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Redesigning Crop Insurance for Coping with Climate Change in India

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Abstract: India being located in the low latitude region of the globe is extremely vulnerable to climate change due to its tropical climate, monsoon-based rainfall, long coast line, high dependence on agriculture and preponderance of small holders. Manifestations of climate change in India are steady increase in temperature, rise in rainfall variability, water stress, inundation of coastal areas, and increase in frequency and intensity of weather extremes such as drought, flood, cyclone and storm surge. This has enhanced agricultural risk and endangers rural livelihood and food security. Insurance is an ex-ante adaptation measure and a risk transfer mechanism. In the context of climate change, the vulnerable rural community needs more of insurance at lower premium, whereas the insurance company has a tendency to increase premium and limit insurance for its financial viability. This paper analyses the efficacy of major crop insurance schemes implemented in India in addressing the enhanced agricultural risk. The paper concludes that crop insurance product needs to be designed in such a manner that it not only acts as a risk transfer tool but also a potent device to reduce risk and crop loss by inducing desirable proactive and reactive responses in insurance users.

Keywords: Climate change, Agricultural risk, Crop insurance, India

INTRODUCTION

Climate change is an environmental challenge that is threatening rural livelihood and food security mostly in developing agrarian economies. It is unequivocally accepted that climate is changing and the globe is warming up due to emission of greenhouse gases (GHGs) which have been rising since the industrial revolution as a result of primarily human activities. During the 20th century, earth's mean global temperature increased by almost 0.74 °C and is expected to increase by a further 1.1°C to 6.4°C by the

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end of the 21st century (IPCC 2007). Mean global sea levels are also expected to rise, although the exact extent is still a topic of heated debate, with estimates ranging from 18 cm to 140 cm increase by the year 2100 (IPCC 2007). An increase in global precipitation is projected, but this increase will very likely spread unevenly across different regions. Many subtropical areas are expected to become drier.

The impacts of climate change are already visible all over the world. The globe is becoming warmer, rainfall is more erratic, the sea level is slowly rising and extreme weather events are becoming more frequent and intense. Prolonged periods of drought, floods and shifting climatic zones are jeopardising development efforts in developing economies (GIZ, India, 2011). The poor and marginalised are often most affected by climate variability and change. It is virtually certain that these trends will continue in the future. The Stern Report (2007) points out that the earliest and most damaging impacts of climate change are likely to be caused by the expected increase in severity of extreme weather events such as drought, flood cyclone and storm surge. These disaster risks can be reduced through systematic efforts to analyse and manage the causal factors of disasters, reducing exposure to hazards, lessening vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. Disaster risk reduction measures are, therefore, thoroughly appropriate to help counteract the added risk arising from climate change.

Risks that cannot be prevented or reduced in a cost efficient manner can either be retained by risk holders or transferred to third parties through financial instruments such as insurance (Warner *et al.*, 2013). Therefore, along with risk reduction measures, the Hyogo Framework calls for financial risk sharing mechanisms, which include a variety of instruments such as catastrophe bonds, weather or index-based derivatives, micro-insurance and traditional disaster insurance. Risk transfer tools including insurance do not reduce risk as such; they lessen the economic impacts caused by hazards by providing financial support.

India is a large emerging economy with a great variety of geographical regions, biodiversity and natural resources. However, the country's growth path is not smooth as it is most vulnerable to climate change risks due to its tropical climate, monsoon-based rainfall, long coastline, high dependence on agriculture and preponderance of marginal and small farmers. More than half of India's population lives in rural areas and depends on climate-sensitive sectors like agriculture, fisheries and forestry for their livelihoods. With India's large size, its numerous agro ecological zones, prevalence of small, fragmented holdings and dependence on the vagaries of monsoon,

the issue of climate change becomes even more challenging. Consistent warming trends and more frequent and intense extreme weather events are being observed across India during the last two decades. Several areas have been identified as risk prone due to impact of climate change like coastal areas, Indo-Gangetic plains and the drought and flood prone regions of the country.

Government of India has taken several steps to address climate change and reduce the vulnerability of rural populations to adverse impacts of climate change through implementation of National Missions and preparation of National and State Action Plans on Climate Change (SAPCC). The use of micro-insurance to cover losses caused by severe natural hazard events is drawing the attention of the Government. The Government has implemented various crop insurance schemes at different points of time to provide economic support to the farmers and stabilise farm income in the event of crop failure due to non-preventable risks such as natural calamities, infestation of plant diseases and pest attack.

In the context of climate change, the primary concern is to reduce risk, whereas crop insurance is a risk transfer mechanism. However, in recent years emphasis is placed on designing insurance products in such a manner that it encourages risk reduction activities by providing proper incentives. Nonetheless, insurance analysts acknowledge that development of crop insurance schemes for the poor face a number of challenges including a lack of reliable information for pricing risk, affordability, accessibility, low levels of awareness, and sustainability of the schemes themselves. These fundamental obstacles to expanding micro-insurance must be addressed if it is to become a useful disaster reduction tool in poor and vulnerable communities. Crop insurance can act as an important tool of a comprehensive climate risk management strategy including risk reduction, disaster preparedness, and risk transfer.

In the above backdrop, the primary objective of this paper is to critically examine the insurance schemes implemented in India and highlight the innovations required to redesign these schemes to address the enhanced agricultural risk in the changing climate. The rest of the paper is organised as follows. Section 2 analyses the climate change manifestations in India and its impact on agriculture. Section 3 examines the implications of climate change for insurance industry and how it threatens its viability and sustainability. Section 4 examines the strategies adopted by insurance companies to manage climate change risks. Section 5 outlines the initiatives taken in different international platforms to combat adverse impacts of climate change on agriculture. Section 6 examines the suitability of crop insurance schemes implemented in India in addressing climate change risks.

Section 7 indicates how insurance can act as a risk reduction mechanism along with its primary role of risk transfer instrument. Section 8 is the concluding section highlighting some policy implications of the study.

IMPACT OF CLIMATE CHANGE ON INDIAN AGRICULTURE

India is primarily an agrarian economy with more than half of its population depending on agriculture for their livelihood. Agriculture accounts for 18.8 per cent of Gross Value Added (GoI, 2021). India is a tropical country located in low latitude region. Agriculture is highly dependent on the monsoon rains. Agriculture is a highly risky venture with vagaries of monsoon, because nearly 60 per cent of gross cropped area is rain fed.

Vulnerability of India in the event of climate change is more pronounced due to its high dependence on agriculture, preponderance of marginal and small farmers, high incidence of poverty, and poor coping mechanisms. The warming trend in India over the past 100 years (1901-2000) is estimated to be 0.4^0C (GoI, 2015-16). The projected impact of further warming is likely to aggravate yield fluctuations of many crops. While in the short run the impact might not be severe, many crops may witness yield decline after 2020 when the temperature threshold limit of many crops might get breached. A one-degree Celsius rise in mean temperature is likely to affect wheat yield in the heartland of green revolution. There is already evidence of negative impacts on yield of wheat and paddy in parts of India due to increased temperatures, increasing water stress and reduction in the number of rainy days.

Irrigation requirements in arid and semiarid regions are estimated to increase by 10 per cent for every 1 degree Celsius rise in temperature. Rise in sea level is also likely to have adverse effects on the livelihoods of fishermen and coastal communities. Climate change is likely to significantly alter the dynamics of extreme events such as tropical cyclones, associated storm surges and extreme rainfall events; possibly increasing their frequency and intensity.

The trends of rise in temperature, heat waves, droughts and floods, and sea level shown by the Indian scientists are in line with the views of Inter-Governmental Panel on Climate Change (IPCC) though magnitude of changes could differ. The mean temperature in India is projected to increase up to 1.7ºC in Kharif (July to October) and up to 3.2ºC during Rabi (November to March) season, while the mean rainfall is expected to increase by 10 per cent by 2070. Agricultural scientists predict that Kharif crops will be impacted more by rainfall variability while Rabi crops by increase in mean temperature. Wheat is likely to be negatively impacted in Rabi due to terminal heat stress.

Agriculture is an important source of Green House Gas (GHG) emissions and estimates suggest that about 18 per cent of the annual GHG emissions in India during 2007 were from the agricultural sector (INCCA, 2010). The major sources of these emissions in the agricultural sector are enteric fermentation (63.4 per cent), rice cultivation (20.9 per cent), agricultural soils (13.0 per cent), manure management (2.4 per cent) and on-field burning of crop residues (2.0 per cent). Thus, quantification and reduction of GHGs from agriculture is fundamental for identifying adaptation solutions that are consistent with the goals of achieving greater resilience in production systems and food security and in supporting farmers in adopting less carbon-intensive farming practices. Organic farming preserves soil quality and diversity in crop production, and avoids hazards to the environment on a long-term basis. Besides production from crops and livestock, fresh water and marine ecosystem is also likely to be affected due to warming of sea surface temperatures. Such climatic fluctuations could adversely affect agricultural sustainability resulting in unforeseen situational shortages which could also impact other economic sectors. Poor rural households, whose livelihoods depend predominantly on agriculture and natural resources, will bear a disproportionate burden of adverse impacts of climate change (Kates, 2000; Mendelsohn *et al.*, 2007).

Many scientists and economists have estimated the impact of climate change on Indian agriculture. 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 2^0C temperature increase and a 7 per cent 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 2^0C with an 8 per cent increase in precipitation, agricultural net revenue may fall by 12 per cent in India. By using ORYZA1 and INFOCROP rice model, Krishnan *et al.* (2007) predict that for every 1.8^0C increase in temperature average yield decline will be 6.7 per cent to 7.2 per cent respectively, at the current level of CO^2 (380 ppm) emission. These negative impacts will have serious consequences for food security in India (Fisher *et al.*, 2001). IPCC also predicts that in tropical countries like India mainly Kharif rice, sugarcane and wheat yield could decrease due to decline in water availability and rise in temperature. Rao *et al.* (2011) find that Kharif (autumn) crops will be impacted more by rainfall variability while Rabi (spring) crops by rise in minimum temperature.

In India, significant negative impacts have been implied with medium-term (2010-2039) climate change, predicted to reduce yields by 4.5-9.0 per

cent, depending on the magnitude and distribution of warming. Since agriculture makes up roughly 16 per cent of India's GDP, a 4.5-9.0 per cent negative impact on production implies a cost of climate change to be roughly up to 1.5 per cent of GDP per year (Venkateswarlu *et al*., 2013).

Economic Survey of India (GoI, 2018) using district-level data on temperature, rainfall and crop production documents a long-term trend of rising temperatures, declining average precipitation, and increase in extreme precipitation events in India. The study reveals that when temperatures are much higher, rainfall is observed to be significantly lower and the number of "dry days" greater than normal. These impacts are significantly more adverse in unirrigated areas producing rain fed crops compared to irrigated areas growing cereals. The study predicts that climate change could reduce annual agricultural incomes in the range of 15 per cent to 18 per cent on an average, and up to 20 per cent to 25 per cent for unirrigated areas. The fall in farm income may cause agrarian distress and farmers' unrest.

To combat negative impacts of climate change on agriculture a number of programmes, namely, National Mission for Sustainable Agriculture (NMSA), Pradhan Mantri Krishi Sinchayee Yojana (PKVY), Paramparagat Krishi Vikas Yojana (PMKSY), National Initiative for Climate Resilient Agriculture (NICRA), National Food Security Mission, Soil Health Card Scheme (SHC), Mission for Development of Integrated Horticulture (MIDH), Pradhan Mantri Fasal Bima Yojana etc., have been factored in the climate resilient initiatives of the Government (GoI, 2015-16). 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 risks.

THREATS TO INSURANCE INDUSTRY

In the context of climate change and increase in agricultural risks, crop insurance plays a very important role in providing economic support to farmers in the event of crop failure due to occurrence of climate induced natural disasters. Climate change increases agricultural risks 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. The fundamental principle of insurance is to collect premium from many and make payment to a few suffering from the occurrence of the insured event. Also, premium

collected from many in normal years are paid to a few losers in bad years (Dandekar, 1976). In the case of correlated risks such as drought, flood and cyclone, risks cannot be pooled because of simultaneously affecting many at a time and thus pose potential threats to insurance industry.

Many are of the view that climate change with the increase in frequency and intensity of climate induced natural disasters may erode the insurability of many catastrophic risks. The United Nations Environment Programme´s Finance Initiative (UNEPFI) reports that by 2025, insurers may withdraw from some markets as the risks become too high for the pool of premium available. Mills (2012) perceives climate change as a stress test for insurance, the world's largest industry with U.S. $4.6 trillion in revenues. While climate change undermines the viability of the insurance industry, it also offers enormous opportunities to innovate new insurance products to minimise 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 climatic risks, the insurance company may respond by increasing premium, insisting greater deductibles, refusing to insure unless the insured 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 & 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.

The major objective of the insurance company is to reduce risk to the insurance company, i.e. the variability in its income from insurance business. While the insurers tend to retreat from insurance business in the face of climate change, insurance users 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).

ADAPTATION STRATEGY OF INSURANCE INDUSTRY

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.

With increase in the incidence 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 mediated 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.

Nearly 40 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; Warner *et al.*, 2012, 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.

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 subsidisation 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 landholders, 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 buy insurance, which they need most to stabilise their income in the event of crop loss.

INTERNATIONAL INITIATIVES TO STRENGTHEN INSURANCE

Many economists are of the view that without donor support, insurance is hardly affordable in highly exposed developing countries, which helps to explain why only 1 per cent of households and businesses in low-income countries, and only 3 per cent in middle-income countries, have catastrophe coverage, compared with 30 per cent in high-income countries (Bayer & Mechler, 2006). Climate change is a global phenomenon and a negative externality. The history of high carbon growth and high emissions of developed industrialised countries has been major contributor to global warming. On the other hand, agriculture dependent developing countries are most vulnerable to climate change and having insufficient financial resources and modern technology, they have a low capacity to cope with the adverse effects. 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, 2007) 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.

To address expected losses due to climate change, the UNFCCC Parties have identified both disaster risk reduction strategies and risk transfer mechanisms including insurance as potential elements in a new climate agreement. The Bali Action Plan, which was agreed by Parties to the UNFCCC in Bali, Indonesia in December 2007 as the basis for developing a new international agreement on climate change, states that adaptation requires consideration of "risk management and risk reduction strategies, including risk sharing and transfer mechanisms such as insurance", as well as "disaster reduction". Thus, the Bali action plan strengthens the mandate to consider insurance instruments, as set out by Article 4.8 of the 1993 UNFCCC and Article 3.14 of the 1997 Kyoto Protocol.

The Alliance of Small Island States (AOSIS, 2008), the Munich Climate Insurance Initiative (MCII, 2008) have submitted two separate but similar proposals for disaster prevention and insurance. Each proposal suggests that international adaptation finance would support comprehensive risk reduction of climate change impacts with a specific focus on the most vulnerable countries. Both AOSIS and MCII suggest two promising ways to link international support for insurance with disaster risk reduction activities: First, support can depend on the "smart" design of insurance that builds in incentives for reducing disaster risks and minimises maladaptive behaviour or moral hazard. Second, risk reduction activities like land-use restrictions, early warning, building codes and other collective risk reduction measures could be prerequisites for participating in internationally-supported climate risk insurance programmes.

CROP INSURANCE SCHEMES IN INDIA

Over the past three decades, the Government of India has launched several comprehensive and nation-wide crop insurance schemes at different points of time modifying them as and when required to address operational issues. The features of the major schemes are discussed below.

National Agricultural Insurance Scheme (NAIS)

NAIS was introduced in India from the Rabi season of 1999-2000. This is an area-based crop yield insurance scheme widely adopted across India, which covered 30.85 million farmers and a cultivated area of 33.8 million hectares during 2015-16. The objectives of NAIS are to provide financial support to the farmers and stabilise farm income in the event of crop loss as a result of natural calamities, pest attack and plant diseases. Insurance may also encourage farmers to adopt modern method of production and apply high value inputs such as HYV seeds and chemical fertilisers.

All farmers including sharecroppers and tenant farmers growing the notified crops in the notified areas are eligible for coverage. The scheme covers all food crops (cereals, millets and pulses), cotton, sugarcane, potato and other annual commercial/horticultural crops. This scheme compulsorily covers all loanee farmers and also allows non-loanee farmers growing insurable crops to opt for the scheme. The scheme provides comprehensive risk insurance against yield losses due to non-preventable risks such as natural fire, lightening, storm, hailstorm, cyclone, typhoon, tempest, hurricane, tornado, flood, inundation and landslide, drought, dry spells, pests, diseases, etc. If the actual average yield per hectare of the insured crop for the defined area (on the basis of requisite number of Crop Cutting Experiments) in the insured season, falls short of specified threshold yield, all the insured farmers growing that crop in the defined area are deemed to have suffered shortfall in their yield and the scheme provides coverage against such contingency. Indemnity claims are worked out as per the following formula:

$$\frac{\text{Shortfall in yield}}{\text{Threshold Yield}} \times \text{Sum Insured for the farmer}$$

(Shortfall = Threshold Yield – Actual Yield for the Defined Area).

Threshold yield is the moving average based on past three year's average yield in case of rice and wheat and five years average yield in case of other crops. For Kharif crops the farmer premium rate is 3.5 per cent for all oilseed crops and bajra and 2.5 per cent for all other food crops. For Rabi crops the farmer premium rate is 1.5 per cent for wheat and 2 per cent for all other food crops. Premium rates paid by farmers in respect of commercial and horticultural crops are determined at the state level for each crop.

Recognising the need for an exclusive organisation for agricultural insurance, the Government of India established Agriculture Insurance Company of India Limited (AICI) in December 2002. AICI took over the implementation of NAIS from GIC (General Insurance Corporation) in 2003-

04. AICI covers the claim up to the premium, then the state and central governments contribute equally to cover the remainder.

Several empirical studies reveal that NAIS has failed to achieve its objectives due to its low coverage, poor financial performance and less effectiveness (Sinha, 2004; Kalavakonda & Mahul, 2005; Vyas & Singh, 2006; Raju and Chand, 2008; Swain, 2015). This scheme has not performed well because collection of yield data based on crop-cutting experiments is a time consuming activity, which results in delay in the payment of compensation. The awareness about the scheme is poor due to the lack of effective awareness campaigns about the features and benefits of the scheme (Raju & Chand, 2008).

Weather Based Crop Insurance Scheme (WBCIS)

Of all the risk factors in agriculture, weather is the most important (Miranda & Vedenov, 2001). The Weather Based Crop Insurance Scheme (WBCIS) was introduced in India in Kharif 2007 season on a pilot basis. WBCIS is a weather index-based insurance product designed to offer insurance protection against losses to crop resulting from adverse weather conditions. Nearly 40 crops are insured under the category for various climatic risks such as deficit rainfall, dry-spells, excess rainfall, low temperature, high temperature, high humidity, and high wind. The major objective of introducing the scheme was to speed up claim payment, as data on weather parameter can be easily obtained from meteorological stations and the weather index is more objective, transparent and verifiable in comparison to yield data. WBCIS also operates on the concept of area approach. During 2015-16, the scheme was executed in 19 states covering 9.03 million farmers and a cultivated area of 9.43 million hectares.

The WBCIS was received with good response due to the fact that claims calculation does not depend on yield results but on a weather index, mostly rainfall, whose estimation is objective, verifiable and transparent (Gine *et al.*, 2008). Therefore, the administrative and claims assessment costs are lower in comparison to NAIS and claims are released quickly i.e. within 45 days of obtaining the weather data. But WBCIS covers only weather related risk and the compensation is paid on the basis of deficit or excess in weather parameter which is considered as a correlate or proxy of crop loss. The most challenging disadvantage of WBCIS, however, is the basis risk, which refers to the variability between the value of losses as measured by the weather index and the value of actual losses experienced on the farm, (Collier *et al.*, 2009, Greatrex *et al.*, 2015). Thus, the basis risk can result in a mismatch between the actual loss and payout. Furthermore, 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.

Modified National Agricultural Insurance Scheme (MNAIS)

The Government formulated a new scheme, modified NAIS (MNAIS) to correct the loopholes in the existing NAIS. It was implemented on a pilot basis in 50 districts from the Rabi season of 2010–11. Like NAIS, MNAIS is compulsory for loanee farmers and voluntary for non-loanee farmers. The main objective of the scheme is to provide insurance coverage to the farmers in the event of failure of the any of the notified crop as a result of natural calamities, pests, diseases or errant weather conditions. Modifications from NAIS to MNAIS included: changing the governments financial liability into up-front subsidy on premiums, reducing the insurance unit size to village level to lower basis risk, elimination of calamity years in calculating threshold yield, coverage for prevented sowing and post-harvest risks, and provision of higher level of indemnity.The novel features of MNAIS are provision for mid-season on-account payment of compensation on the basis of expected crop loss and allowing private sector participation. In case of adverse seasonal conditions during crop season, claim amount up to 25 per cent of likely claims would be released in advance subject to adjustment against the claims assessed on yield basis. During 2015-16, MNAIS covered 8.61 million farmers and cultivated area of 9.04 million hectare.

Pradhan Mantri Fasal Bima Yojana (PMFBY)

Government of India approved the Pradhan Mantri Fasal Bima Yojana (PMFBY) to replace NAIS and MNAIS from Kharif 2016. PMFBY was launched by Prime Minister Narendra Modi on February 13, 2016. PMFBY provides comprehensive insurance coverage against crop loss on account of non-preventable natural risks, thus helping in stabilising the income of the farmers and encourage them for adoption of innovative practices. The risk coverage of crop cycle has increased which include not only crop loss during plant growth stage but also prevented-sowing and post-harvest losses. Inundation has been incorporated as a localised calamity in addition to hailstorm and landslide for individual farm level assessment. An area approach has been adopted for settlement of claims for widespread damage.

For more effective implementation, a cluster approach is adopted under which a group of districts with variable risk profile is allotted to an insurance company through bidding for a longer duration up to 3 years. Notified Insurance unit has been reduced to village/village panchayat for major crops. Uniform maximum premium of only 2 per cent, 1.5 per cent and 5 per cent is to be paid by farmers for all Kharif crops, Rabi Crops and

Commercial/ horticultural crops respectively. There is provision of individual farm level assessment for post-harvest losses against the cyclonic and unseasonal rains for the crops kept in the field for drying up to a period of 14 days.

The scale of finance in each district for each crop forms the basis for calculation of sum assured. This roughly corresponds to costs incurred in cultivation of crops and gives farmers adequate financial protection without any capping as followed in earlier schemes. The sum assured has doubled in the case of PMFBY in comparison to earlier schemes.

PMFBY is an actuarial model based scheme where token premium is charged from the client farmers, and government pays the balance premium quoted by insurance companies selected by states through transparent bidding. However, the full liability of payment of claims lies with the insurance companies.

The claim amount is credited electronically to the individual farmer's bank account. Remote sensing technology, smart phones and drones are used for quick estimation of crop losses to ensure early settlement of claims. A Crop Insurance Portal has been launched. This is used extensively for ensuring better administration, co-ordination, transparency and dissemination of information. Focused attention and adequate publicity are given on increasing awareness about the schemes among all stakeholders and appropriate provisioning of resources for the same.

There has been a quantum jump in voluntary enrolments of farmers in the scheme. Government is keen to improve the implementation of scheme by focusing on timely settlement of claims. There are penal provisions on agencies which cause delays in release of claims to farmers. During 2016-17 PMFBY covered 55.07 million farmers and 55.1 million hectare of cultivate area.

Thus, a number of crop insurance schemes have been introduced in the last three decades, and modified as and when required to improve scheme performance. Payment of crop insurance claims was delayed in many cases because of anomalies in data relating to insured area and estimated yield of insured crops. Committees and groups were also set up periodically to address various issues. Low participation of farmers in crop insurance schemes is a major worry for the Government. During 2019-20, NAIS, MNAIS and WBCIS taken together covered 49.6 million ha of cropped area, which accounted for 24.8 per cent of total gross sown area (GoI, 2020). Also, more than ninety per cent of insured farmers were loanee farmers compulsorily covered under crop insurance schemes. Voluntary adoption of crop insurance as a risk management tool is awfully low. Causes of low penetration include the lack of insurance literacy and the complexity of

insurance products on the one hand, and low willingness and ability to pay by the customers on the other (Warner *et al.*, 2013)

However, in all the crop insurance schemes so far launched in India, the role of insurance has been emphasised only as a risk transfer mechanism. In PMFBY, there has been provision to encourage risk reduction measures by lowering premium for group of farmers undertaking soil and water conservation activities and adopting environment friendly technology. However, this has not been operationalised while implementing the schemes. The following section deals with how insurance can be used as a risk reducing device along with transferring risk to the insurer.

ROLE OF INSURANCE IN RISK REDUCTION

Evidence is emerging that if properly designed, insurance can also be useful in reducing risk and managing the disaster risks posed by climate change. However, current micro insurance programmes implemented in India do not have direct links and incentives to reduce disaster losses.

Some encouraging experiences in developed countries show that collaboration between the insurance industry and the public sector can promote risk reduction (Warner *et al.*, 2012) as follows:

- *Awareness raising and risk education:* Insurers and government can partner to make available risk data and information systems.
- *Risk pricing:* By accurately pricing risk, insurers can incentivise risk reducing decision making.
- *Enabling conditions and regulation of insurance programmes:* Through legislation, financial oversight and monitoring, government can provide incentives for insurance to promote risk-reducing activities.
- *Direct financing of risk reduction measures*: Insurers can invest directly in risk reduction measures to avoid large compensation claims.
- *Risk reduction as a prerequisite for insurance:* As a prerequisite for coverage, insurers can require that policy holders undertake specific disaster risk reduction measures.

Insurers and public authorities can work together in increasing public awareness by collecting and providing accurate information about hazard risks and helping to translate this awareness into real action. By sharing risk information with policymakers, the insurance industry can contribute to the establishment of appropriate regulatory frameworks for risk management, for example through lobbying for building codes and for planning that account for relevant risks including climate change impacts.

Risk should be properly priced through appropriate premium-setting. Where premiums do not reflect the risk, this can provide a disincentive for

risk reduction. It is evident that cropping behaviour, which is incentivised by insurance pricing, can potentially increase gross revenues for farmers during La Niña years (by a factor of up to seven) and substantially reduce losses during El Niño years (Warner *et al.*, 2012). Creative design of an insurance programme, in this case integrating seasonal rainfall forecasts into the premium pricing, can greatly increase the coping capacity of farmers to increased climate-related drought risk – and thus further adaptation.

Nevertheless, insurance has its own limitations: it does not prevent the loss of lives, crops or assets. It is not always the most appropriate option to manage risks, in terms of cost-effectiveness or affordability. With climate change, insurance tools will be challenged to cover increasingly frequent and intense events. Furthermore, traditional insurance may not be the appropriate tool for longer term foreseeable risks like sea-level rise and desertification. In such cases, other measures including basic investments in risk reduction make more sense. Insurance on its own is not the solution. Insurance could fail to reduce risk and to advance adaptation unless it is implemented along with disaster risk reduction measures. The Caribbean Island States recently formed the world's first multi-country catastrophe insurance pool, reinsured in the capital markets, to provide governments with immediate liquidity in the aftermath of hurricanes or earthquakes. The World Bank and other institutions are exploring the possibility of extending the benefits of similar pooled risk transfer solutions to other regions, such as Asia and South-eastern Europe.

POLICY IMPLICATIONS

From the discussion in the foregoing sections, it is evident that the insurance industry faces numerous challenges in the context of climate change with increase in frequency and intensity of extreme weather events such as drought, flood cyclone and storm surge. In the climate change scenario, the following suggestions are made to redesign the crop insurance schemes to increase their operational efficiency and effectiveness not as a mere risk transfer device but more importantly a risk reduction strategy.

Integration of PMFBY and WBCIS

PMFBY is the major insurance scheme which is currently implemented across India. This is an area based crop yield insurance scheme. The most important shortcoming of PMFBY as revealed by many empirical studies is delay in payment of indemnity due to a long time required to collect yield data based on crop cutting experiments. In the context of climate change, to expedite the release of pay-out, WBCIS is being promoted to replace PMFBY in due course of time. Weather data are objective, verifiable

and transparent. It is easy to collect weather data from meteorological stations. Nevertheless, major disadvantage of WBCIS is the basis risk i.e. the mismatch between actual loss and payout. In case of WBCIS, the basis risk is high if there are factors other than weather index that affect crop yield, faulty design of the product in defining the trigger event and inaccurate measurement of local weather parameter due to distant location of the weather measuring device. Therefore, both the schemes have advantages and disadvantages. Instead of having two schemes, a hybrid product combining good features of both the schemes need to be offered. To remove the basis risk, the indemnity may be calculated on the basis of actual crop loss data. However, to save delay in payment based on yield data after harvest, an interim payout may be made on the basis of indemnity calculated by using relevant weather data in the middle of the season, and the remaining indemnity amount may be released on the basis of actual crop loss data after harvest.

Public-private Partnership

In India, public-private partnership approaches, also with international support, are important, where pure market-mediated solutions are often not feasible due to high start-up costs, unavailability of data and limited access or low demand for standard insurance products from the small holders (Warner *et al.*, 2013). Thus, a joint effort from the public and private sector with support from international development partners, or through international climate financing sources such as the Green Climate Fund, is needed to approach climate-risk management more effectively. The private insurance industry can play an important role in product design, marketing, underwriting, distribution and claims management. Government is required to provide financial support to climate-related insurance in different forms such as direct premium subsidies, guarantee, and financial support for reinsurance facilities or meeting operational costs (Marcel *et al.*, 2002).

There may be layering of risk to define the role of public and private insurance industry. The Government or international donors may finance low-probability, high-consequence, catastrophic events. This can ''crowd in'' private-sector weather insurance markets for risk layers that reflect more frequent but less severe weather events (Collier *et al.*, 2009). Government or donor provision of catastrophic coverage will help in reducing the cost of complementary private insurance products. General premium subsidies may be avoided, as this may encourage risk-taking behaviour that lowers productivity. Subsidies may be targeted for marginal and small farmers having low ability to pay.

Insurance for Risk Adaptation and Mitigation

In the context of climate change, insurance industry can help both in mitigation and adaptation to climatic risks by inducing proper proactive and reactive responses in insurance users. The mitigation measures include incentivising use of clean technology, climate friendly cropping pattern, promoting organic farming and less energy intensive agriculture. Insurance can induce proactive adaptation responses such as 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.

Thus, insurance being appropriately embedded among risk reduction measures and with the right incentives has important potential to reduce disaster risk and advance adaptation. Insurance programmes need to be designed in such a manner that promote risk reduction. These include careful planning and close coordination in the implementation of insurance with disaster risk reduction measures, raising community risk awareness, investing in the gathering and dissemination of risk information, government regulation to ensure a longer term focus on risk reduction from insurers, and government regulation to ensure insurer solvency, licensing and insurance distribution. Premiums for every insurance programme should be "risk adequate"—meaning that the premiums are sufficient to cover expected losses. Risk-adequate pricing is a fundamental building block for sustainable insurance.

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 methods 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. 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.

Supplementary Role of Insurance

Insurance is primarily a risk transfer mechanism. It does not prevent or reduce risk. Also, insurance has its own limitations as an instrument of providing safety net to farmers in the event of crop failure. Insurance may fail for a variety of reasons: as a result of an ineffective legal system to enforce insurance contracts, strong and simultaneous exposure by a large segment of population to risk, incomplete risk information and high transaction costs. A primary misunderstanding is that insurance is a "silver bullet" for risk management and adaptation. In fact insurance will fail to reduce risk and to advance adaptation unless it is implemented along with disaster risk reduction measures. Agricultural insurance supplements, but does not replace, farmers' risk management strategies. It is crucial that *ex ante* strategies to reduce the negative impacts of climate change be developed and implemented. Insurance should be adopted as a complementary tool to risk prevention and reduction measures for managing risks which cannot be prevented or reduced efficiently (Warner *et al.*, 2013). Insurance solutions can only support effective adaptation where they are implemented among measures to reduce disaster risk and increase societal resilience. If not embedded in a comprehensive risk reduction strategy, insurance may actually encourage risk taking behaviour, potentially leading to greater fatalities and damage (Warner *et al.*, 2012). In developing countries like India, the penetration of insurance is low due to the lack of insurance literacy, the complexity of insurance products and farmers' low willingness and ability to pay the premium. Therefore, steps need be taken to educate farmers about financial products, create awareness about insurance scheme and explain the scheme details to increase its adoption.

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