98.6	1.4	100.0
Kalahandi	97.2	2.8	100.0	96.4	3.6	100.0
Phulbani	100.0	0.0	100.0	100.0	0.0	100.0
Rayagada	99.9	0.1	100.0	100.0	0.0	100.0
Gajapati	100.0	0.0	100.0	100.0	0.0	100.0
Nowrangpur	99.9	0.1	100.0	99.7	0.3	100.0
Malkanagiri	99.8	0.2	100.0	99.8	0.2	100.0
Total	99.0	1.0	100.0	98.4	1.6	100.0
Coastal Plain						
Balasore	99.8	0.2	100.0	99.8	0.2	100.0
Cuttack	99.3	0.7	100.0	98.9	1.1	100.0
Puri	100.0	0.0	100.0	99.8	0.2	100.0
Ganjam	99.9	0.1	100.0	99.7	0.3	100.0
Bhadrak	100.0	0.0	100.0	100.0	0.0	100.0
Jajpur	100.0	0.0	100.0	100.0	0.0	100.0
Jagatsinghpur	100.0	0.0	100.0	100.0	0.0	100.0
Kendrapara	100.0	0.0	100.0	100.0	0.0	100.0
Khurda	99.4	0.6	100.0	99.6	0.4	100.0
Nayagarh	99.3	0.7	100.0	98.6	1.4	100.0
Total	99.8	0.2	100.0	99.7	0.3	100.0

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 7

Percentage Distribution of Different Categories of Farmers according to Loanee and Non-Loanee category Region and District-wise Kharif 2009-2010

Region	% of Farmers						% of Area				
	Loanee			Non-Loanee			Loanee			Non-Loanee	
	S/M	Others	Total	S/M	Others	Total	S/M	Others	Total	S/M	Others
Northern Plateau											
Mayurbhanj	92.4	7.6	100.0	91.9	8.1	100.0	81.6	18.4	100	75.5	24.5
Keonjhar	98.8	1.2	100.0	96.0	4.0	100.0	95.2	4.8	100	87.7	12.3
Sundargarh	91.7	8.3	100.0	88.4	11.6	100.0	86.2	13.8	100	77.0	23.0
Jharsuguda	81.6	18.4	100.0	52.4	47.6	100.0	64.6	35.4	100	30.5	69.5
Deogarh	88.4	11.6	100.0	53.7	46.3	100.0	72.6	27.4	100	31.3	68.7
Total	93.3	6.7	100.0	87.1	12.9	100.0	84.9	15.1	100	73.6	26.4
Central Table Land											
Bolangir	85.1	14.9	100.0	67.6	32.4	100.0	73.1	26.9	100	46.4	53.6
Sambalpur	67.2	32.8	100.0	45.3	54.7	100.0	47.3	52.7	100	21.8	78.2
Bargarh	74.0	26.0	100.0	36.7	63.3	100.0	57.3	42.7	100	18.4	81.6
Dhenkanal	98.8	1.2	100.0	94.1	5.9	100.0	96.8	3.2	100	86.8	13.2
Sonepur	82.4	17.6	100.0	79.8	20.2	100.0	64.3	35.7	100	58.1	41.9
Angul	99.1	0.9	100.0	94.1	5.9	100.0	97.5	2.5	100	89.5	10.5
Boudh	91.7	8.3	100.0	68.1	31.9	100.0	79.1	20.9	100	40.6	59.4
Nawapara	0.0	100.0	100.0	64.9	35.1	100.0	0.0	100.0	100	38.5	61.5
Total	87.9	12.1	100.0	65.2	34.9	100.0	76.4	23.6	100	38.9	61.1
Eastern Ghat											
Koraput	87.8	12.2	100.0	62.1	37.9	100.0	69.8	30.2	100	23.7	76.3
Kalahandi	69.6	30.4	100.0	57.3	42.7	100.0	46.4	53.6	100	26.9	73.1
Phulbani	97.9	2.1	100.0	0.0	0.0	0.0	89.5	10.5	100	0.0	0.0
Rayagada	71.7	28.3	100.0	40.0	60.0	100.0	51.1	48.9	100	31.1	47.1
Gajapati	97.3	2.7	100.0	0.0	0.0	0.0	92.4	7.6	100	0.0	0.0
Nowrangpur	94.4	5.6	100.0	65.9	34.1	100.0	84.5	15.5	100	32.6	67.4
Malkanagiri	96.8	3.2	100.0	65.5	34.5	100.0	93.0	7.0	100	73.6	26.4
Total	83.1	16.9	100.0	57.9	42.1	100.0	64.2	35.8	100	27.3	72.6
Coastal Plain											
Balasore	99.2	0.8	100.0	95.6	4.4	100.0	97.9	2.1	100	83.3	16.7
Cuttack	99.6	0.4	100.0	100.0	0.0	100.0	98.5	1.5	100	100.0	0.0
Puri	99.0	1.0	100.0	0.0	100.0	100.0	95.9	4.1	100	0.0	100.0
Ganjam	97.4	2.6	100.0	46.6	53.4	100.0	92.8	7.2	100	20.8	79.2
Bhadrak	99.5	0.5	100.0	0.0	0.0	0.0	97.8	2.2	100	0.0	0.0
Jajpur	99.2	0.8	100.0	0.0	0.0	0.0	94.5	5.5	100	0.0	0.0
Jagatsinghpur	99.2	0.8	100.0	0.0	0.0	0.0	96.3	3.7	100	0.0	0.0
Kendrapara	99.8	0.2	100.0	0.0	0.0	0.0	98.7	1.3	100	0.0	0.0
Khurda	99.2	0.8	100.0	98.6	1.4	100.0	97.6	2.4	100	95.3	4.7
Nayagarh	98.7	1.3	100.0	90.8	9.2	100.0	95.7	4.3	100	70.3	29.7
Total	99.0	1.0	100.0	91.6	8.4	100.0	96.4	3.6	100	70.5	29.5
State Total	90.8	9.2	100.0	75.4	24.6	100.0	80.5	19.5	100.0	52.6	47.4

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 8
Percentage of Farmers Benefited under NAIS
Kharif and Rabi 2000-2010

Year	Kharif			Rabi		
	Farmers Covered	Farmers Benefited	Percentage of Farmers Benefited	Farmers Covered	Farmers Benefited	Percentage of Farmers Benefited
2000	681010	349406	51.3	232836	15	0.0
2001	627568	10854	1.7	123964	25759	20.8
2002	1204849	839345	69.7	212162	18541	8.7
2003	638303	38188	6.0	142871	16806	11.8
2004	872551	45657	5.2	202699	1335	0.7
2005	900022	19352	2.2	210853	7451	3.5
2006	880330	68532	7.8	230039	7039	3.1
2007	840727	65885	7.8	199886	19541	9.8
2008	611477	55928	9.1	132418	964	0.7
2009	1068687	99184	9.3	161720	44323	27.4
2010	1107710	213325	19.3	34676	2941	8.5

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha.

Table 9
Regionwise Farmers Benefited under NAIS
Kharif 2009-2010

Region	Rank in Agril Dev	Loanee			Non-Loanee		
		No. of Loanee Farmers	No.of Farmers Benefited	% of Total	No. of Non-Loanee farmers	No.of Farmers Benefited	% of Total
Northern Plateau	4	156252	48903	31.3	13408	10555	78.7
Central Table Land	2	245639	29196	11.9	16951	3309	19.5
Eastern Ghat	3	139211	6812	4.9	1391	35	2.5
Coastal Plain	1	494997	374	0.1	838	0	0.0
State Total		1036099	85285	8.2	32588	13899	42.7

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 10
Claim-Premium Ratio under NAIS Kharif and Rabi from 2000-2009

Year	Kharif			Rabi		
	Premium (Rs.)	Claims (Rs.)	Claim/ Premium	Premium (Rs.)	Claims (Rs.)	Claim/ Premium
2000	112392562	1054716278	9.38	22844642	16556	0.01
2001	102218804	23401452	0.23	18561159	14494434	0.78
2002	298560969	2440291965	8.17	33184437	10819387	0.33
2003	138160518	181844628	1.32	25437944	11741081	0.46
2004	254954481	146885827	0.58	33678681	981629	0.03
2005	243334143	37382700	0.15	49858874	3593957	0.07
2006	275039791	274771560	1.00	57848102	22079443	0.38
2007	282415471	240172446	0.85	52583352	41629009	0.79
2008	217694400	303489566	1.39	38119451	1703855	0.04
2009	396960881	469004449	1.18	49783305	83697450	1.68
2010	470714428	1375082096	2.90	42429399	9912081	0.50

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 11
Regionwise Claim Premium Ratio under NAIS
Kharif 2009-2010

Region	Loanee			Non-Loanee		
	Premium (Rs.)	Claims (Rs.)	Claim-Premium Ratio	Premium (Rs.)	Claims (Rs.)	Claim-Premium Ratio
Northern Plateau	49925083	226124293	4.53	4073856	47700491	11.71
Central Table Land	105381168	159329369	1.51	13085837	23156777	1.77
Eastern Ghat	55077045	12010752	0.21	727688	1180	0.002
Coastal Plain	168389711	681586	0.004	28228034	46315914	1.04
State Total	657695848	344043414	0.52	28228034	46315914	1.64

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 12
Distribution of Farmers and Area Covered according to Loanee and Non-Loanee category Under NAIS and WBCIS during Kharif 2008-2010

Season	No. of Loanee Farmers	% of Total	No. of Non-Loanee Farmers	% of Total	Total	Area of Loanee Farmers (ha)	% of Total	Area of Non-Loanee Farmers (ha)	% of Total	Total
NAIS										
2008	595858	97.4	15619	2.6	611477	564402	95.5	26530	4.5	590932
2009	1036099	97.0	32588	3.0	1068687	928301	94.6	52986	5.4	981287
2010	1096604	99.0	11106	1.0	1107710	1011782	98.1	19403	1.9	1031185
WBCIS										
2008	0.0	0.0	13289	100.0	13289	0.0	0.0	22278	100.0	22278
2009	74283	91.2	7146	8.8	81429	97332	85.9	15934	14.1	113266
2010	72557	97.1	2177	2.9	74734	95877	94.3	5841	5.7	101718

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha

Table 13

Performance Indicators of NAIS and WBCIS (Kharif 2008-2010)

Season	Area Insured (Ha/Farmer)	Sum Assured (Rs/Ha)	% of Farmers Benefited	Premium Paid (Rs/Ha)	Claim Received (Rs/Ha)	Claim/ Premium
NAIS						
2008	1.0	14235	9.1	368	514	1.4
2009	0.9	16054	9.3	405	478	1.2
2010	0.9	18161	19.3	456	1333	2.9
WBCIS						
2008	1.7	20000	100.0	500*	1862	3.7
2009	1.4	12000	67.3	300*	662	2.2
2010	1.4	12000	18.6	300*	123	0.4

Note: * These are subsidised premium calculated at 2.5% of sum assured. The gross premium is 10% of sum assured and Rs.2000 in 2008 and Rs.1200 during 2009 and 2010.

Source: Agriculture Insurance Company of India Limited, Regional Office, Bhubaneswar, Odisha.