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The Economics of Crop Insurance: A Review of the Empirical Literature

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Abstract

Farmers in India face risk and uncertainty on a regular basis due to susceptibility of agriculture to various risks arising from weather variability, fluctuation in the input and output prices, difficulties in storage, pest attack and plant diseases etc. Traditional measures of risk mitigation such as self- insurance, borrowings, crop diversification cannot work effectively in catering to catastrophic shocks. One important policy intervention to reduce production and market risks is to provide crop insurance in the event of adverse situation. Crop insurance is a potential market-based intervention that helps farmers to cope with systematic shocks and stabilise their income. But providing insurance against a crop failure is not as easy as that of against accidents, fire etc. The covariate nature of agricultural risk goes against the working of insurance market and makes government funding imperative for crop insurance to be available for farmers. Apart from this, there is a substantial amount of asymmetric information that restricts private participation in crop insurance business. Research on working and dynamics of crop insurance is fairly recent. The present paper reviews and discusses the recent developments in the literature on crop insurance. The paper reports the empirical study on the impact of crop insurance on output, input use and willingness to pay for insurance.

Key Words*: Agricultural risk, Asymmetric information, Crop insurance, Compensation*

1. INTRODUCTION

Farmers in India face risk and uncertainty on a regular basis due to susceptibility of agriculture to various risks arising from weather variability, fluctuation in the input and output prices, difficulties in storage, pest attack and plant diseases etc. Variations in weather indicators (rainfall, humidity, temperature etc.) affect the crop yield adversely. Again Crop yield is affected by weather induced natural disasters like droughts, flood, hurricane cyclone

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and hailstorm. There is also substantial market risk in agriculture due to wide variations in input and output prices. Crop prices are more volatile because of difficulties in storage owing to perishability of the products. Apart from weather risks unforeseen contingencies like infestation of plant disease and pest attack very often causes huge crop loss.

Traditional measures of risk mitigation such as self- insurance, borrowings, crop diversification cannot work effectively in catering to catastrophic shocks. As for a farmer's production risk, there are few market provided mechanisms in operations in India. Ideally a crop insurance market could provide farmers the opportunity for hedging against the risk of such production losses. Crop insurance is a potential market-based intervention that helps farmers to cope with systematic shocks and stabilise their income. It is a risk transfer mechanism that transfers the production risk from the insured to the insurer and reinsurer.

The present paper reviews and discusses the recent developments in the literature on crop insurance. The paper reports the empirical study on the impact of crop insurance on agricultural output, input use and willingness to pay for insurance.

The paper is organized in four sections. The second section discusses the theoretical perspectives of economics of crop insurance. The review of empirical study on impact of crop insurance on agricultural output, input use and willingness to pay for insurance are presented in the third section. The last section provides a concluding comment of the paper based on the inferences from literature.

2. ECONOMICS OF CROP INSURANCE: THE THEORETICAL PERSPECTIVES

The insurance business thrives on the fact that while many people run risks and buy insurance policies, in reality only a handful of them actually suffer the loss and therefore need to be compensated. As for demand for insurance is concerned, there is a theorem, which states if fair insurance is available, a risk-averse person would insure fully, i.e. the person would go for full coverage of his risk (Hands 2004: pp.162-163). A fair insurance is insurance at a premium which leaves the insurance provider with zero expected profit.

In real life, completely fair insurance is unlikely to be available. After all, an insuring firm is required to cover its administrative expenditures to remain in business. Yet, if insurance is available at not too 'unfair' price, most people would buy full or partial insurance cover. Only those whose risk aversion is very close to zero, i.e., those who are very nearly risk neutral may opt out of the insurance market.

Insurance is not provided for all kinds of risks to which people are exposed. For supply of insurance to be available the following two conditions need to be met.

a) Risk pooling

b) Risk sharing

Supply of insurance is available only if risk pooling is possible. For risk pooling to be successful risks must be repeated to which many agents are exposed. In addition risk must be independent, i.e. those who have pooled their risk should not fall into the adverse state of

nature at the same time. Otherwise risk pooling will fail and so insurance will not be available.

Theoretically supply of insurance against crop failure is not easy to be available. From the insurance perspective, most of the agricultural risks are covariate in nature which cannot be pooled and market is unlikely to naturally ensure supply of crop insurance. The insurance markets work perfectly if the underlying risks are independently distributed, risk position of the insured is known, and the insured has no control over the event or the claim. In crop insurance, seldom these conditions are met and result in market failure (Ahsan et al. 1982). Private insurers have not been able to cope with systemic, non-diversifiable risks in assessing crop yields stemming from say, natural disasters, affecting a large number of farms. Hence, state intervention becomes an imperative for a crop insurance to be available to farmers.

Apart from that, there are two problems associated with insurance market because of asymmetric information and therefore, the insurance business is often exposed to market failure. These two problems are moral hazard and adverse selection, which prevent insurance providers from offering fair insurance. Moral hazard occurs when the individuals has an incentive to engage in more risky behaviour because he or she is insured. Formally, moral hazard occurs when the probability of a bad state of nature is a function of the level of care or safety taken by the individual (Hands 2004: p.164). Adverse selection occurs when the individual has more information about the probability of a loss than the insurance provider does, which eventually, leads only high-risk people left in and no insurance policies for the low-risk people.

In the line of general insurance, agricultural insurance market also faces the problem of adverse selection and moral hazard. Higher premium rates discourage majority participation and only high risk individuals purchases the insurance, leading to adverse selection. An insured farmer hardly takes care in preventing the loss or takes more risk at the expense of the insurance provider because he or she would be indemnified if he/she faces uncertain events that results in damage. The asymmetric information and hidden action on the part of the insured party discourages private participation in the crop insurance market.

3. REVIEW OF EMPIRICAL LITERATURE

3.1 Impact of Crop Insurance on Agricultural Output

There are number of studies that have looked at the impact of crop insurance on agricultural output and acreage.Usually agricultural output relates to productivity or level of production per hectare. Using output as a measure to study the impact of crop insurance on agriculture is preferred because data on output is more reliable than that of inputs. Again input requirement differs across crops and region. Thus to study the effectiveness of crop insurance, output and acreage are taken as standard measure.

Quiggin et al. (1993) determine that insured farmers are likely to produce lower yield more frequently than uninsured farmers with similar observed characteristics using a sample of 355 cotton farmers in the US. Similarly, Sporri et al. (2012) show a negative impact of insurance on productivity in Hungary. On the assumption that insurance is endogenous to yield, the study used a two-stage least squares approach on farm level data.

ISSN PRINT 2319 1775 Online 2320 7876
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Roberts et al. (2006) also find moral hazard effects using a large increase in US Federal crop insurance subsidies as a natural experiment to examine how harvest changed in response to the policy-induced change in insurance coverage.

On the other hand, Walters et al. (2012) found positive acreage effects of insurance for wheat, corn and soybean farmers in the USA using a fixed effects model on farm level data from 1995- 2002.

Among other impacts, insurance subsidies are shown to cause modest increase in enterprise specialisation and production efficiency. O'Donoghue et al. (2009) show that an increase in insurance coverage causes an increase in specialisation using farm level data of eight crops in the USA. They find that producers specialised by cutting back activities with little or no direct connection to their operation's main focus.

Similarly, Vardhan and Kumar (2012) find that uninsured farmers are more likely to diversify when compared to insured farmers in India. They employ a Heckman selection model on rice farmers in India to show that insured farmers earn higher revenues due to specialisation.

Chang and Mishra (2012) also show a negative association between the decision to purchase crop insurance and work off-farm (i.e. diversify) using a two-stage quantile model on US farmers.

Though the Indian crop insurance programme is considered as one of the largest in the world, there is only a handful of studies on the impacts of crop insurance on agriculture in the country. Mishra (1994) traces the Comprehensive Crop Insurance Scheme (CCIS), which was a mandatory insurance scheme prevalent in the 1980s to find that loan linked insurance leads to an increase in the flow of credit to insured farmers. In other words, insurance encourages credit behaviour. This may not be the case for voluntary insurance policies.

While some studies have found positive association between the crop insurance and agricultural yield, others have reported a negative association. Higher acreage and better productivity is only possible in the presence of an efficient insurance product that responds to the actual needs of the community under study. Any impact analysis on output needs to assess both mandatory and voluntary policies, as the effects could be different.

3.2 Impact of Crop Insurance on Agricultural Inputs

Households whose consumption levels are close to subsistence and highly vulnerable to income shocks are likely to cultivate safer, traditional crops rather than riskier, high yielding variety crops. Such households also tend to make low investments in chemical inputs and prefer to use traditional inputs and production techniques.

The presence of ex-anterisk management mechanisms such as crop insurance may play a critical role in enabling farmers to accept and invest in riskier, better quality inputs in production leading to an increase in overall output. This is referred to as the risk reduction effect of crop insurance investments. A moral hazard effect could also emerge leading to lower investments across all inputs in anticipation of insurance claims.

The theoretical framework to ascertain the impact of insurance on input use was set by Ramaswami (1993). He proposes that since insurance reduces risk, risk averse decisions

could move towards risk neutral decisions encouraging farmers to use better quality and risk increasing inputs[1] in production (risk reduction effect). Alternatively, insurance could also lead to a moral hazard effect, which reduces the use of inputs and decreases mean output.

Horowitz and Lichtenberg (1993), examines a cross section of 376 corn farmers in the US to find that insured farmers use more nitrogen, pesticides and insecticides indicating a risk reduction effect. They use a two-step regression framework under the assumption that crop insurance is endogenous to input purchase decision making.

Karlan et al. (2012) uses a randomized field experiment on maize producers in north Ghana to show that insurance leads to larger agriculture investment and riskier production choices in the medium term.

Cole et al. (2012) also find that insurance induces farmers to switch to higher risk (and higher return) crops using 1063 farm households in Andhra Pradesh, India.

Funing et al. (2006) also find that a cotton farmer who applies more fertilizer is more likely to purchase crop insurance in China using a simultaneous equations approach indicating a risk reduction effect.

While some other studies conclude that insurance leads to a moral hazard effect on inputs. Quiggin et al. (1993) show that insured wheat farmers in the US have lower observed levels of variable inputs and lower total factor productivity when compared to uninsured farmers.

Goodwin et al. (2004) find that insurance participation is lower for farms that use greater chemicals and fertilizers.

Nimon and Mishra (2001) uses a simultaneous equations approach to conclude that that moral hazard effect of federally subsidized revenue insurance products induces U.S wheat farmers to increase expenditures on pesticides and reduce expenditures on fertilizers, though, the overall effect is ambiguous.

Thus, the literature is not conclusive on the effects of insurance on inputs. Studies show a positive or negative effect relative to crops and location of the study in question.

3.3 Willingness to Pay for Crop Insurance

The awareness that insurance policies are an effective ex-ante source of risk coping has grown in the past decade. However, the demand for voluntary crop insurance continues to remain low globally. Poor households are wary of market-based solutions where they are required to make an upfront premium that will not be reimbursed to them, if the 'risk' does not occur (Dercon et al., 2008). Insurance companies, on the other hand, are keen to exploit this market base, but struggle both on product design and marketing aspects.

Most of the existing literature on insurance demand tend to directly estimate demand by eliciting willingness to pay for a particular product at a specific predetermined price or use randomised control trials, where insurance is offered only to the treatment group.

[1] Risk increasing inputs refers to inputs which may reduce the occurrence of low yield but increase yield variability overall.

ISSN PRINT 2319 1775 Online 2320 7876
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Various economic theories have been put forward to summarise the uptake of low premium based insurance products. According to Ito and Kono (2009), the low take up of insurance can be understood using the prospect theory proposed by Kahneman and Tversky in 1979. Prospect theory presumes that people behave in a risk-averse way in evaluating gains but in a risk-loving way in evaluating losses. Since insurance covers losses, those who are risk-loving in evaluating losses are less likely to purchase the insurance.

Factors affecting demand for crop insurance include premium amounts and household wealth. Demand for rainfall insurance is shown to be highly dependent on price and sensitive to cash on hand (Cole et al., 2008) based on a study in India.

Insurance demand is shown to be increasing in household wealth (Cole et al., 2009). However, recent findings by Clark and Kalani (2011) provide evidence for a hump-shaped relationship between weather index insurance demand and wealth based on a study in rural Ethiopia. In other words, insurance demand is lower in the poorest and richest households and is highest in households with intermediate wealth. In this case the total livestock units are used as a proxy for wealth.

Households which assume that they are more vulnerable to risk opt not to use any financial services at all and are especially unlikely to use insurance on top of othe services (Bendig et al., 2009).

Similarly Gine et al. (2008) identify that households that face credit constraints are less likely to take up crop insurance. However, households that belong to social networks and/or have access to savings and borrowings are likely to have more knowledge of insurance products and are thus exhibit higher demand for such products (Clarke and Kalani, 2011).

McGuinness and Tounytsky (2006) identify that while clients have a high level of trust in their microfinance institution, they have no interest or faith in the insurance companies based on a study in Pakistan. Gine et al. (2008) show that demand for crop microinsurance is higher among households who were familiar with the insurance vendor in India.

Another factor that affects the willingness to participate in index based microinsurance programmes is basis risk. Basis risk is the difference between the rainfall on a farmer's field and rainfall recorded in a weather station situated *x* kilometres away from the field.

Gine et al. (2008) show that insurance take-up is decreasing in basis risk. The fact that very few farmers have access to weather information through radio, television or friends reduces their demand considerably (McCarthy, 2003).

Past insurance experiences (Link and Wirz, 2008) and risk aversion (Gine et al, 2008; Cole et al, 2009) are also important determinants of crop insurance demand.

Thus, factors affecting demand for crop insurance include premium amounts, past insurance experiences, access to financial institutions, risk aversion and household wealth. In most these studies, a sizeable portion of the sample agrees to purchase the product but the numbers fall short when the actual sale happens, which imply the underlying difference between willingness to join and willingness to pay.

ISSN PRINT 2319 1775 Online 2320 7876
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4. CONCLUSION

Crop insurance is one of the mechanisms to manage and mitigate production risk that results in yield loss by the farmers. It helps in stabilizing farm production and income of the farming community. But due to covariate nature of agricultural risks, insurance against a crop failure requires government funding. Crop insurance has both risk reduction effect and moral hazard effect. The findings of the literature are mixed, with some showing a positive risk reduction effectand other showing a moral hazard effect. While risk reduction effect enable farmers to accept and invest in riskier, better quality inputs in production leading to an increase in overall output, the moral hazard effect results in lower investments across all inputs in anticipation of insurance claims. On the willingness to pay, factors affecting demand for crop insurance include premium amounts, past insurance experiences, access to financial institutions, risk aversion and household wealth.

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