Systematic review

The effectiveness of index-based micro-insurance in helping smallholders manage weather-related risks

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Contents

List of abbreviations

3ie	International Initiative for Impact Evaluation
AICIL	Agriculture Insurance Company of India
BUA	Bore well User Association
CGAP	Consultative Group to Assist the Poor
CMO	Context–mechanisms–outcomes
CRRA	Constant relative risk aversion
DFID	UK Department for International Development
EPPI	Evidence for Policy and Practice Information (EPPI-Centre)
HYV	high-yielding variety
IAM	Insurance Association of Malawi
IBLI	Index Based Livestock Insurance (Kenya)
ILO	International Labour Organization
LSA	Livelihood Service Agents
MK	Malawian kwacha
NASFAM	National Smallholder Farmers Association of Malawi
NDVI	Normalised Differential Vegetation Index (Kenya)
NGO	non-governmental organisation
NISCO	Nyala Insurance Company (Ethiopia)
NREGA	National Rural Employment Guarantee (India)
Rs	Indian rupee
SEWA	Self Employed Women's Association (India)
Tsh	Tanzanian shilling
WBCIS	Weather Based Crop Insurance Scheme (India)
WTP	willingness to pay

Abstract

Background

The lack of access to formal risk management mechanisms for the majority of the world's smallholders means that households are forced to self-insure (i.e. draw down on savings or assets to meet consumption needs in the event of a catastrophe) against catastrophic events such as drought. Informal risk management methods, however, often diminish the productivity of agricultural activities, and provide only limited coverage.

Index-based micro-insurance overcomes many of the challenges faced by crop insurance programmes by delinking indemnification from individual production. Although subject to its own limitations, such as basis risk, index insurance may provide less-costly and more-transparent risk management than other alternative products, enabling farmers to make more-productive investments and better manage consumption risk.

Methods

We conducted a systematic search of published and unpublished material relevant to take-up and impact of index-based micro-insurance. The search was based on a programme theory outlining the causal channels of interest, which was used to create a list of search strings and the criteria for including studies in the review.

A coding tool, based on the EPPI-Reviewer platform, characterising studies and collecting information on context, mechanisms and outcomes, was used to collect information from the included studies. The review methodology is influenced by the realist approach to synthetic analysis, and only includes high-quality studies presenting new evidence on take-up or impact of index-based micro-insurance products.

Results

Keeping in mind the limitations of generalizing from just thirteen studies, our synthesis nonetheless identifies some notable patterns. In terms of take-up, higher liquidity and income levels available to the household were found to be positively associated with take-up. A lower level of income diversification appears positively associated with insurance demand.

Financial literacy is positively correlated with interest in weather insurance. Familiarity and trust in the external agent or organisation selling the insurance product as well as trust in the insurance product elicited by information from, or decisions by, personal networks are also associated with higher levels of take-up. Surprisingly, higher levels of risk aversion are associated with lower demand for index-based micro-insurance.

We also find mixed evidence of the impact of insurance cover on input usage. Farmers offered a bundled loan and insurance products were found to be less likely to accept the loan to finance hybrid seeds. In another study, insurance coverage is associated with greater purchases of fertiliser, where heterogeneous effects revealed that this effect was larger for smallholders who had used fertiliser in the past and portrayed better understanding of the insurance product. In addition, it was found that having to pay for the insurance product, rather than it being offered for free, increased the impact on fertiliser purchases.

Conclusions

The review shows that several non-price factors, including financial literacy, trust and liquidity, appear to affect demand for index-based micro-insurance products and that there is some, although mixed, evidence that access to index-based insurance increases the use of agricultural inputs, such as fertiliser.

In terms of research implications, the review has revealed substantial evidence gaps in the literature on take-up and impact of index-based micro-insurance. Little is known about issues such as the level and impact of basis risk, financial literacy, consumer education and the possibility of group-based index insurance. Future research needs to focus on these important areas to gain in order for a more complete understanding of the relevance of index-based insurance as a policy solution. The field is in urgent need of evaluations analysing take-up and, more importantly, impact of marketed index-based micro-insurance products.

Executive summary

Background

Approximately 55 percent of people in developing countries live in rural areas (IFAD 2010), and most rely on agricultural activities for their livelihoods. In the absence of formal risk management mechanisms, households self-insure against catastrophic events, such as drought, by employing informal risk management methods, many of which diminish the expected returns of agricultural activities and provide only limited coverage. Crop insurance programmes, which provide payouts based on individual (or nearby area) yield, are offered around the world as a formal method for mitigating aggregate risks faced by farmers. Yet, these programmes have met with limited success. The cost of sending trained assessors to evaluate damage has proved high. In addition, the presence of insurance coverage reduces farmers' incentives to make profit-maximising decisions on inputs. Crop insurance programmes may also suffer from the problem of adverse selection.

Index-based insurance overcomes some of the challenges faced by crop insurance programmes by delinking indemnification from individual production. Instead, the payout is based on an observable index which is unrelated to a farmer's own effort. Because of these contracting innovations, index-based insurance has the potential to be a financially sustainable mechanism to mitigate the risks faced by agricultural households in developing countries.

Index-based insurance can provide agricultural households with a mechanism to formally mitigate risk, which in turn may allow them to make riskier, more-profitable investment decisions. Similarly, insurance can help households smooth income across years, with the possibility of improving longer-term outcomes through increases in agricultural production and savings, and increased investment in education and health.

Although theoretically promising, take-up of index-based products has grown only slowly. Households perceive weather risks as very serious, and existing informal risk sharing mechanisms as inadequate; yet significant barriers to adoption remain. These include liquidity constraints, limited financial literacy, and inadequate trust in the insurance provider. In addition, basis risk, the risk of low correlation between insurance payouts and actual crop losses, is potentially a real threat both to demand for, and effectiveness of, index-based micro-insurance.

Objectives

This review investigates the effectiveness of weather insurance and area yield-based crop insurance in helping smallholders manage weather-related risk in low- and middle-income countries. The review focuses on understanding the determinants of demand and quantifying the impact of such products on household investment decisions and overall well-being. Since formal index-based insurance products have only recently begun to proliferate, there is a limited body of literature on their impacts. However, a compilation and analysis of the evidence thus far will create context and provide direction for future research.

Methods

The search for relevant studies was conducted using 17 electronic databases, 16 journals and 23 development and policy institution websites. Experts in the field of

banking and financial services for the poor were also contacted to provide information on on-going research. The resulting list of studies was screened using specific criteria relevant for the review. Studies had to meet the following criteria to be included: they were conducted since 1990 in countries classified as low- or middle-income at the time of data collection, focus on low-income households, analyse the impact of index-based insurance products that fall in the broad category of weather insurance and area yield-indexed crop insurance, and assess impact on household investment decisions, household well-being, take-up or consumption smoothing. Studies were excluded if they are not published in English, do not measure micro-economic impact of access and use of index-based micro-insurance, are general discussion papers that do not present data on impacts, do not explicitly address the issue of index insurance, have poor identification strategies, are based on government relief programmes, or focus on risk mitigation mechanisms instead of risk management.

The inclusion/exclusion criteria were applied in two stages: first to the title and abstract of all studies resulting from the search, and second, to the full text of studies that passed the first phase. The studies making it through the second screening stage were coded using the full coding tool.

The review methodology is influenced by the realist synthesis approach, which analyses outcomes with explicit focus on context and causal mechanisms. The coding tool used for data extraction classifies information on study population, intervention, comparison condition, outcomes, process, context and relevance of the findings. The tool particularly focuses on extracting information relating to the mechanisms of change–take-up, investment decisions and agricultural investment in well-being.

Details of the included studies

Of the thirteen studies included in the review, five are randomised controlled trials, one is a quasi-experimental study, and seven employ econometric methods. Seven are based on hypothetical products or decisions. The majority are working papers, as research in the field of index-based insurance is relatively recent. All except two have been released post-2008. The studies were conducted across Africa and Asia, including Ethiopia, Kenya, Malawi, Morocco, Tanzania, China, India and Vietnam. Most of the studies assess the willingness to pay (WTP) for index-based insurance products, while only two assess the effect of insurance on investment. Seven of the included studies measure take-up of or WTP for index-based insurance using a hypothetical insurance policy.

Synthesis results

Caution must be observed when generalizing from this small number of studies to the diverse contextual environments of the developing world, however, our synthesis identifies some notable patterns in the study results.

In terms of take-up, higher liquidity and income levels available to the household were found to be positively associated with take-up. As would be expected, a lower level of income diversification appears positively associated with insurance demand.

Financial literacy is positively correlated with interest in insurance. Familiarity and trust in the external agent or organisation selling the insurance product as well as trust in the insurance product elicited by information from, or decisions by, personal networks are also associated with higher levels of take-up.

In terms of risk factors and risk management techniques of the household, studies looking at irrigation and other risk management techniques yield negative but insignificant results. Higher levels of yield and rainfall variability are associated with greater interest in index-based insurance products. Surprisingly, higher levels of risk aversion are associated with lower interest in index-based micro-insurance.

Results were less clear in terms of marketing and product design. A preference for group-based insurance policies over household-based policies was noted in one study. Higher trigger levels (with payouts during less-catastrophic events) were also favoured. Even if only few marketing treatments had significant impact on take-up across the studies included in the review, it was shown that framing of the insurance product in promotional materials to focus on vulnerability, group/family responsibilities or network-based trust can affect the demand for insurance.

In one study looking at a product that bundled index-based insurance with a loan to finance hybrid seeds, take-up rates were lower for the bundled product than the uninsured loan. In terms of the impact of insurance, one study found that coverage is associated with greater purchases of fertiliser, where heterogeneous effects revealed that this effect was larger for smallholders who had used fertiliser in the past and portrayed better understanding of the insurance product. In addition, it was found that having to pay for the insurance product, rather than it being offered for free, increased the impact on fertiliser purchases.

Conclusions and recommendations

Two of the most important take-away messages are that (i) several non-price factors including financial literacy, trust and liquidity appear to affect demand for index-based micro-insurance products, and (ii) there is some evidence that access to index-based insurance increases the use of agricultural inputs, such as fertiliser.

In terms of policy, the review offers cautious encouragement to continue pilots and programmes based on index-based insurance. In addition, some recommendations regarding policy design and implementation can be made based on the results of the review. First, piloting group-based micro-insurance products, which have the potential to ease both informational and liquidity constraints, might increase take-up rates. Second, combining the roll-out of insurance products with agricultural extension programmes and financial literacy training is likely to increase both take-up and impact of products sold.

In terms of research implications, the review has revealed substantial evidence gaps in the literature on take-up and impact of index-based micro-insurance. Roughly half of the studies included in the review analyse hypothetical contracts. Even if these offer valuable insights on factors affecting the demand for these products, it has been shown that actual rates of take-up tend to be much lower. The field is in urgent need of evaluations analysing take-up and impact of marketed products.

To ensure completeness, ease of comparison between evaluations of different index-based insurance products, as well as future systematic syntheses, it is important that reports and publications carefully explain the design and marketing of the insurance product, including the loading factor, trigger level, indemnity prices and specific marketing strategies used, if insurance companies are willing to share this information.

Additional analyses on the relationship between risk aversion, income levels and take-up have the potential to generate interesting insights into the barriers to household adoption. Another fruitful area of research includes testing specific

aspects of product design and how they relate to take-up, and evaluating the level and impact of basis risk in relation to demand for insurance. Even if most studies included in the review analyse determinants of take-up, several evidence gaps exist.

At this stage, research on the impacts of index-based insurance on economics and agricultural outcomes should be the key priority. Very few real-world empirical evaluations of marketed index-based micro-insurance programmes exist. Research on how access to insurance affects agricultural investment choices needs to be extended. Research on impact on different aspects of household well-being is a key, and so far largely underexplored, area of research on index-based micro-insurance.

1. Background

1.1 Aims and rationale for review

The risk of unfavourable weather conditions is one of the most important risks faced by hundreds of millions of poor rural households around the world. Governments have implemented a range of programmes to address these risks, most notably crop insurance programmes and disaster relief aid. Programmes which tie payments to individual farmer's experience may suffer from two serious problems: moral hazard, whereby farmers may not exert as much effort to avoid risk or its consequences; and adverse selection, whereby farmers with higher risk are more likely to take up such products.

Traditional crop insurance has proved expensive to administer, since each individual claim needs to be verified before payouts are made. It has also suffered from lack of transparency and long lags in administering payouts. Contracting innovations have de-linked indemnification from individual production by basing insurance against losses arising from poor weather on an observable index (e.g. local rainfall or aggregate local crop yields) which is not directly linked to individual production.

Such 'index-based' micro-insurance products promise to offer a financially sustainable mechanism to reduce the risk faced by agricultural households. While there are some examples of success, by and large farmers have been reluctant to hedge substantial amounts of risk with these instruments. Whether this is due to product design aspects, such as basis risk, lack of demand, or barriers to demand linked to liquidity, financial literacy or lack of trust, is unclear. It is therefore of central importance to understand the determinants of demand for these products, and quantify their ability to affect household's economic decisions and improve well-being. This review synthesises the emerging body of evidence surrounding two specific types of index-based insurance: (i) weather insurance and (ii) area yield-based crop insurance. These two types of insurance have been chosen, as they represent the vast majority of agricultural index insurance programmes currently being implemented or evaluated. The review concentrates on the various issues associated with these forms of insurance, provides the best synthesis possible using existing evidence, and suggests priorities for future research.

1.2 Definitional and conceptual issues

The importance of this question is evident in light of the significant body of evidence that rural households around the world face fluctuating consumption, and engage in costly risk coping strategies. Crop insurance can improve the livelihood of poor farmers faced with potential disasters both by smoothing their consumption ex-post and allowing them to engage in more-productive strategies ex-ante.

Under the assumption that most consumers are risk-averse[1], fluctuations in agricultural income can have significant utility effects. While people tend to have informal coping mechanisms to deal with income shocks, these strategies are less efficient when faced with an aggregate shock such as a drought. For instance, if a

[1] Subjects are risk-averse if they would prefer to receive the expected value of any lottery rather than playing the lottery itself. Empirical studies of risk aversion find most people to be risk-averse in most situations. Halek and Eisenhauer (2001) contains a good survey.

farmer loses income due to illness, he is likely to be able to cope by receiving gifts or loans from family and selling assets. But if the entire community is hit with a drought, it will be difficult to obtain loans, and asset markets will also be depressed. Although migration can provide a stream of remittance income that is uncorrelated with local agricultural production, this form of self-insurance is often incomplete (Clarke and Wallsten 2003). Townsend (1994) documents that Indian villagers do a good job of protecting against idiosyncratic shocks, but that household consumption still drops sharply when faced with aggregate shocks. Rosenzweig and Wolpin (1993) show that uninsured rainfall shocks lead to farmers sub-optimally selling productive assets (bullocks).

There is also evidence that households pay heavy costs ex-ante to self-insure against weather risk (Dercon et al. 2005, Keyzer et al. 2007, Rosenzweig and Binswanger 1993). Agricultural households may over-supply labour (relative to a profit-maximising choice) or reduce input provision to limit the downside in the event of a poor harvest (Bliss and Stern 1982). Skees et al. (2002) show that vulnerable agricultural households diversify income and reduce risk by relying on off-farm employment for substantial portions of total income. Jensen (2000) suggests that uninsured agricultural risk adversely affects households' abilities to transfer resources across time, especially through investments in human capital.

They may also plant particular crops, which have reliable yields, or delay planting until more-complete information about the season's weather arrives. By employing these devices, vulnerable households effectively insure themselves against extreme duress in the event of a crop failure. This insurance, however, comes at a cost. These portfolio adjustment aimed at reducing weather risk have been estimated to lower efficiency by up to 25 percent (Dercon et al. 2005, Murdoch 1995). An analysis of the economic impact of weather insurance therefore must include an analysis of changes in household investment decisions and well-being.

While there are clear theoretical benefits to farmers from agricultural insurance, insurance markets have been slow to develop. Most insurance products offer indemnity insurance, which provides coverage based on a specific loss suffered by the insured party. Indemnity insurance has mostly been unsuccessful in the agricultural sphere due to high administrative costs to verify claims and guard against adverse selection and moral hazard.

Index insurance, in contrast, makes payouts based on measurements of an easily observable index, which is correlated with crop outcomes. We discuss two types of index insurance in this study: weather insurance and area–yield insurance. Weather insurance provides coverage based on weather data, which are usually measured at a weather station close to the insured's farm. For instance, rainfall insurance provides payouts when rainfall levels, measured at a specific reference weather station, meet specific criteria. The threshold of the index below (or above), which payments begin, is known as the trigger. Area-yield insurance uses selective measurements of crop yield in a certain geographical area as its index. If crop yields fall below the specific trigger, insurance payouts are made.

From the supply side, index insurance should be attractive for several reasons. First of all, as long as the index used to determine payouts cannot be tampered with, the insurer does not need to worry at all about the characteristics of insurance purchasers or their effort on their farms, since these characteristics cannot affect payouts. Also, claim verification is relatively easy. For weather index insurance, the insurance company needs simply to gather the weather data and apply them to the policy payout structure. For area-yield insurance, calculating claims is more costly, as the insurance company must make yield calculations (generally by

visiting a subset of farms). However, this is still much cheaper than visiting each claimant individually. Finally, agricultural risk in a particular market is unlikely to be correlated with the returns of global capital markets. Therefore, insurance companies should find a low cost of capital for financing an index insurance product. All of these supply-side pressures tend to reduce the cost of providing insurance, making index insurance a feasible product to provide to poor farmers at small scales. As is common in the insurance literature, we commonly refer to an insurance policy's loading, which measures how expensive a premium is in relation to the expected payout of an insurance policy. For instance, if an insurance policy has an expected payout of Rs. 100 and costs Rs. 110, it has a loading of 10 percent.

On the demand side, index insurance may face weaknesses compared to traditional insurance. Compared to indemnity insurance, index insurance has a major disadvantage in that payouts are not perfectly correlated with customers' agricultural losses. This lack of correlation is known as basis risk and represents the main drawback of index insurance. Basis risk can take a number of different forms. In one instance, the value of the insured index can simply be different on the customer's farm than at the measured location. For instance, rainfall could be very poor on an individual's farm but be fine at a rainfall station 10km away. Additionally, a farmer can experience loss due to events not covered in the insurance policy. For instance, he may be covered against rainfall risk but suffer crop loss due to a pest attack. Despite the challenges of basis risk, index insurance should have lower premiums than indemnity insurance (due to the supply-side issues discussed above), and therefore may still be an attractive product to consumers.

The existence of basis risk can greatly change the theoretical demand for index insurance as compared to indemnity insurance. While Cole et al. (2010) show that index insurance will have great benefits for risk-averse individuals even at high levels of basis risk, Clarke (2011) argues that basis risk will sharply decrease demand, especially for people who have high levels of risk aversion. Models by Bryan (2011) and deNicola (2011) also stress the important role of basis risk in reducing insurance demand. In order for an index insurance product to be successful, its payouts must be closely (negatively) correlated with agricultural yields, particularly in catastrophe-prone countries.

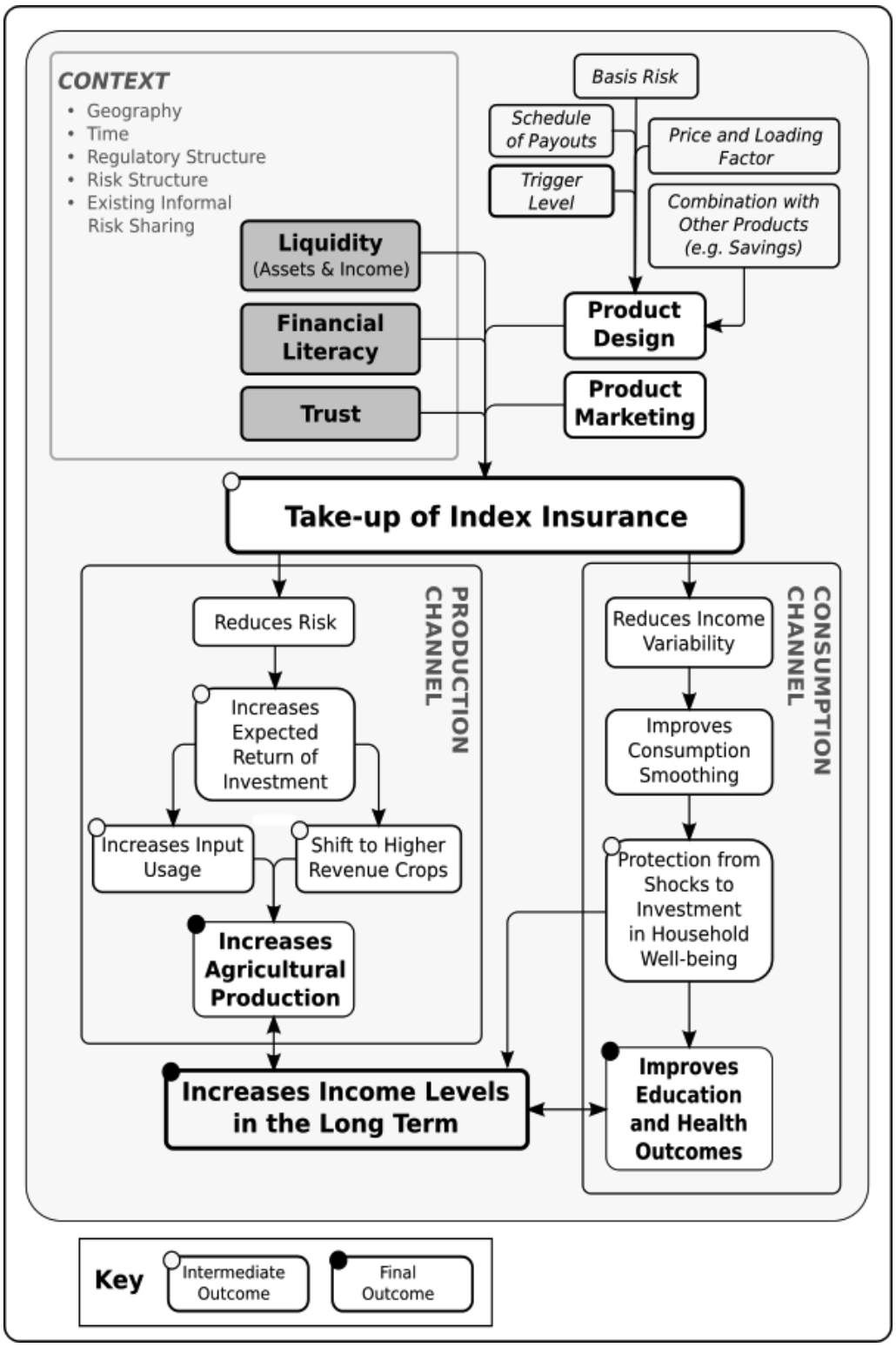
We systematically assess and synthesise high-quality evidence on the effectiveness of index-based micro-insurance in helping smallholder farmers cope with weather-related risk. Our methodology is influenced by the realist synthesis approach, which analyses outcomes while laying emphasis on understanding the context within which they are generated and causal mechanisms, which lead to the outcomes of interest.

To ensure a common vision of the conceptual issues being analysed in this review we outline the theorised causal mechanism in Figure 1.1. As a stylised representation of the causal mechanism, this diagram may omit some important effects, such as losses due to basis risk, but it is a useful tool to systematically analyse this literature.

The top left corner lists a number of contextual variables that were collected and taken into account in the analysis. Mechanism 1 outlines the channels associated with the decision to purchase index-based micro-insurance, which we refer to as take-up. On the product side, the way the product is designed and marketed will be important factors in how well it is accepted in the marketplace. On the consumer side, ability to understand the product (which we refer to as financial literacy) as well as wealth can be important determinants of take-up. Besides

wealth, having cash available to purchase at the time of sale (liquidity) is an important factor. The expected directions and theoretical underpinnings of these channels are discussed in more detail in the synthesis, section 4.2.

Figure 1.1: Causal mechanism for index insurance



The impacts of insurance can be divided into two theoretical channels: the production channel and the consumption channel. These two channels mirror the earlier discussion about the effects of agricultural risk on the poor. The production channel shows ways in which insurance could ease the costs imposed by risks before a shock occurs (ex-ante), while the consumption channel looks at its effects after a shock occurs (ex-post).

We discussed earlier how the prospect of agricultural risk can result in farmers adopting costly risk mitigation strategies. The production channel describes how index insurance can eliminate these costs. First, a decrease in production risk should increase the expected returns to agricultural production, increasing farm investment. We hypothesise that this could take two forms. First, obtaining insurance could make the farmer increase input use on the farm, for instance by purchasing more fertiliser, as a decrease in production risk could make investments more profitable at the margin. Second, he could switch from low-yield traditional crops to higher-yield, riskier crops (as suggested in deNicola 2011). Better productive techniques should result in higher agricultural yields, and therefore higher income and savings.

The consumption channel is somewhat more straightforward, and details the traditional consumption-smoothing effects of insurance. The take-up of insurance should decrease income variability, easing consumption smoothing. As households will not be forced to sell productive assets in a time of shock (Rosenzweig and Wolpin 1993), this should lead to increased accumulation of productive assets and higher long-term income.[2] Higher income should allow households to invest more in health and education (Jensen 2000).

1.3 Policy and practice background

Index insurance around the world arose in response to struggles of traditional agricultural insurance markets. For instance, the Federal Crop Insurance Corporation of the USA was established in 1938, but failed to provide a significant amount of coverage until significant reforms (including subsidies) were made in 1980. One of the earliest large-scale implementations of index insurance was the Comprehensive Crop Insurance Scheme in India, started in 1985. The Indian Government decided on an area yield approach, as they felt this was the only affordable way to provide coverage to a large number of famers. Area yield programmes in other countries such as the USA and Canada followed, but still generally resulted in losses for the insurance provider. Weather index insurance is less costly to provide, and therefore was seen as a way to provide insurance while cutting losses for government-backed insurers.

Weather index insurance is a relatively new product, becoming implemented in developing countries only within the last decade. The World Bank took an early lead in developing early rainfall insurance programmes, starting with a rainfall index insurance product in Morocco (Skees et al. 2001). However, this programme was never implemented, as declining rainfall trends in the region made obtaining re-insurance impossible.

[2] In their study, Rosenzweig and Wolpin (1993) determined that weather insurance would actually not significantly increase welfare, as the minimum level of production in their model gave farmers de facto insurance. Whether or not this is the case in practice is an empirical question.

The first successful pilot was implemented in the Indian state of Andhra Pradesh in 2003, with rainfall insurance products underwritten by ICICI-Lombard and sold by the micro-finance institution BASIX. Described by Giné et al. (2008), these programmes had low customer take-up, but BASIX deemed them enough of a success to scale the programmes up in 2005. In 2009, BASIX had 6,694 rainfall insurance customers (Giné et al. 2012). The Indian Government's Agricultural Insurance Company of India (AICIL) has also been piloting index insurance since 2007 through its Weather Based Crop Insurance Scheme (WBCIS) programme.

Another country that has had a successful scale-up of index insurance is Mexico, which provides weather insurance through a Ministry of Agriculture programme to assist drought-affected farmers (Fuchs and Wolff 2011). This product differs from the weather insurance sold in India, as the insurance contracts are sold to state Governments rather than individuals. This programme has been quite successful, with a US$90 million sum insured in 2007.

There are many other pilot programmes of insurance around the world. Skees et al. (2007) provides a comprehensive overview of all the pilots undertaken or underway by 2007.

Despite the vast number of pilot programmes and some pockets of success, most programmes have achieved little success at moving beyond the pilot stage, especially when insurance is sold on its own (as opposed to being bundled with credit). Therefore, understanding the determinants of take-up is an important question that we will explore in this review.

1.4 Research background

As formal weather insurance products have only recently begun to spread through developing countries, and taking into account the lag time in publishing, the body of published, peer-reviewed literature on the impacts and issues associated with these products is quite limited. To our knowledge, no systematic review of high-quality evidence focusing on index-based micro-insurance has been attempted so far. Giné et al. (2012) have written a book chapter focusing on India's experience with weather insurance. There are a few high-quality overviews of index insurance (Barnett and Mahul 2007, Mookerjee et al. 2011, Skees et al. 2007). These studies contain overviews of the concept behind weather index insurance, case studies and a history of existing programmes (many explained in the previous section), but contain few results on the determinants of take-up or the impact of insurance. Overall, they show that despite many pilots around the world there have been few examples of successful scale-ups.

Dercon and Kirchberger (2008) and Radermacher et al. (2010) have conducted systematic reviews of micro-insurance, without our particular focus on agricultural index insurance. These reviews include two studies on weather index insurance that we also discuss in this review (Giné et al. 2008, Giné and Yang 2009), but the majority of the other studies cited concentrate on micro-health insurance. Most of the studies they cover find that micro-health insurance increases access to care. Radermacher et al. (2010) find that many micro-health insurance interventions increase financial protection, but Dercon and Kirchberger find that most schemes do not decrease out-of-pocket costs. Also, in some cases formal micro-insurance crowded out informal social safety nets.

Overall, there have been no previous systematic reviews of agricultural index insurance, and previous reviews of micro-insurance in general have only touched very lightly on the subject. Part of the reason for this is that there have been very few studies on the impact of index insurance and the determinants of its adoption.

Therefore, an important contribution of this systematic review is to serve as a guide for the research community, helping to identify the research agenda. Our review covers a range of topics such as contract design for weather insurance and the effect of financial literacy training, knowledge and institutional trust on insurance take-up. While credible evidence on the effects of weather insurance (in particular evidence based on randomised trials of marketed products) remains at an early stage, we feel that a systematic literature review related to this issue is constructive at this time, to compile the evidence which has been gathered in disparate studies and to provide directions for future research.

1.5 Objectives

This review examines the effectiveness of index-based insurance in helping the developing country poor manage weather-related risk.

We primarily attempt to answer the following questions through this review:

- Do small-scale farmers adopt rainfall insurance products where available?
- What factors affect the decision to purchase insurance?
- What effect, if any, does holding insurance have on economic behaviour, specifically on investment decisions and well-being?
- What, if any, heterogeneity exists in the effects based on household wealth, education and gender and other characteristics?

Our objectives should be understood in the context of the following two points. First, this is one of the first systematic reviews of the literature relating to index-based micro-insurance. Second, while theory provides substantial guidance about how rainfall insurance could improve economic outcomes, the magnitudes and importance of various channels are not well understood. A parsimonious neo-classical model, for example, may omit many important factors (trust, learning, behavioural biases, etc.). In light of this, our intention is to create a sufficient context from which future academic work can be facilitated by compiling what is empirically known and theoretically accepted, and contrasting it with the areas where there is no empirical or theoretical agreement.

2. Methods used in the review

We conducted a thorough review of quantitative empirical studies that contain credible evidence from developing countries on the impacts of weather insurance on investment decisions (land cultivated, inputs used, type of crops planted, technology adoption, etc.) and household well being (per capita consumption, health indicators, food security, ability to cope with economic shocks, etc.).

This review is influenced by the realist review methodology illustrated in Van der Knaap et al. (2008). We did not intend to conduct a quantitative meta-analysis because we expected to find only a small number of studies with few overlapping outcomes. Instead, we focus on contrasting and synthesising the studies, using the context in which the studies were conducted and the mechanisms through which they proposed to affect outcomes to inform the interpretation of the overall results. While we draw generalisable lessons from the disparate studies considered, we still highlight important differences between them and discuss how context and causal mechanisms influence the results.

While compiling this review we consulted potential users in the academic and policy communities, and tried to ensure that the methodology was designed to generate a final product that catered to these users' needs.

2.1 Identifying and describing studies

2.1.1 Defining relevant studies: inclusion and exclusion criteria

In this section we explicitly state the inclusion and exclusion criteria that we applied to the studies found during the search process. An overview of the exclusion criteria based on the section below and a Microsoft Word version of the EPPI-Reviewer tool is provided in Appendix 2.1.

2.1.1.1 Study design inclusion criteria

We restricted inclusion to quantitative empirical micro-economic studies that use relevant outcome variables for appropriate samples and present causal evidence using the following three research designs:

- Randomised controlled designs,
- Quasi-experimental designs (e.g. regression discontinuity, instrumental variables, interrupted time series, non-randomised controlled trial, controlled before and after study, and statistical matching such as propensity score matching), and
- Regression-based approaches, with greater weight given to studies with well-understood sources of variation and stronger empirical bases that employ an effective identification strategy.

While evaluating whether the studies would be included in the review, special attention was paid to exclude studies which did not properly deal with selection bias or otherwise were deemed to have poor identification strategies. Qualitative studies were excluded from the review.

Finally, since understanding the determinants of take-up is a key outcome of interest, we did include lab experiments which offered hypothetical products, but we are careful to present the results from such studies separately.

2.1.1.2 Time, place and study participants inclusion criteria

Index-based weather insurance for developing country farmers is a very recent phenomenon. Barnett and Mahul (2007) note that the first such policies were offered in India in 2003 by ICICI Lombard General Insurance Company and the microfinance institution BASIX. Considering this relatively recent beginning, and not wanting to exclude any pilots that might have been conducted in the 1990s, we restricted our review to studies conducted since 1990, in order to capture any relevant pilot studies or hypothetical product-based experiments. Special attention was given to identifying studies produced by domestic research bodies in low-income countries, including but not limited to central banks and agricultural and financial research agencies of developing countries.

We included studies conducted in low- and middle-income countries, as defined by the World Bank at the time the data were collected (the complete current list is provided in Appendix 2.2). Within this subset we further focused on including studies on low-income smallholder households.

2.1.1.3 Inclusion and Exclusion criteria: intervention

Studies examining the take-up of real and hypothetical products and the impact of weather and area yield index insurance on investment decisions and consumption smoothing were included. Studies evaluating real products marketed by microfinance institutions, private and public sector insurance and re-insurance companies, government programmes, non-profit organisations and international aid agencies, among others, were included.

Due to the limited literature measuring take-up and impact on investment decisions and household well-being, we employed a slightly broader understanding of index-based micro-insurance in selecting studies for synthesis. In the study screening process, we noticed a number of studies on index-based livestock insurance programmes in developing countries. Although these types of insurance programmes do not specifically fall into the category of weather or area yield-based insurance, we decided to include them. The general characteristics of index-based livestock insurance programmes are similar to those for weather and area yield. All provide indemnity payments based on the value of an index and offer a formal risk management tool for smallholders to manage risk. Although we did not specifically search for livestock index insurance programmes, the general nature of most of our searches, especially of important journals and databases (with search terms such as “index?insurance”), led most of that literature to be captured and screened in this review.

Lab experiments using hypothetical contracts were considered, as long as they met all the other inclusion and exclusion criteria and mimicked index-based agricultural insurance. However, since lab experiments are not the same as field impact evaluations, we report the results separately and indicate clearly in the synthesis discussion which studies use hypothetical products.

In order for a study of a hypothetical contract to bring ‘new evidence’ relevant to this review we needed to analyse what characteristics of purchasers (e.g. education level, income level) or the insurance product (e.g. different contract structures) affect willingness to pay (WTP) or demand. There also needed to be a clear identification strategy (e.g. a convincing econometric estimation technique as well as sufficient variation).

2.1.1.4 Inclusion and exclusion criteria: outcomes

Following from Figure 1.1, we included studies that examine the determinants of take-up, including WTP for index-based insurance products. We also included studies that examine outcomes in the agricultural production channel (changes in crop selection and the pattern and quantity of agricultural inputs, agricultural yields, profits and savings) and consumption channel (changes in expenditure on household well-being and human capital including in education and health).

2.1.1.5 Exclusion criteria

On EPPI-Centre's suggestion, we converted the inclusion criteria listed above into the exclusion criteria summarised in Table 2.1. These exclusion criteria were used to filter through the studies that were found in the search process (Phase 1 outlined in Figure 2.1).

Table 2.1: Exclusion criteria

Category	**Exclusion Criteria**
Time	Study is based exclusively on data collected prior to 1990
Geographical Location	High income country at time of study, according to World Bank classification
Scope	Study discusses risk mitigation (e.g., irrigation or crop diversification) rather than risk management
	Does not assess either impact, take-up or product design of 1) Weather insurance, or 2) Area-yield crop insurance, unless it analyzes impact of lack of insurance schemes or otherwise motivates the review
Study Design	Study is based on macro-economic evidence or a discussion of a program using national level aggregates
	Study is an exclusively theoretical paper which doesn't present data on impacts or determinants of demand/take-up
	Study is based on micro evidence but is a general discussion paper or review which doesn't present data on impacts or determinants of demand/take-up
	Study does not asses the 1) Determinants of take-up, 2) Impact of index-insurance on investment in agriculture, 3) Impact on household wellbeing
	Study is empirical but has unclear identification strategy and does not adequately account for selection bias or missing variables

2.1.2 Identification of potential studies: search strategy

We followed an iterative search strategy, using several online databases relating to general social science as well as to economics and relevant subcategories of the economics literature. General academic databases such as JSTOR and ProQuest were searched for published and unpublished studies. Some journals and databases

were handsearched, especially if they were deemed to be important sources e.g. *Journal of Agricultural Economics*. Other online resources, particularly the websites of federal, national and international development and policy institutions, both governmental and multilateral, were also searched.

A complete list of electronic and non-electronic sources is listed in Appendix 2.3, while Appendix 2.4 provides a detailed search log with details of the keywords searched and the names of the databases consulted.

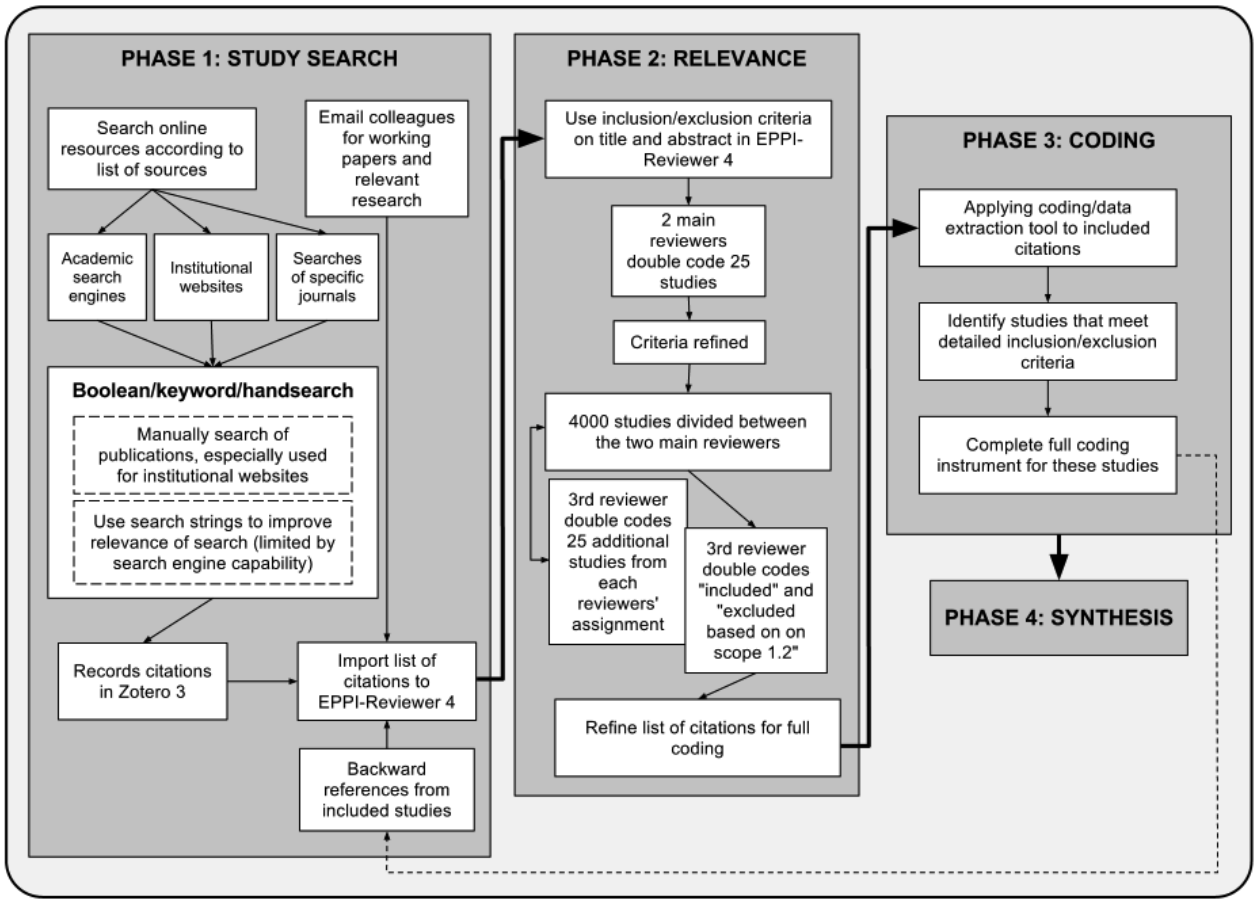
We restricted our search to studies published in the English language. Given the available time-frame and resources, we did not believe we would be able to properly search and synthesise the non-English literature. We did contact the Inter-American Development Bank about any Spanish language studies that might fit the criteria of the review; however, there were no such studies available.

An informal panel of experts in banking and financial services for the poor was formed, including authors of included studies. These experts were contacted to provide information on ongoing research and to fill any gaps in our search.

Titles and abstracts of studies to be considered for the synthesis were extracted from websites using Zotero 3 and then exported to the EPPI-Reviewer software, along with details of where the reference was found. Inclusion/exclusion decisions were also recorded on that platform and all retrieved studies were filed according to detailed inclusion/exclusion criteria.

The details of the search process utilized in this study are shown as Phase 1 in Figure 2.1.

Figure 2.1: Search process map



Keyword searches varied slightly from one database to another, based on the focus and classification codes. Since we expected to find very few studies, we used more-general concepts in the search string such as "insurance" and "risk", and where these searches yielded several hundred or thousand results, we used more-specific concepts like "index insurance". Where possible, however, we ran complex searches applying as many of our inclusion/exclusion criteria as the search engine would permit.

Figure 2.2 illustrates the typical long-form complex search string we utilised on databases such as Google Scholar.

Figure 2.2: Sample complex search string

```
(insurance OR risk)
AND
((crop
AND
((area?yield)OR(area?based))OR weather OR climat*
 OR precipitation OR index OR index?based OR rain*))
```

For websites, which did not permit complex string searches, we utilised simpler search strings of the type illustrated in Figure 2.3.

Figure 2.3: Sample simple search strings

```
insurance OR risk
(insurance OR risk) AND crop
(insurance OR risk) AND weather
(insurance OR risk) AND index
(insurance OR risk) AND rainfall
micro?insurance NOT health
```

2.1.3 Screening studies: applying inclusion and exclusion criteria

Studies were included in this review following the rigorous screening and coding process outlined below and mirroring Phase 2 of Figure 2.1.

We followed a two-stage screening algorithm, where in the first stage the search database was divided amongst researchers who individually applied the inclusion and exclusion criteria to the title and abstracts. There was no double coding in this stage. If the study did not violate our exclusion criteria and fulfilled our inclusion criteria, it was included in the review set. If the study violated our exclusion criteria or failed to meet our inclusion criteria, it was excluded from the review set. If it was unclear from this basic information whether the study should be included or excluded, we included the study in the review set. Twenty-five studies were double coded to ensure consistency.

In the second stage, we re-applied the criteria to the full report of studies in the review set generated by first-stage screening. In order to ensure that there was consistency in the coding at this stage, two main reviewers double coded 25 studies and compared their results. No conflicts were found. The reviewers then divided the 4000 studies yielded from the previous stage into two groups and single-coded them for inclusion/exclusion. Of these 4000 studies another 25 were randomly

selected to be double coded by a supervising reviewer; again no conflicts were found. All studies generated by the search have been included in the EPPI-Centre database and made available to researchers. Included and excluded studies are clearly marked.

2.1.4 Characterising included and excluded studies

Following the characterisation-coding tool reproduced in Appendix 2.1, we configured the EPPI-Reviewer software to allow us to code the final set of studies that was yielded by the two-stage screening process described in the previous section. The objective of the characterisation-coding tool is to assess the quality of the study through a framework that allows easy comparison with other studies. The coding tool also breaks down the study into its components, context, mechanisms and outcomes, to facilitate a realist-style review.

After screening duplicate studies, and multiple papers relating to the same study, we recorded, in EPPI-Review, the study characteristics (sample size, data collection, regression specifications etc.), programme characteristics (geography, programme details, etc.), identification strategy (randomisation methodology, identification strategies including controls for selection bias and omitted variable bias, etc.) and mechanism through which the programmes were expected to affect outcomes.

The outcomes of interest (described in Figure 1.1) captured as coefficients and standard errors from relevant regressions were recorded in a separate spreadsheet to facilitate analysis.

Finally, reviewers free-form comments were recorded, and a decision taken to include or exclude the study in the technical review; if a study was not appropriate for the technical review, but would be useful to inform the background of the study, that was also noted.

2.1.4.1 Examples of included studies

Examples of included studies include high-quality, randomised evaluations such as Cole et al. (2010), who study a weather index-based crop insurance product in India and Giné and Yang (2009), which evaluates a linked credit-weather insurance product in Malawi.

We included one study on index-based livestock insurance (Chantarat et al. 2009). This study examines WTP and take-up of an index-based livestock insurance programme in Kenya. The product protects against livestock mortality due to covariate rangeland conditions. The index is constructed using observations of the normalised differential vegetative index, the value of which broadly depends on rainfall. Additionally, the product is area-based, providing policyholders with identical payouts per policy in the same geological coverage area.

We also included studies that shed new light on take-up through surveys categorising households' WTP for a hypothetical index-based insurance product. As long as these studies analyse what characteristics of purchasers or insurance products affect demand and have a clear identification strategy (e.g. a convincing econometric estimation technique as well as sufficient variation), we believe that these studies are relevant because they bring new evidence to the review. An example of such a study is Turvey and Kong (2010), who look at demand for a hypothetical weather insurance product in China.

2.1.4.2 Examples of excluded studies

While characterising studies, we were careful to exclude studies that do not mention index-based insurance even if they deal with the broader areas of risk management; for instance Yang and Choi (2007), which examines remittances as a mechanism for managing rainfall related risk in the Philippines. We did not include studies such as Giné et al. (2007) which are general in nature, and do not provide a specific, detailed evaluation of index-based insurance. Advocacy articles or policy studies such as Ahuja and Guha-Khasnobis (2005), Barnett and Mahul (2007) and Sennholz (2009) were also excluded. We avoided studies such as Zeng (2000) that explore the conceptual issues behind insurance products but do not evaluate determinants of take-up or impact. To be clear, we also excluded studies related to social insurance programmes such as India's National Rural Employment Guarantee (NREGA) scheme, since they cannot be classified as micro-insurance or index-based insurance.

2.1.5 Identifying and describing studies: quality assurance process

We were careful to ensure that all members of the team understood and applied our coding and screening tools uniformly. During the search process all researchers, to ensure consistent search results to the extent permitted by different search engines, used the master search phrase described in Figure 2.2.

In order to ensure consistency and full understanding of the tools used, both the inclusion/exclusion criteria and the full coding tool were circulated for comments and then piloted using a blind double coding process. In terms of the inclusion/exclusion criteria, 25 studies were double coded before the screening process began. During this process, there were four incidences of citations being excluded according to different criteria, but no inconsistencies in terms of whether a citation should be included or not.

During the screening process, a random selection of the citations was double coded by a third reviewer to ensure consistency. In the characterisation stage, once the list of final studies to be included in the review was finalised, approximately 30 percent of studies were randomly assigned for double coding.

After double coding, one of the two members reconciled the codes. If there were any differing codes between the two coders that were not easily reconcilable, the studies were discussed among the team. Additionally, any studies which either of the coders was unsure about including in the technical review were discussed and resolved with the team. Double coding ensured a high-quality characterisation process and ensured that uniform standards were applied to studies in our technical review. This process did not reveal any significant sources of inconsistency.

2.2 Methods for synthesis

2.2.1 Assessing quality of studies

Our coding tool is provided in Appendix 2.1. It provides the basis of the quality assessment for each study we decided to include in the review and is based on the inclusion and exclusion criteria outlined in section 2.2.1. Appendix 2.5 lists the research method, identification strategy, regression type, unit of analysis and sample size of each of the studies included in the review.

With reference to Figure 1.2, we dealt with two groups of studies in this review, those examining the determinants of take-up and those examining outcomes

beyond take-up. Because of the different nature of these two types of outcomes, we treated quality assessment for them differently.

For studies related to take-up we deemed all studies that took a quantitative approach to estimating the determinants of take-up to be of a sufficient quality to be included in the review. Studies that establish predictors of demand for insurance may be useful in a policy environment even if they do not establish causal links.

For studies that considered outcomes beyond take-up, we categorized studies into those that had an adequate identification strategy that overcame potential biases and those that had weak or poorly formulated identification strategies or were unable to overcome biases. The former were included and the latter excluded.

We focused on weeding out the studies that had identification problems and did not properly deal with potential confounding factors (income, education,) which may affect the impact channels of index insurance in developing countries. Without properly accounting for these relationships, it is not possible to understand whether observed impact can be attributed to availability and use of index insurance.

2.2.2 Overall approach to and process of synthesis

We employed a synthesis methodology based on the realist approach to conduct our systematic review. This process-oriented methodology examines the mechanisms that drive changes in outcomes within the context of the studies. Our results are analysed and presented using the realist synthesis framework of context–mechanisms–outcomes (CMO). A flowchart of the proposed causal mechanism is included in Figure 1.1.

The realist synthesis approach is of special interest to policy-makers because of its focus on the mechanisms of change and the context of programmes. While meta-analysis focuses on the statistical synthesis of outcomes, this methodology also examines the context of the studies and mechanisms at work to evaluate the underlying theory of change (Greenhalgh et al. 2007). Ideally, the policy-maker will better understand how to use different mechanisms of change in different contexts to build successful programmes (Pawson et al. 2004).

From a research perspective, the realist synthesis can give insights into the specific channels through which access to and take-up of index- insurance affect smallholders' ability to manage weather related risks. The CMO model also enables researchers to analyse which contexts weaken these causal mechanisms and make interventions less effective.

Recent research has combined methods that focus primarily on internal validity, such as the Campbell standards, with methods that focus more on external validity such as realist reviews (Van der Knaap et al. 2008). We followed this example by applying strict methodology/study design criteria during our coding phases alongside the careful tracking and analysis of context and mechanisms.

The context of the studies included in the review was recorded in the data extraction phase. Coding of standard context variables like geography, gender and existing insurance options were supplemented by textual summaries of important contextual information. We focused on collecting information about contextual aspects that carry the potential to influence the effectiveness of the causal mechanisms. Examples include the management and credibility of the insurers, social and economic characteristics of the target group and existing market failures in the insurance market.

The mechanisms assumed to be at play were carefully mapped before the data extraction phase and were tracked, where possible, in the coding process for each paper. The key mechanisms that we addressed include take-up/WTP and investment in both agricultural production and household well-being. Where studies did not explicitly state the assumed causal mechanisms, we tried to reconstruct CMO configurations based on the context and outcome variables addressed, which was the method followed in Van der Knaap et al. (2008). The synthesis of this information allows us to gauge the importance and direction of the causal channels as well as identify channels where an evidence gap exists.

The intermediate outcomes were classified and compared in groups, all linked to the final goal of higher household incomes. As illustrated in Figure 1.1, they are (i) increased take-up, (ii) higher productivity of agriculture, (iii) improved household well-being (e.g. education and health levels) and (iv) increased income levels in the longer term. Tables comparing sizes, directions and significance were analysed in light of the context and mechanisms at work. We provide a tabulation of the directionality, magnitude and statistical significance of the results of the empirical studies including indicators for heterogeneous treatment effects.

2.2.3 Selection of outcome data for synthesis

We recorded regression outcomes for all the studies included in the review. Where multiple outcomes were reported we focused on the most comprehensive specification that is available in the paper, e.g. the one that includes the most control variables. However, any reading of scientific literature must recognise the risk of publication bias: e.g. the authors have the flexibility to make sample selection decisions and specification decisions that may affect the point estimates and statistical significance of the coefficients. For obvious reasons, we are not able to control for such publication bias.

We recorded the name of the outcome analysed and the intervention or independent variable in question, followed by the level effect or point estimate, significance level and standard error. The standardised effect size[3] for each point estimate was calculated, to increase the comparability of results across studies. For each entry, information on whether the full sample or a specific subsample was used as well as sample size was also recorded. The final two columns record which reviewer carried out the coding and the quantitative methodology used, such as OLS (ordinary least squares) or linear probability, to derive the results.

All results from these regressions were recorded, including estimates of control variables and insignificant results where each row records one specific estimate. Results from analysis of specific subsamples were also recorded, including households with a specific religion, crop choice or income level.

2.2.4 Process used to combine/ synthesise data

Most studies found during the screening process analyse the determinants of take-up of index-based micro-insurance products rather than the impact of such products. This means that studies often provide information on several of the causal channels of take-up, such as financial literacy, trust and level of wealth or liquidity. We did, however, identify and categorise reported effects by gender,

[3] The standardised effect sizeStandardized Effect Size (Std. Effect) is the point estimate divided by the standardStandard deviation.

occupation, insurable asset and location of the study (urban/rural) where information was available.

In order to synthesise this information, each regression result relating to a specific channel was classified. These results were then grouped according to classification to facilitate comparisons between studies. Separating regression outcomes from the context of the full regressions clearly places some limits on the interpretation of the specific results. We were cautious of this potential risk in the synthesis and made sure to refer to the full regression output whenever in doubt about the correct interpretation.

2.3 Deriving conclusions and implications

Once the results of the synthesis had been compiled and analysed, the potential implications for policy, practice and research were discussed amongst the reviewers. Conclusions presented in this review were informed by the team's knowledge of the wider economic development literature as well as our experience in project implementation and analysis. This process included conference calls and written suggestions from the more-experienced members of the review team.

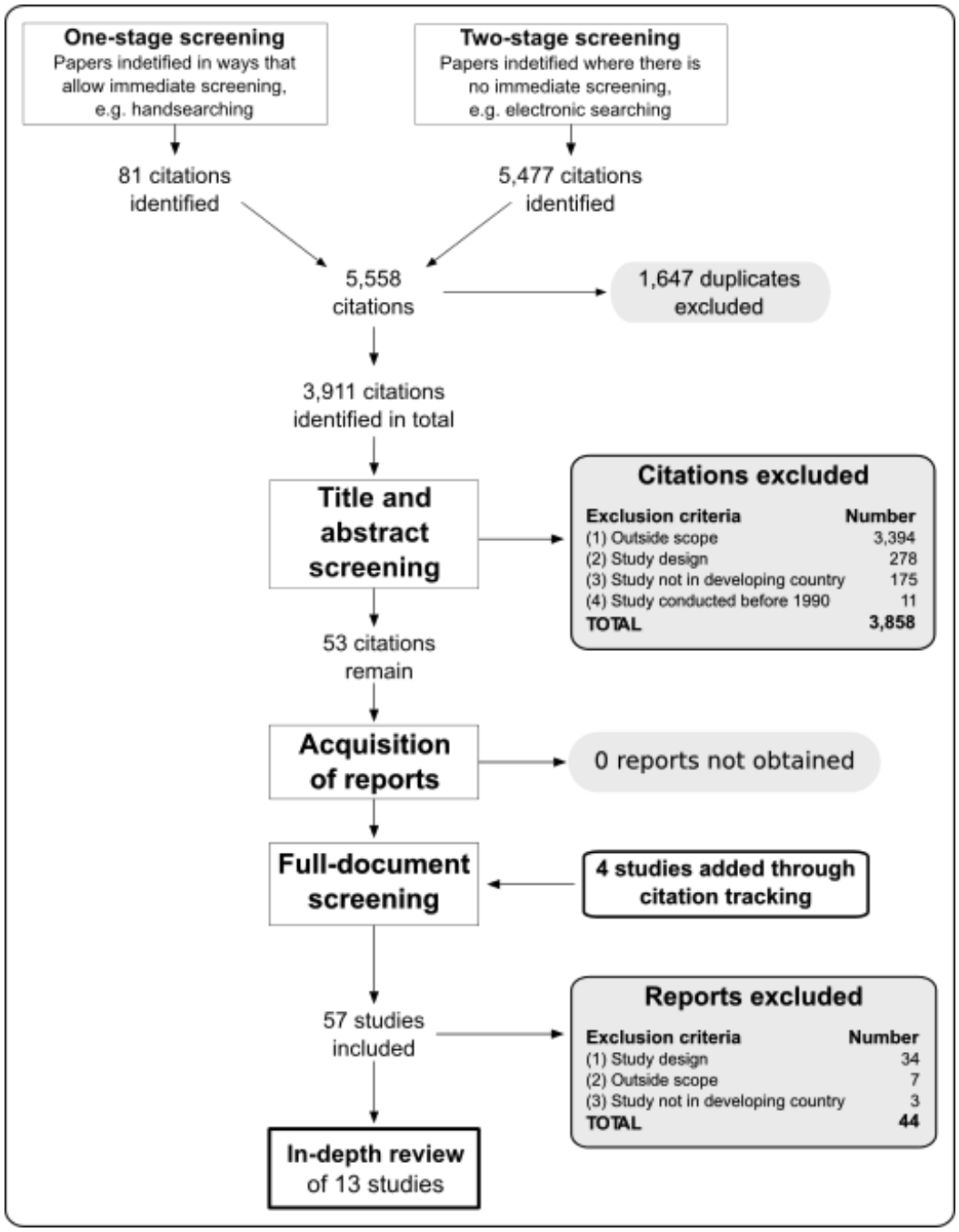
Due to the limited number of studies included in the synthesis, we are careful not to overplay the external validity of our conclusions and focus on the evidence gaps and implications for future research that are highlighted through the systematic review.

3. Search results

3.1 Studies included from searching and screening

Figure 3.1 outlines the method used to search for studies and screen them for relevance and quality.

Figure 3.1: Filtering of papers from searching to map to synthesis



The search process was undertaken using two methods. Handsearching was used for sources where automated searching was not possible and consisted of a team member browsing through titles and abstracts of specific sources. This process generated 81 citations. The second method consisted of electronic searches, where

all hits relating to specific strings of keywords were recorded using the EPPI-Reviewer software. A large majority of studies was found using electronic searches on scholarly databases and websites of international organisations. This process generated thousands of citations. In total, 5558 citations were identified using the search methods outlined above. After excluding duplicates, 3911 citations remained.

After the search phase, papers were screened based on title and abstracts using the inclusion/exclusion criteria outlined in section 2.2.1. This process drastically reduced the number of relevant papers to 53. A total of 3858 papers was excluded in this process, with 11 papers excluded based on time period of the study, 175 papers excluded based on geography, 3394 excluded based on scope of the study and 278 papers excluded based on study design.

Copies of the 53 approved papers were then obtained for full document screening. These papers were coded using a coding tool in EPPI-Reviewer, which can be found in Appendix 2.1. During this process, three papers were excluded based on geographical location, seven papers excluded based on scope of the study and 34 papers excluded based on study design. We also used backward reference searches to look for papers we might have missed in the initial search; this process generated four additional papers. After the screening and coding processes had been completed, 13 papers remained for inclusion in the synthesis.

3.2 Details of included studies

This section describes the characteristics of included studies and gives brief descriptions of study design and methodology. More-detailed information on the projects and results are given in section 4. The first section summarises studies analysing marketed products, and the second section summarises studies of hypothetical products.

3.2.1 Studies analysing marketed products

Six studies examine the demand and impact of marketed index-based insurance products. Three studies use randomised experiments, of which one is an impact evaluation. Giné and Yang (2009) analyses a bundled loan and weather insurance product offered to maize and groundnut farmers in Malawi and explores whether bundling weather insurance with a loan to finance hybrid seeds induces higher take-up rates than the loan on its own. The bundled product recorded lower rates of take-up.

Two studies use randomised experiments to examine the determinants of demand. Cole et al. (2010) evaluate take-up of rainfall-based index insurance offered to villages in Gujarat and Andhra Pradesh, India. Interventions include marketing treatments, faster payout schedules and bundling the product with a loan to help finance the premium payment. In a second study focusing on India, Gaurav et al. (2010), test whether financial literacy treatments affect take-up of rainfall insurance.

Three studies used regression-based approaches to examine determinants of take-up. Giné et al. (2008) evaluate take-up of rainfall-based index insurance in Andhra Pradesh, India. Hill and Robles (2010) assess take-up rates of weather securities in southern Ethiopia. Weather securities allow farmers to choose different levels of insurance for different time periods without limitations on applicable crops and are therefore very similar to index-based rainfall insurance, but do in some cases offer higher levels of flexibility. Stein (2010) examines dynamic aspects of take-up of

weather-insurance products in India. The project examined how previous insurance payouts affect future insurance purchase decisions.

3.2.2 Studies analysing hypothetical products

Seven studies examine the demand and impact of hypothetical (non-marketed) index-based insurance products. Since these studies are not based on real-world products it is important to note that the results from these studies should be cautiously interpreted, especially when generalising their results to the real world.

One randomised experiment examines the impact on production decisions (in this case input purchases) of access to a hypothetical insurance product. This lab experiment by Hill and Viceisza (2010) assesses the impact of providing weather insurance on fertiliser purchases in Ethiopia.

Studies analysing the determinants of take-up of hypothetical insurance products mainly use regression-based approaches. Turvey and Kong (2010) examine the insurability of weather-related risks in China by assessing the demand for a hypothetical product. Vandeveer (2001) examines district and commune insurance decisions by analysing hypothetical agricultural insurance programmes for litchi farmers in Vietnam. In a similar vein, Seth et al. (2009) use survey data to assess determinants of demand for weather securities in Rajasthan, India. Looking at index-based insurance for livestock, Chantarat et al. (2009) examine WTP for insurance in northern Kenya, where livestock mortality due to drought is considered a major threat to livelihoods for pastoralists.

Two studies compare demand for different versions of index-based weather insurance. Sarris et al. (2006) evaluate WTP for rainfall-based insurance in Kilimanjaro and Ruvuma, Tanzania, by offering six hypothetical contracts. In a similar vein, McCarthy (2003) examines the determinants of demand for hypothetical weather insurance contracts offered in four provinces in Morocco. Six contracts were tested with varying coverage and trigger levels.

4. Synthesis results

4.1 Further details of studies included in the synthesis

In line with the CMO framework, detailed information about the context, product design and implementation strategies of the included papers were collected.

4.1.1 Context of studies included in synthesis

Roughly half (six) of the studies were conducted in Africa, and the other half (seven) in Asia, with survey populations from Ethiopia, Kenya, Malawi, Morocco, Tanzania, China, India and Vietnam. Six of the studies were conducted in countries that were classified as lower-income countries at the time of data collection, and seven studies were conducted in middle-income countries. Figure 4.1 and Table 4.1 summarise the context of the studies included in the review.

Table 4.1: Context of studies – geography, sample and partners

CONTINENT/ Country	Location in country	Study short title	Data timeline	Insurance underwriters
AFRICA				
Ethiopia	Silte Woreda, southern Ethiopia	**Hill and Robles (2010)**	Experimental game 2009, Insurance pilot 2010	NISCO (Nyala Insurance Company)
		Hill and Viceisza (2010)	Experimental game 2009	Simulation only
Kenya	Marsabit, northern Kenya	**Chantarat et al. (2009)**	June 2008	Simulation only
Malawi	32 different localities	**Giné and Yang (2009)**	September 2007	Insurance Association of Malawi (IAM)
Morocco	Settat, Meknas, Oujda and Essaouira	**McCarthy (2003)**	1978-99 (uses data from Skees et al. 2001)	Simulation only
Tanzania	Kilimanjaro and Ruvuma	**Sarris et al. (2006)**	Kilimanjaro 2003–04, Ruvuma 2004–05	Simulation only
ASIA				
China	Shaanxi and Gansu	**Turvey and Kong (2010)**	October 2009	Simulation only
India	Gujarat and Andhra Pradesh	**Cole et al. (2010)**	2006–07	ICICI Lombard (marketing by BASIX)
	Gujarat	**Gaurav et al. (2010)**	November–December 2009	Agriculture Insurance Company of India (AICIL)
	Andhra Pradesh	**Giné et al. (2008)**	2004	ICICI Lombard
	Rajasthan	**Seth et al. (2009)**	2007	Simulation only
	Andhra Pradesh and five other states	**Stein (2010)**	2005–07	ICICI Lombard (marketing by BASIX)
Vietnam	Luc Ngan, Bac Giang Province, northern Vietnam	**Vandeveer (2001)**	September 2008	Simulation only

In the eight studies where summary statistics on income are given, the range of annual income spans from $106 to $936 per capita. The low is recorded in the Ruvuma region of Tanzania (Sarris et al. (2006) and the high in Gujarat, India (Gaurav et al. (2010).

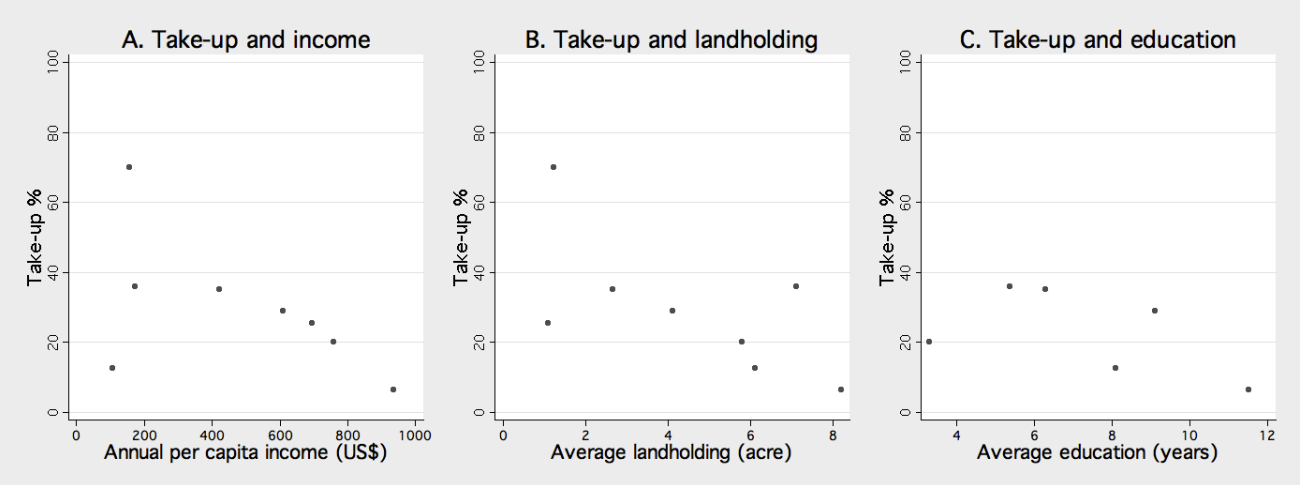
In studies that analyse different regions within the same country, income levels are substantially different; $422 in Kilimanjaro versus $106 in Ruvuma in the Tanzania-based study (Sarris et al. 2006). In Cole et al. (2010), the average income is much higher in Gujarat, at $610, compared to $393 in Andhra Pradesh.

Average reported landholdings are low, and reported in only eight of the studies. Gaurav et al. (2010) studying farmers in Gujarat, India report the largest average landholdings of 8.2 acres or 3.32 hectares. Giné and Yang (2009) report an average landholding of 7.1 acres or 2.87 hectares amongst their Malawian respondents. The lowest average holdings are recorded for respondents in Ethiopia, 0.61 acres or 0.25 hectares (Hill and Viceisza 2010), and China, 1.1 acres or 0.44 hectares (Turvey and Kong 2010).

The level of education varies substantially between respondents in different studies, ranging from a high of 11.52 years of schooling recorded by Gaurav et al. (2010) to a low of 2.5 years in Settat, Morocco, recorded in the study by McCarthy (2003). This value is not included in the graph below, as the average take-up rate is not available. The average age of the respondents of all papers is mid-forties and most respondents tend to be male (where recorded).

Figure 4.2 shows scatter plots of average take-up and income, landholding and education levels in studies where information is available.

Figure 4.2: Take-up and contextual factors



The correlation coefficient between income and take-up is negative and strong (-0.54), but is insignificant (p-value 0.165). The correlation coefficient between landholdings and take-up is negative and strong (-0.65), and is significant at the 90 percent level (p-value 0.083). The correlation coefficient between take-up and education is also negative and strong (-0.52), but is insignificant (p-value 0.288). It should be noted that the correlations reported above are based on very few observations (8-9) and the high take-up rate in Chantarat et al. (2009) of nearly 70 percent has the potential to greatly affect the results. The fact that loading factor is not accounted for also has the potential to bias these estimates, as the Chantarat et al. (2009) product is sold below the actuarially fair price, whereas for most of the other products the price is above actuarially fair or unknown. Table 4.2 outlines the characteristics of participants in more detail.

Table 4.2: Context of studies – characteristics of participants

Study short title	Household mean annual income	Household assets	Age profile	Gender profile (Percentage of males in sample)	Education profile	Occupation profile
Chantarat et al. (2009)	$157	Mean assets: $2,351 Mean landholding: 1.24 acres Mean of total livestock units: 15.5	Mean: 47, Median: 48	76%	1–12 years of school: 13% Post-secondary education: 3%	Average income from livestock: 63%
Cole et al. (2010)[a]	$393 (AP) $610 (GJ)	Number of assets/durable goods: 2.71 (AP), 2.3 (GJ)	Mean: 47.6 (AP), 48.9 (GJ)	93.7% (AP), 75.7% (GJ)	Secondary school or higher: 33.2% (AP), 33% (GJ)	Agriculture primary income source: 65% (AP), 72% (GJ)
Gaurav et al. (2010)	$936	Household with bullocks: 55% Household with TV/radio: 53% Household landholding: 8.2 acres	—	—	Mean years of school: 11.52 Mean financial literacy score: 0.51/2	—
Giné and Yang (2009)	$173	Average landholdings: 7.10 acres (SD 8.32)	Mean: 40.64	56%	Mean years of school: 5.37 (SD: 3.50)	—
Giné et al. (2008)	$759	Liquid assets: $313 (mean), $184 (median) Landholding: 5.8 acres (mean), 4.0 acres (median)	—	—	—	—
Hill and Viceisza (2010)	—	Landholding: 0.61 (mean), 0.50 (median)	Mean: 45, Median: 45	84%	—	Primarily agriculture: 91% Primarily housework: 6%
McCarthy (2003)	—	Physical asset index: 1.74 (Settat), 0.30 (Meknes), 1.5 (Essaouira), 0.46 (Oujda).	—	—	Mean years of school: 2.5 (Settat), 2.9 (Meknes), 2.8 (Essaouira), 2.7 (Oujda)	All are landowners and net sellers of agriculture products
Sarris et al. (2006)	$ 422 (Kilimanjaro) $106 (Ruvuma)	Value of wealth per household: Tsh 3,375,000 (Kilimanjaro), Tsh 820,000 (Ruvuma) Area of land cultivated: 2.66 acres (Kilimanjaro), 6.1 acres (Ruvuma)	—	—	Mean years of school (household head): 6.3 (Kilimanjaro), 8.1 (Ruvuma)	—
Turvey and Kong (2010)	$694	Average landholding: 1.1 acres Average amount of debt: $2,115 Asset–debt ratio: 22.9%	—	—	—	—
Vandeveer (2001)	$427	—	—	—	Mean years of school: 7	—

[a] AP: Andhra Pradesh; GJ: Gujarat.

Notes: Seth et al. (2009), Stein (2010) and Hill and Robles (2010) are excluded (no information to present). Dollar values are in US$ as of 24 January 2011. Hectares have been converted to acres, where applicable.

4.1.2 Mechanisms of studies included in synthesis

To facilitate CMO analysis, information on product design and implementation strategies was collected for the included studies. This information is summarised in Appendix 3.1. The majority of the included studies, 11 out of 13, examine the mechanisms associated with take-up, rather than impact, of index-based insurance.

4.1.2.1 Product design

To recap, the key advantages of index-based insurance relative to traditional insurance lie in the resolution of moral hazard and adverse selection problems, combined with cheap and fast settlement procedures and the ability to hedge local risk on global capital markets. The key disadvantages are basis risk, the relatively complex nature of the product and, in some cases, its cost.

A comparison of product design across these studies yields some patterns worth examining. There is some variation in design in terms of coverage levels and periods. Cole et al. (2010), Giné and Yang (2009) and Stein (2010) analyse policies in which the season is split into phases such as sowing, flowering and harvesting. These multiphase policies allow premiums and trigger levels for payouts to differ according to season and be more-closely linked to local weather and rainfall conditions. There are two studies that test WTP for weather derivatives and securities, rather than index-based insurance (Hill and Robles 2010, Seth et al. 2009). Weather securities and derivatives are very similar to index-based insurance products in that they offer an instrument that will pay the holder a certain amount at a certain date if a weather-linked index is outside a pre-specified range of values. These offer more flexibility than some index-based insurance products that are only offered for a specific crop, season or region.

In terms of the index used for the insurance product, there is also some variation across products examined in the synthesis. Most studies use a rainfall index to determine payouts. One exception is the study by Seth et al. (2009) that tests preferences for different combinations of indices. Customers show a preference for a combination of rain and temperature indices. McCarthy (2003) offers insurance contracts with varying trigger and coverage levels and finds that farmers who are subject to higher rain variability prefer cheaper contracts with higher trigger levels. The product in Vandeveer (2001) is the only one based on an area yield index included in this review. Chantarat et al. (2009) examine livestock insurance based on an innovative Normalised Differential Vegetation Index (NDVI) to predict covariate herd mortality.

In terms of pricing, not all papers clearly indicate the loading (pricing) of insurance policies, or specify exactly how the loading is calculated. It is suggested that future publications on index-based insurance carefully outline the loading factor along with other important product design features, if possible, to facilitate comparisons across insurance products.

4.1.2.2 Liaison with local NGOs

Approximately half of the projects liaise with a local NGO (non-governmental organisation) for project implementation. Examples include Cole et al. (2010), Gaurav et al. (2010) and Giné et al. (2008). Co-operating with local NGOs, microfinance institutions and other local organisations to market insurance products and administer payouts has the potential to simplify the implementation by tapping into the established trust of these organisations and lower premium costs. Organisations like BASIX and NASFAM (National Smallholder Farmers

Association of Malawi) are trusted local organisations whose involvement has significant potential to increase take-up of these products. In addition, farmers often have less than complete understanding of the products and explanations by representatives can help overcome informational barriers. Of course, the impact of co-operating with a local body will differ depending on the reputation of the organisation, the staff's knowledge of the products, their performance in marketing and providing information, and their success in implementing different aspects of the project.

The relationship between local NGO co-operation and take-up has been quantified. We calculated a simple correlation coefficient between take-up and whether or not the project co-operated with an NGO, mostly as an interesting exercise. The correlation was –0.287, but insignificant (p-value 0.468). In terms of results from the papers, the connection between prior knowledge of the NGO by potential customers of the insurance product and take-up seems to depend on the organisation in question, with both positive and negative effects reported. This is analysed in greater detail in section 4.2.5.

4.2 Synthesis of evidence

This section synthesizes and analyzes the evidence on take-up and impact of index-based insurance presented in the papers included in the review. Section 1 gives an overview of the studies that evaluate the impact of insurance, which represents the outcomes section of the causal mechanism in section 1.2. Sections 4.2.2– 4.2.6 analyse the role of contextual factors identified in the causal mechanism. These include the relationships between assets, income, liquidity, financial literacy, trust and take-up. Sections 4.2.7 and 4.2.8 look at the role of the mechanisms identified in the causal chain, such as product design and marketing, in take-up of index-based insurance products.

4.2.1 Potential threats to validity

The small number of studies that were finally included in the review is itself a reason for pause when generalizing the results, however it is also important to consider the potential threats to the validity of these studies as well. Table 4.3 below lists the analytical methods and product type, describes the sample and treatment allocation and notes some potential threats to study validity.

As discussed in section 2.2.1 above, we deal with two different types of studies, those that deal with determinants of take-up and those that deal with impact of having insurance. Of the eleven studies that addressed take-up, two use randomized assignment and the remainder use econometric methods on non-randomized data sets. Cole et al (2010), Gaurav et al (2010), Hill and Robles (2010) use randomized assignment of real contracts and Stein (2010) uses exogenous variation from rainfall to overcome selection bias and other confounding factors. The other eight studies however limit themselves to identifying credible correlates for willingness to pay for hypothetical contracts, and therefore selection bias is not a serious concern. These studies that report predictors of demand for insurance may be useful in a policy environment even if they do not establish causal links.

Both Giné and Yang (2009) and Hill and Viciesza (2010) which are the only included studies that address impact beyond take-up use randomized field experiment methodologies with no substantial differences in the treatment and control groups at baseline.

Table 4.3: Potential threats to study validity

Short title	Analytical Method *(Product Type)*	Sample Description	Treatment Allocation	Notes on Study Validity
Chantarat et al. (2009)	Econometric *(Hypothetical insurance contracts)*	210 households, 42 in each of 5 locations Marsabit district in northern Kenya participated in a survey. The 5 arid and semi-arid pastoral locations are broadly representative of Kenya, encompassing variability in climate, geographical resources, pastoralism, ethnic majorities and market access.	No treatment allocation all surveyed households participated in educational insurance games and willingness to pay experiment.	Since this is a non-experimental study, there was no random assignment of treatment and control and no measurement of spillovers. Power calculations are not reported. However 3 wealth classes, based on herd size, stratified the sample. Fourteen households were sampled from each wealth strata at each location. 3 households were dropped because 2 didn't own livestock and 1 couldn't participate in the insurance game.
Cole et al. (2010)	Randomized field experiment *(Real insurance contracts)*	This study used samples in two different states. In 2006 700 households were randomly selected for treatment in Andhra Pradesh from a total of 952 available households from the 2004 baseline sample. The full sample in 2004 was 1060, however by when the experiments were conducted in 2006 there was attrition of 10.2% primarily due to death and out-migration. In Gujarat, the study was conducted in two groups of villages. The first group, comprising 30 villages randomly selected from among 100, received marketing visits in 2006. A second group of 20 villages, randomly selected from among the 70 that had not received marketing in 2006, were added in 2007.	Experimental treatments were randomly assigned at the household level in both states. In Andhra Pradesh, the 700 treatment households were then randomly assigned treatments along three different dimensions. The remaining households serve as the control group. In the first group of villages in Gujarat, from the set of households visited in 2006, 2,391 households received a second marketing visit in 2007. Each of these households received 1 of 6 randomly assigned flyers. In the second group of villages there were 315 surveyed households. Each surveyed household was randomly assigned 1 of 4 possible video treatments. A further 1,100 households, who had not been selected for survey, were assigned 1 of 8 videos, and a randomly selected discount between Rs. 5 and Rs. 30.	In Andhra Pradesh the financial literacy modules were implemented very quickly, which the authors believe might explain why it did not have any measured impact. Surveyed households are 16 to 18 percent more likely to purchase insurance than those who were not part of the survey. However, surveyed households were not randomly assigned, and the identified effect thus includes any effect of being surveyed, combined with the fact that surveyed households were selected because they were more likely to purchase insurance. The surveyed samples do no differ appreciably from the population; differences between treatment and control groups are not reported. No power calculations are discussed.
Gaurav et al. (2010)	Randomized field experiment *(Real insurance contracts)*	3 coastal sub-districts in Gujarat, India, heavily exposed to monsoon risk were identified by the implementing agency. Although the sites have agro-climatic differences, almost all households in the selected area grow cotton and groundnuts without irrigation.	300 households were randomly assigned to receive financial literacy education, and 300 households in the control group received no financial literacy education. The financial literacy education comprised of an invitation to attend the financial literacy training	Baseline characteristics for the treatment and control groups were similar. No specific randomization problems were noted, nor were power calculations discussed. Survey compliance was near perfect, 597 of 600 sampled farmers participated.

Short title	Analytical Method *(Product Type)*	Sample Description	Treatment Allocation	Notes on Study Validity
		5 villages in each sub-district were selected; within each village 40 farming households were randomly selected from a sampling frame comprising all the landholding farmers in the village with experience growing cotton or groundnut.	in the village before the rainfall insurance product was marketed to all 600 households.	
Giné and Yang (2009)	Randomized field experiment *(Real insurance contracts)*	The sample comprised 32 localities in Malawi. Each locality has an average of 5 clubs from neighboring villages, where the clubs are the official recipients of the loans. Clubs are supposed to be jointly liable for loans but this is rarely enforced so in reality loans are effectively given at an individual level	16 localities were randomly assigned to be in the treatment group to receive weather insurance linked loans and 16 in the control group that received uninsured loans. There were 393 farmers in the treatment group and 394 farmers in the control group.	Although the outcomes measured at the baseline for the treatment and control groups were similar, the control group had almost one additional year of schooling. Controlling for this difference doesn't substantially alter the results. No problems with randomization or statistical power calculations were reported.
Giné et al. (2008)	Econometric *(Real insurance contracts)*	This study uses a weighted probit regression to analyze data from a sample drawn from a census of landowning households across 37 villages in two districts in Andhra Pradesh. Empirical analysis is restricted to 25 villages where at least five households purchased insurance in 2004 were surveyed. The surveyed sample was stratified by the following characteristics: (i) household purchased insurance (267 households), (ii) household attended insurance marketing meeting but did not purchase insurance (233 households) and (iii) household did not attend marketing meeting (252 households). The total sample size is 752 households. The sample of 267 purchasers represents a large fraction of the 315 total households that purchased insurance in 2004.	Non-random treatment allocation was determined by BASIX the agency selling insurance.	The authors' note that the hypothesis that their results reflect unobserved heterogeneity across groups, rather than the effect of local social interactions cannot be ruled out. For example, BASIX may have marketed the insurance at greater intensity to particular groups in the village, which would generate correlation in insurance take-up decisions amongst members of a group. On some of the baseline characteristics there are significant differences between insurance buyers and non-buyers. Buyers have 50% more land and nearly twice as much liquid assets as non-buyers. Buyers less risk-averse than the overall sample. A third of insurance purchasers belong to bore well user association (BUAs), relative to only 4% in the general population. Additionally, 46% of buyers have outstanding credit from BASIX at the start of Kharif relative to 7% of the overall population. Power calculations were not discussed explicitly.
Hill & Robles (2010)	Econometric *(Real insurance contracts)*	This study examines data from an experimental game conducted in 2009 and an insurance pilot	For the insurance pilot insurance was offered to 480 randomly selected farmers in 24 villages.	Most households participated through the burial societies, which greatly reduced the number of effective

Short title	Analytical Method *(Product Type)*	Sample Description	Treatment Allocation	Notes on Study Validity
		conducted in 2010. In the experimental game index-insurance was offered in two Ethiopian villages. 406 households were surveyed, of which 23 were participating individually, 343 were participating as part of burial insurance societies and 40 did not participate in the experiment.		observations, limiting variation and adversely affecting the power of the results. Since the game and pilot used different samples, there is no attrition problem.
Hill and Viceisza (2010)	Randomized laboratory experiment *(Hypothetical insurance contracts)*	Four villages with varying agro-climatic conditions and market accessibility were selected. In each village the largest burial insurance group was automatically chosen, and five of the smaller groups were were randomly sampled from each village for a total of 20 burial insurance groups.	12 persons were randomly sampled from a census of group members provided by the group leaders. The sample was stratified to ensure that at least two leaders from each group participated. 10 additional persons were randomly selected to participate as part of the largest groups in each village. Six laboratory sessions a day were randomly offered no insurance while the other six were mandated insurance in the final two periods of decision-making. Initial wealth, returns on fertilizer use, good and bad weather and actuarially fair pricing of insurance were randomized at the individual level.	Only the median yield loss from bad weather differed significantly between treatment (81%) and control groups (75%). Due to the many levels and rounds of randomization, there were significant wealth differences in subsequent rounds of the game, since the control group experiences more adverse shocks from bad weather. This change may affect perceptions about risks and benefits of fertilizer purchases in the final round. Author's control for these differences by adding covariates in a fixed-effects regression. There is also some evidence of differences in initial fertilizer preference between the two groups. This is netted out and controlled for in the regression. No formal power calculations are discussed.
McCarthy (2003)	Econometric *(Hypothetical insurance contracts)*	The author chose the sample. Data is collected through a simple survey eliciting willingness to pay for a hypothetical weather-indexed insurance contract was administered in 4 districts of Morocco– Settat, Meknes, Ourjda, and Essaouira. Settat and Meknes have relatively high mean rainfall and crop yields compared to the two others. Also, Settat and Essaouira experience greater variability in crop yields.	Only households within a 20-kilometer radius of a rainfall station and holding sufficient landholdings to be net sellers were included in sample. This meant a minimum of 5 hectares for households in Settat and Meknes, and a minimum of 10 hectares for households in Oujda and Essaouira. This measure was taken to reduce basis risk.	Due to a data entry error, there is no available data for two of the contracts offered. Meknes district was not included in empirical analysis data, due to problems. Enumerators did not collect complete data on females, so study only presents data on males. Finally, in eliciting willingness to pay, there was a bias for those who started with the lower bound. Because follow-up questions were open-ended, respondents could have engaged in loss-averting behavior when responding to the open-ended follow-up, giving a lower value in the belief that this might influence actual contracts offered in the future. Data clearly reflect this predicted pattern of bias in the

Short title	Analytical Method *(Product Type)*	Sample Description	Treatment Allocation	Notes on Study Validity
				second-stage responses, so author restricts analysis to the first-stage dichotomous choice responses. No formal power calculations or actual number of observations were provided.
Sarris et al. (2006)	Econometric *(Hypothetical insurance contracts)*	This study utilizes a random sample of 957 rural households in 45 village of Kilimanjaro region and 892 rural households in 36 villages of Ruvuma region. Kilimanjaro is relatively more developed and populated, while Ruvuma is more agro-climatically diverse. The sample is representative of cash and non-cash crop farmers. Data were collected in Kilimanjaro in November 2003 and November 2004, and in Ruvuma in February-March 2004 and February-March 2005.	All surveyed households were asked about willingness to pay.	No statistical power calculations or attrition data are reported.
Seth et al. (2009)	Econometric *(Hypothetical insurance contracts)*	536 respondents were randomly chosen from 6 villages in Rajasthan an arid state in northern India. Villages were chosen based on the number of policies sold through two index-insurance products sold by the Agricultural Insurance Company of India.	All survey respondents were asked questions about contingent valuation/willingness to pay.	Respondents were chosen proportional to the number of farmers who had opted for insurance schemes; this yielded an almost equal proportion of farmers who had subscribed to existing crop insurance schemes, and those who had not. The authors provide detailed power calculations, and compute that the sample of 536 gives a confidence interval of 4.2% with a confidence level of 95%
Stein (2010)	Econometric *(Real insurance contracts)*	Using administrative data from the entire sample of 19,882 BASIX customers, the author constructs a panel of rainfall index insurance from 2005-07 covering 6 states in India.	Uses administrative data, no random treatment allocation.	Marketing intensity is not observable in the available data, which is an important limitation on interpretation.
Turvey and Kong (2010)	Econometric *(Hypothetical insurance contracts)*	897 farming households in Shaanxi and Gansu provinces in central China were surveyed during the harvest of October 2009. Author's report that 98% of households completed the survey with few reported problems.	All surveyed households were asked about willingness to pay.	No information on how the households were chosen is provided. No formal power calculations were provided.
Vandeveer (2001)	Econometric *(Hypothetical insurance contracts)*	100 households were interviewed about their interest in buying 12 different types of area-	All surveyed households were asked about their interest in and willingness to pay for indexed	A problem of multi-collinearity was suspected due to the correlation between a higher premium, a higher

Short title	Analytical Method *(Product Type)*	Sample Description	Treatment Allocation	Notes on Study Validity
		yield insurance. This yielded 1200 observations on insurance decisions. Binomial Logit models were estimated for district and commune insurance decisions to identify determinants of take-up by exploiting the variance in household characteristics.	insurance.	yield guarantee, and a higher indemnity price. In response to this problem, the yield guarantee was instead represented with a dummy variable No formal power calculations were provided.

4.2.2 The impact of insurance

There are two studies that analyse the impact of insurance. Giné and Yang (2009) analyse an experiment in which the treatment group is offered a loan product and an insurance product bundled together, without the possibility to purchase either separately. Respondents in the control group were offered the loan without the requirement (or option) to purchase weather insurance. The only study to examine the direct impact of insurance on investment behaviour is Hill and Viceisza (2010). In a lab experiment, respondents are randomly assigned insurance to evaluate the impact on fertiliser purchases.

In terms of direct effects, Giné and Yang (2009) find that the level of take-up is lower for a loan to finance hybrid seeds that is bundled with actuarially fair weather insurance than a loan offered on its own. This is a surprising finding, given that it is commonly argued that one of the major obstacles to technology adoption is imperfect credit and insurance markets. It is possible that this finding is explained by the implicit limited liability clause in the loan contract, as defaulters could apply for future loans. In essence, the lender was already providing an alternative insurance mechanism. Table 4.4 summarises the findings on impact of insurance and heterogeneous treatment effects.

Hill and Viceisza (2010), on the other hand, find that households that are offered a hypothetical insurance product significantly increase their purchases of fertiliser. The authors do stress, however, that results are mixed depending on the methodology used. The most favourable results (reported above) indicate that access to insurance makes the purchase of an additional bag of fertiliser 29 percent more likely, which is a sizeable effect. In fact, the calculations of the authors imply that general insurance provision would increase the average return realised by farmers in Ethiopia by 21.8 percent, in addition to other welfare and consumption smoothing benefits arising from insurance coverage. These would be considered very large impacts and undoubtedly need to be complemented by other research both within Ethiopia and in other contexts.

Table 4.4: Impact of insurance

Short Title →	Giné & Yang, (2009)		Hill and Viceisza (2010)	
Product Type →	Real		Hypothetical	
Outcome →	Take-up of hybrid seeds		Purchase of fertilizer	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
DIRECT EFFECTS				
Insurance	-0.128 *	-0.062	0.291 ***	0.219
	(0.074)		(0.085)	
INTERACTION EFFECTS				
Insurance*Pay for product			0.312 ***	0.120
			(0.096)	
Insurance*Free product			0.264 ***	0.113
			(0.085)	
Insurance*High understanding			0.306 ***	0.130
			(0.087)	
Insurance*Low understanding			0.234 *	0.071
			(0.120)	
Insurance*Risk averse			0.285 ***	0.130
			(0.080)	
Insurance*Risk neutral			0.274 **	0.095
			(0.106)	
Insurance*High CV of return to fertilizer			0.328 ***	0.120
			(0.100)	
Insurance*Low CV of return to fertilizer			0.257 ***	0.106
			(0.089)	
Insurance*Has purchased fertilizer			0.289 ***	0.131
			(0.081)	
Insurance*Has not purchased fertilizer			0.270 ***	0.100
			(0.099)	
Sample Size	787		248	
Method	OLS		Difference in difference (FE)	
Country	Malawi		Ethiopia	
Data Year	2006		2009	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.
[Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

In terms of the interaction effects presented in Hill and Viceisza (2010), the impact on fertiliser purchases is higher if the smallholder has to pay for the hypothetical insurance product rather than it being offered for free. It is also shown that farmers that have a high level of understanding of the contract increase their purchases of fertiliser significantly more than farmers with a lower level of understanding. Access to insurance also appears to have a marginally higher impact on fertiliser purchases for more risk-averse farmers.

Hill and Viceisza (2010) also find that farmers who face more-risky investment prospects, i.e. a higher variation in the returns to fertiliser, respond more strongly to insurance provision. Finally, they find that insurance has a stronger impact on farmers who had purchased and used fertiliser in the past.

4.2.3 Assets, income and liquidity

This section looks at how the decision to purchase insurance is related to the current asset base, income level and availability of liquidity to the household.

Table 4.5: Asset outcomes

Short Title →	**Chantarat et al. (2009)**		**Hill and Robles (2010)**		**Turvey and Kong (2010)**		**Giné et al. (2008)**		**Seth et al. (2009)**		**Cole et al. (2010)**	
Product Type →	**Hypothetical**		**Real**		**Hypothetical**		**Real**		**Hypothetical**		**Real**	
Outcome →	**WTP**		**Take-up**		**Take-up**		**Take-up**		**Take-up**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
Ln (Total livestock)	-0.920 ***	*-0.400*										
	(0.160)											
Ln (Productive assets)	0.130 ***	*0.226*										
	(0.040)											
Ln (Non-productive assets)	-0.110 ***	*-0.191*										
	(0.040)											
Endowment			0.288 **	*0.441*								
			(0.112)									
Asset value					0.00	*0.00*						
					(0.000)							
Log (Wealth in Rs., start of Kharif)							0.029 *	*0.001*				
							(1.720)					
Log(Landholdings, start of Kharif)							-0.006	*-0.001*				
							(0.310)					
Log(landholdings, start of Kharif)							-0.006	*-0.001*				
							(0.310)					
Livestock holding									0.247 ***	*0.194*		
									(0.055)			
											(0.013)	
Wealth index											0.046 ***	*0.127*
											(0.013)	
Sample Size	207		34		897		752		536		1047 (Full AP) 772 (Gujarat)†	
Method	Weighted interval regression model		Not clear		Maximum Likelihood GLM		Weighted Probit		Linear Random Utility Model		Linear Probability	
Country	Kenya		Ethiopia		China		India		India		India	
Data Year	2008		2009-10		2009		2004		2007		2006 and 2007	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. † Only included surveyed households
[Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

Table 4.5 presents a summary of findings that relate to holdings of wealth, productive assets and livestock. In terms of assets, the results are mixed, with negative relationships found in Chantarat et al. (2009) and a positive relationship found in Seth et al. (2009). Most of the results relating to landholding are insignificant, which is in line with a priori expectations. General wealth and endowment variables are found to have a positive, but less-significant, relationship with interest in insurance.

Table 4.6: Income outcomes

Short Title →	**Chantarat et al. (2009)**		**Vandeveer (2001)**		**Giné and Yang (2009)**		**Cole et al. (2010)**		**Sarris et al. (2006)**	
Product Type →	**Hypothetical**		**Hypothetical**		**Real**		**Real**		**Hypothetical**	
Outcome →	**WTP**		**Take-up**		**Take-up**		**Take-up**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
Ln (Income per capita)	0.450** (0.170)	0.184								
Average total income			0.025** (0.004)	0.163						
Net income (MK 100, 000)					0.075* (0.053)	0.071				
Log of monthly per capita expenditures (winsorized)							0.032 (0.038)	0.026		
Per capita income in Tsh									0.000** (2.640)	0.000
Herfindahl Index of gross income diversification									-0.003** (2.440)	0.000
Sample Size	207		1200		393		1047		914	
Method	Weighted interval regression model		Logit model		OLS		Linear Probability		Probit	
Country	Kenya		Vietnam		Malawi		India		Tanzania	
Data Year	2008		2008		2006		2006 and 2007		2003, 2004 and 2005	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

Table 4.6 presents results about the relationship between income and take-up. These relationships tend to be positive, when significant. Chantarat et al. (2009), Vandeveer (2001) and Sarris et al. (2006) report positive relationships between their measures of income and interest in the hypothetical insurance products offered in those studies. This finding is not in line with a priori expectations and it is possible that the relationship between income and liquidity is driving these findings. Sarris et al. (2006) finds a negative correlation between income diversification and take-up which is consistent with expectations.

Table 4.7: Liquidity and credit outcomes

Short Title →	Sarris et al. (2006)		Seth et al. (2009)		Chantarat et al. (2009)		Giné et al.(2008)	
Product Type →	**Hypothetical**		**Hypothetical**		**Hypothetical**		**Real**	
Outcome →	**Take-up**		**Take-up**		**WTP**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
Share of cash to total gross income	0.002 ** (2.350)	*0.000*						
Easy access to short term credit (1=yes)	0.021 (0.330)	*0.002*						
Used own savings when shock occurred (1=yes)	0.204 *** (4.630)	*0.001*						
Used family assistance when shock occurred (1=yes)	-0.125 ** (2.52)	*-0.002*						
Monthly savings			0.055 *** (0.023)	*0.103*				
Credit constrained (1=yes)					0.570 (0.530)	*0.075*		
Household is constrained (1=yes)							-0.026 (1.550)	*-0.001*
Credit from BASIX							0.177 *** (3.620)	*0.002*
Sample Size	914		536		207		752	
Method	Probit		Linear Random Utility Model		Weighted interval regression model		Weighted Probit	
Country	Tanzania		India		Kenya		India	
Data Year	2003, 2004 and 2005		2007		2008		2004	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

Table 4.7 presents results about liquidity and credit, and take-up/WTP. Five significant results in three studies are found for variables that are associated with liquidity levels. The share of cash to total gross income, monthly savings and credit from BASIX are all positively associated with insurance take-up. Sarris et al. (2006) find that using family assistance during the last shock is negatively related with take-up of a hypothetical insurance product. This is in line with a priori expectations if we imagine that access to informal risk sharing mechanisms lowers the demand for formal insurance.

4.2.4 Risk structure and risk management

Table 4.8 presents a summary of risk structure and risk management variables and their association with take-up of index-based insurance products. The results for irrigation variables are zero or negative, which is in line with a priori expectations, although none of the irrigation or risk management variables is significant. In terms of past variability of yields and rainfall, four findings are significant and all six results indicate a positive relationship with take-up. This makes logical sense, as one would expect experience of more-variable weather conditions and harvest levels to induce higher levels of demand for insurance.

The relationship between variables measuring the level of risk and take-up is less clear. The historic average rainfall variables are negative, which is in line with a priori expectations if we expect that higher levels of average rainfall are associated with lower demand for insurance products that are primarily intended to

insure against loss in the event of inadequate rainfall. The variables measuring the number of risk factors in Vandeveer (2001) and number of years with income substantially below normal (Sarris et al. 2006) are both insignificant. Expected risk, as measured by expected livestock loss in Chantarat et al. (2010), is positively related with take-up, which is in line with a priori expectations.

Table 4.8: Risk structure and risk management outcomes

Short Title →	**Turvey and Kong (2010)**		**Sarris et al. (2006)**		**Cole et al. (2010)**		**Vandeveer (2001)**		**Stein (2010)**		**Seth et al. (2009)**		**Chantarat et al. (2009)**	
Product Type →	**Hypothetical**		**Hypothetical**		**Real**		**Hypothetical**		**Real**		**Hypothetical**		**Hypothetical**	
Outcome →	**Take-up**		**Take-up**		**Take-up**		**Take-up**		**Take-up**		**Take-up**		**WTP**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
IRRIGATION														
Irrigation use	-0.009	-0.001												
	(0.346)													
Proportion of irrigated land			0.000	0.000										
			(0.290)											
Per cent of cultivated land that is irrigated					-0.012	-0.010								
					(0.037)									
VARIABILITY														
Revenue coefficient of variation	0.002 *	0.056												
	(0.001)													
Yield coefficient of variation	1.272 **	0.069												
	(0.617)													
Historical rainfall standard deviation									0.029	0.044				
									(0.024)					
Historical rainfall standard deviation									0.083 ***	0.125				
									(0.025)					
Standard deviation of litchi yield							-0.000	-0.011						
							(0.000)							
Surety of yield											0.054 ***	0.106		
											(0.022)			
RISK STRUCTURE														
No. of risk mgmt. responses mentioned							0.032	0.008						
							(0.111)							
Number of risks mentioned							-0.177							
							(0.099)							
Number of litchi trees that died in 1997-98							0.043 **							
							(0.019)							
Historical average rainfall									-0.015 **	-0.096				
									(0.006)					
Historical average rainfall									-0.014 ***	-0.104				
									(0.005)					
Drought since 1998 affected living conditions (1=yes)			0.028	0.002										
			(0.590)											
No. of years when total household income declined significantly below normal, during last 10.			-0.009	0.000										
			(0.800)											
EXPECTED RISK														
Expected livestock loss in 2009													1.820 **	0.154
													(0.820)	
Sample Size	897		914		1047		1200		733		536		207	
Method	Max. Likelihood GLM		Probit		Linear Probability		Logit		OLS		Linear Random Utility Model		Weighted Interval regression model	
Country	China		Tanzania		India		Vietnam		India		India		Kenya	
Data Year	2009		2003, 2004 and 2005		2007 and 2008		2008		2005, 2006 and 2007		2007		2008	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

4.2.5 Financial literacy

Table 4.9 summarises the results for the five studies that examine the relationship between financial literacy and take-up. All significant results indicate a positive relationship between variables that measure either existing skills or financial literacy training and take-up of index-based insurance. A small, negative coefficient is recorded in Cole et al. (2010) for the financial education module, but the result is insignificant.

Table 4.9: Financial literacy outcomes

Short Title →	**Chantarat et al. (2009)**		**Gaurav et al (2010)**		**Giné et al. (2008)**		**Seth et al. (2009)**		**Cole et al. (2010)**	
Product Type →	**Hypothetical**		**Real**		**Real**		**Hypothetical**		**Real**	
Outcome →	**WTP**		**Take-up**		**Take-up**		**Take-up**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
Have bank account (1=yes)	0.680 (0.850)	0.056								
Invited to Training			0.046 * (0.030)	0.063						
Invited to Training *below median financial literacy†			0.073 **							
Use accumulated rainfall to decide to sow					0.056 * (1.710)	0.001				
Has other insurance					0.012 (0.910)	0.000				
Insurance awareness							0.287 *** (0.063)	0.197		
Visit									0.120 *** (0.043)	0.086
Education module									-0.003 (0.036)	-0.003
Insurance skills (normalized)									0.046 *** (0.015)	0.095
Household has other insurance policy (1=Yes)									0.113 *** (0.033)	0.106
Sample Size	207		597		752		536		1047	
Method	Weighted interval regression model		OLS		Weighted Probit		Linear Random Utility Model		Linear Probability	
Country	Kenya		India		India		India		India	
Data Year	2008		2009		2004		2007		2006 and 2007	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. † Standard Deviation not reported for heterogeneous effects in original paper. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

In terms of heterogeneous effects, the training treatment yields a significant increase in take-up when analysed for the subsample including only respondents with lower than median financial literacy (Gaurav et al. 2010).

4.2.6 Trust and networks

Table 4.10 summarises two studies that analyse the relationship between higher trust in an external agent and take-up of index-based insurance. Trust is particularly important in the context of insurance because, unlike for credit, the policyholder relies on the insurance company to honour its promise of a payout in case a payout is triggered. Given that index-based insurance is a relatively new product, trust may be an important determinant of participation in insurance markets. Five out of six results indicate a positive and significant relationship

between previously earned trust or familiarity and take-up. Only the variable capturing a strong focus on the connection with the Self Employed Women's Association (SEWA) in a commercial video advertising weather insurance in the Cole et al. (2010) study points in the opposite direction. This finding is surprising as we would expect that emphasising the connection with a well-regarded and trusted NGO would increase interest in the insurance product. Overall, however, this relationship appears positive, and relatively strong.

Table 4.10: Trust and networks outcomes

Short Title →	**Giné et al. (2008)**		**Cole et al. (2010)**		**Chantarat et al. (2009)**	
Product Type →	**Real**		**Real**		**Hypothetical**	
Outcome →	**Take-up**		**Take-up**		**WTP**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
TRUST IN EXTERNAL AGENT						
BUA member	0.313 *** (2.960)	0.004				
Credit from BASIX	0.177 *** (3.620)	0.002				
Strong SEWA brand [a]			-0.096 ** (0.040)	-0.064		
Does not know BASIX [b]			-0.054 ** (0.027)	-0.062		
Endorsed by LSA[b]			0.104 ** (0.043)	0.075		
Does not know BASIX x Endorsed by LSA[b]			-0.173 ** (0.076)	-0.070		
TRUST IN PEERS/NETWORKS						
No. of well known households who bought insurance	0.012 ** (2.040)	0.000				
Peer endorsed [b]			0.028 (0.056)	0.013		
Belong to active network (1= yes)					1.270 *** (0.410)	0.215
Sample Size	752		[a]1413, [b]1047		207	
Method	Weighted Probit		Linear Probability		Linear Probability	
Country	India		India		Kenya	
Data Year	2004		2007 and 2008		2008	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

In terms of trust elicited by peers or networks, the association with take-up is positive in all three studies examining this type of relationship, although the Cole et al. (2010) result is insignificant. Overall, trust seems to have a positive relationship with take-up, especially trust in the organisation offering insurance.

4.2.7 Risk aversion

Table 4.11 summarises results from the five studies that examine the relationship between risk aversion and take-up. Four out of five estimates suggest a negative relationship between risk aversion and take-up, but only one of these is significant at the 90 percent level.

This is contrary to a priori expectations. A possible explanation for the negative relationships observed is the possibility that the product itself is seen as risky, either because of basis risk or because it is not properly understood. In either case, risk-averse households would be less likely to demand the product offered. If this is the case, product improvements that reduced basis risk and a focus on clear

communication and financial literacy would have the potential to increase demand for insurance.

Another possible explanation for these results is the relationship between risk aversion and income, as households with lower incomes tend to be more risk-averse. It is possible that the estimation equations used for the results below did not adequately control for income, with risk aversion proxying for low income, which is also associated with lower demand for insurance.

Table 4.11: Risk aversion

Short Title →	**Chantarat et al. (2009)**		**Gaurav et al (2010)**		**Giné and Yang, (2008**		**Giné et al. (2008)**		**Cole et al. (2010)**	
Product Type →	**Hypothetical**		**Real**		**Real**		**Real**		**Real**	
Outcome →	**WTP**		**Take-up**		**Take-up**		**Take-up**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
Risk aversion (CRRA)	-0.620	-0.108								
	(0.400)									
Risk aversion (self reported)					-0.008	-0.067				
					(0.006)					
Risk aversion			0.053	0.043			-0.049	-0.001	-0.102 *	-0.053
			(0.050)				(1.390)		(0.059)	
Sample Size	207		597		393		752		1047	
Method	Weighted interval regression model		OLS		OLS		Weighted Probit		Linear Probability	
Country	Kenya		India		Malawi		India		India	
Data Year	2008		2009		2006		2004		2007 and 2008	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

4.2.8 Product design

Table 4.12 summarises the results of studies that examine the importance of product design in influencing rates of take-up, including cost, design and past payouts.

Three studies measure the relationship between the cost of the insurance policy and take-up. Unsurprisingly, lower cost (or a higher discount) is positively correlated with take-up of insurance. In terms of basis risk and product design more broadly, Giné et al. (2008) find that farmers who plant a high share of groundnut, one of the crops for which the contract is designed, are more-likely to purchase insurance. This finding is in line with predictions that farmers who face lower levels of basis risk have higher demand for insurance.

Stein (2010) looks at the impact of having received a payout in the past. Receipt of a payout increases demand for insurance, and having received a payout that was more than twice the size of the premium yields an even larger effect size. Even if these findings seem plausible, they are surprising, given that a rational actor who fully understands the product should purchase the insurance based on the merits of the contract, not based on past payout experience. This finding corroborates previous analysis suggesting that trust in the product or its representatives and understanding of the insurance product may not be complete. It is worthy of note that marketing is endogenous, so a payout may trigger larger marketing efforts.

Four studies test the impact of different aspects of insurance policy design on take-up. Vandeveer (2001) finds that higher yield guarantee levels are associated with higher take-up in a hypothetical setting. Interestingly, Seth et al. (2009) find that potential customers show a preference for opting for hypothetical group-based insurance policies.

In McCarthy (2003), comparisons between regressions show that respondents in high rain variability regions prefer contracts that have higher trigger levels (i.e. that pay out more often). However, estimated coefficients for explanatory variables did not have consistent impacts, either across or within regions. Seth et al. (2009) also show that the type of weather factor that an insurance policy hedges against, as well as the time period covered, has a significant impact on WTP for insurance. Most people preferred a policy that hedges against both variations in rainfall and temperature.

Both Vandeveer (2001) and Sarris et al. (2006) look at the indemnity prices of contracts. A higher indemnity price means a higher indemnity payment in case of loss and should therefore be an appealing feature of an insurance contract, all else being equal. The result reported in Vandeveer (2001) points in the opposite direction, indicating a negative relationship between indemnity price offered and WTP. It is noted by the author that this is a surprising finding.

4.2.9 Marketing

Studies examining the impact of marketing on take-up are summarised in Table 4.13. In terms of marketing effects, there are very few significant results to report. In Gaurav et al. (2010), the effects of a money-back guarantee (offering a full refund if the policy did not yield a payout), provision of weather forecasts regarding the quality of the upcoming monsoon and a promotional demonstration were tested. None was shown to significantly affect take-up rates on its own. The combination of all three marketing treatments did increase take-up somewhat, but the combined cost of these treatments would probably be prohibitive on a larger scale.

Table 4.12: Product design

Short Title →	Giné et al. (2008)		Sarris et al. (2006)		Cole et al. (2010)		Vandeveer (2001)		Stein (2010)		Seth et al. (2009)	
Product Type →	**Real**		**Hypothetical**		**Real**		**Hypothetical**		**Real**		**Hypothetical**	
Outcome →	**Take-up**		**Take-up**		**Take-up**		**Take-up**		**Take-up**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
COST												
Premium							-0.067 **	-0.070				
							(0.028)					
Highest bid value at which respondent said 'yes'											-0.033 ***	-1.425
											(0.001)	
Discount in Rs.					0.004	0.035						
					(0.003)							
DESIGN												
Yield guarantee dummy							1.686 ***	0.193				
							(0.252)					
Indemnity price for produce							-0.038 *	-0.051				
							(0.022)					
Preference for opting for groups											0.090 ***	0.097
											(0.040)	
Preference of weather factors to hedge against											0.116 ***	0.100
											(0.050)	
Preference for contract time period											0.127 ***	0.229
											(0.024)	
Type A contracts (low indemnity)			0.000 ***	0.000								
			(5.060)									
Type B contracts (medium indemnity)			0.000 ***	0.000								
			(5.300)									
Type C contracts (high indemnity)			0.000 ***	0.000								
			(5.590)									
Percent cultivated land used for groundnut (Measure of basis risk)	0.092 **	0.001										
	(2.480)											
PAST EXPERIENCE												
Received payout									0.090 ***	0.035		
									(0.024)			
Payout more than twice premium									0.140 ***	0.043		
									(0.031)			
Payout greater than premium but <2x									0.011	0.005		
									(0.020)			
Payout smaller than premium									-0.026	-0.015		
									(0.016)			
Sample Size	752		914		1047		1200		11002, 10997		536	
Method	Weighted Probit		Probit		Linear Probability		Logit model		OLS		Linear Random Utility Model	
Country	India		Tanzania		India		Vietnam		India		India	
Data Year	2004		2003, 2004 and 2005		2007 and 2008		2008		2005, 2006 and 2007		2007	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

Table 4.13: Marketing

Short Title →	Gaurav et al. (2010)		Cole et al. (2010)	
Product Type →	**Real**		**Real**	
Outcome →	**Take-up**		**Take-up**	
Explanatory Variable	*Est. Effect (Std. Err.)*	*Std. Effect*	*Est. Effect (Std. Err.)*	*Std. Effect*
Money back guarantee	0.018	0.015		
	(0.050)			
Weather forecasts	0.013	0.011		
	(0.050)			
Demo	0.006	0.005		
	(0.050)			
Money back guarantee*Forecasts*Demo	0.107 *	0.073		
	(0.060)			
Vulnerability framing [a]			0.209 *	0.052
			(0.107)	
Positive framing [a]			-0.068	-0.041
			(0.044)	
Group emphasis Flyer [b]			0.060 **	0.044
			(0.028)	
Muslim emphasis flyer [b]			0.045	0.027
			(0.034)	
Hindu emphasis flyer [b]			0.022	0.015
			(0.030)	
Sample Size	597		[a] 1413, [b] 2391	
Method	OLS		Linear Probability	
Country	India		India	
Data Year	2009		2007 and 2008	

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level. [Std. Eff. = Est. Eff./Std. Dev. (Duflo et al 2006)]

Cole et al. (2010) show that emphasising the vulnerability of the farmer in promotional flyers significantly increases take-up. Similarly, emphasising the responsibility towards a group or family also induces higher levels of take-up. Including subtle religious cues in promotional materials does not have an impact on its own, but does impact take-up decisions when combined with group or family emphasis. Providing discounts is a common marketing strategy, which seems to have a significant and positive impact on take-up as reported in Table 4.12.

4.3 Synthesis: quality assurance

We identified several sources of potential overlap, in which the same data appear to be analysed by multiple papers. Hill and Robles (2010) and Hill and Viceisza (2010) both use the same sample population from an experiment conducted in Silte Woreda, southern Ethiopia. While the former paper analyses take-up, the latter addresses impact.

Giné et al. (2008) and Stein (2010) both base their analyses on an index-based weather insurance project marketed by BASIX with presence in Andhra Pradesh, India, but are using different datasets with radically different sample sizes, whereas that used by Stein also draws on data from five other states in India. The papers by Cole et al. (2010) and Gaurav et al. (2010) are both based on studies in Gujarat, India, but are evaluating different experiments on different samples. Overall, we have taken this issue into account during the analysis and are not of the opinion that it affects the results of the synthesis.

4.4 Summary of results of synthesis

The table below summarises the main results of the synthesis.

Table 4.14: Matrix of synthesis results

		Take-up		Impact on purchase of inputs	
	Factor	**Effect direction**	**Studies**	**Effect direction**	**Studies**
1	Access to insurance			**Negative**	Giné and Yang, (2009)
				Positive	Hill and Viceisza (2010)
2	Liquidity and credit	**Positive**	Sarris et al. (2006), Seth et al. (2009), Giné et al. (2008)		
3	Income	**Positive**	Chantarat et al. (2009), Vandeveer (2001), Sarris et al. (2006)		
4	Income diversification	**Negative**	Sarris et al. (2006)		
5	Assets (wealth)	**Positive**	Hill and Robles (2010), Giné et al. (2008), Cole et al. (2010)		
6	Assets (productive)	**Negative**	Chantarat et al. (2009)		
		Positive	Chantarat et al. (2009), Seth et al. (2009)		
7	Assets (non-productive)	**Negative**	Chantarat et al. (2009)		
8	Variability of weather yields and return of fertiliser	**Positive**	Turvey and Kong (2010), Stein (2010), Seth et al. (2009)	**Positive†**	Hill and Viceisza (2010)
9	Historical risk	**Positive**	Vandeveer (2001), Stein (2010)		
10	Expected risk	**Positive**	Chantarat et al. (2009)		
11	Financial literacy	**Positive**	Gaurav et al. (2010), Cole et al. (2010)		
12	Experience with insurance	**Positive**	Set et al. (2009), Cole et al. (2010)	**Positive†**	Hill and Viceisza (2010)
13	Familiarity with external agent	**Negative**	Cole et al. (2010)		
		Positive	Giné et al. (2008)		
14	Trust in peers/network	**Positive**	Chantarat et al. (2009), Giné et al. (2008)		
15	Risk aversion	**Negative**	Cole et al. (2010)	**Positive†**	Hill and Viceisza (2010)
16	Cost of product	**Negative**	Vandeveer (2001), Seth et al. (2009)		
17	Past payouts	**Positive**	Stein (2010)		
18	Marketing††	**Positive**	Cole et al. (2010)		
19	Pay for product (vs free)			**Positive†**	Hill and Viceisza (2010)
20	Experience Fertiliser			**Positive†**	Hill and Viceisza (2010)

† Interaction effect between indicated factor and access to insurance.
†† Framing in terms of production vulnerability and group responsibility.

5. Strengths and limitations

The main strength of this review comes from its narrow focus on index-based micro-insurance. This is a relatively new product, and particular attention was given to identifying works in progress and unpublished papers. This review has a clear focus on smallholders and rural households in lower- and middle-income countries. The specific focus on index-based micro-insurance has allowed a more-detailed analysis of the causal mechanisms underlying the decisions of smallholders on whether or not to buy insurance. It has also allowed the review to map out why and to what extent the decision to purchase insurance might lead to different household outcomes, both in terms of production earnings and in terms of socio-economic indicators in the areas of health and education.

The realist review methodology guided the focus on causal channels throughout the process of searching, screening and analysing the studies ultimately included in the review. Incorporating this focus from the start helped ensure that we gathered the relevant information about the causal mechanisms assumed to be at play.

Compared to other reviews on micro-insurance, this review has a lower number of included studies. This is due to the focus on index-based insurance, which has primarily gained popularity during the last decade, and the focus on insurance schemes targeting broadly agricultural producers. Dercon and Kirchberger (2008) have conducted a structured literature review on micro-insurance for the International Labour Organization (ILO). Churchill (2006), in collaboration with MunichRe, the CGAP (Consultative Group to Assist the Poor) working group on micro-insurance and the ILO produced a very comprehensive review on micro-insurance. The majority of studies included in other reviews are related to micro health insurance products, which have been available in a range of lower- and middle-income countries for much longer. Radermacher et al. (2010), for instance, has only three of 35 studies relating to non-health microinsurance, and only one (Giné and Yang 2009) relating to index insurance.

The main limitation of this review is the lack of empirical research pursued and published to date, especially research examining the impacts of insurance coverage. Empirical research is at an early stage, with most studies focusing on take-up and WTP for index-based insurance products and very few studies analysing the impacts of participating in an insurance scheme. A consequence of the pioneering feature of this field is that only a limited number of authors have conducted empirical research on this topic, with the two authors co-ordinating this review in that limited group. Having a relatively narrow pool of studies included in the final review limits the ability to generalise the findings and make strong claims of external validity. Nonetheless, the systematic review is able to offer a summary of the current state of knowledge and provide direction for future research and policy.

6. Conclusions and recommendations

6.1 Main conclusions

One of the most important conclusions of the review is the fact that there is a large evidence gap on the impact of index-based insurance. While presenting our conclusions we would like to emphasise that our results are based on a very small sample of studies and our results and conclusions should be interpreted with this in mind. There is some evidence from lab experiments that access to index-based insurance increases the use of agricultural inputs, such as fertiliser and high-yielding variety (HYV) seeds. These findings are encouraging in terms of the potential impacts on agricultural productivity but urgently need to be complemented by more research in more realistic settings.

In addition, the lab experiment by Hill and Viceisza (2010) provides some indication that there is value in exploring heterogeneous effects of marketed insurance programmes. In this study, insurance coverage has a higher impact on insurance takers with better understanding of the insurance product and prior experience with the technology or input in question. More risk-averse smallholders and those who face more-risky investment prospects also show higher impacts of access to insurance. This suggests that efforts to increase understanding both of insurance products and the agricultural inputs and techniques available are important.

Larger behaviour changes are observed amongst farmers who purchase insurance, than from farmers who were provided insurance cover for free. Loans for hybrid seeds bundled with weather insurance was taken-up more often than a pure weather insurance products.

Considering the fact that index-based micro-insurance products and insurance products in general typically face low rates of take-up, it is important to understand the constraints facing potential customers and the aspects of product design that affect demand. While one cannot exclude the possibility that there is a genuine lack of demand for this type of product, the findings that levels of financial literacy, liquidity, trust and other non-standard economic factors affect demand suggest that there is more to the story than low demand.

Several non-price factors appear to affect demand for index-based micro-insurance products. First, households with greater levels of liquidity are much more likely to purchase insurance. Second, both existing financial literacy and participation in training courses are found to increase demand for the insurance products analysed in the review. Finally, higher levels of trust in the agent offering insurance and information about the product from the potential customer's network are also shown to increase levels of take-up.

The impact of marketing and product design factors on take-up rates are also analysed. Most marketing treatments analysed in the papers included in the review have insignificant effects on take-up rates. Framing promotional materials to focus on group and family responsibilities and the vulnerability of the smallholder is shown to have some impact on take-up. In terms of product design, one study indicates that there may be interest in group-based insurance policies.

6.2 Policy recommendations

The evidence in this review suggests a cautious encouragement to continue index-based weather insurance pilots and programmes. This is based in part on a need to increase the pool of empirical research on the impact of these programmes. In light

of the importance of the challenges this product seeks to address and its theoretical possibilities, more projects are necessary to fully evaluate its potential.

In addition, some recommendations regarding policy design and implementation can be made based on the results of the review. First, piloting group-based micro-insurance products, which have the potential to ease both informational and liquidity constraints, might increase take-up rates and is favoured in Seth et al. (2006). The basic idea of group-based micro-insurance is that a group buys insurance together instead of insurance being sold to individuals. Group-based insurance could offer interesting possibilities in terms of how payouts are distributed, ranging from equal shares for all, payouts according to contribution, or increased risk sharing by distributing the payouts to those in the group who were worst affected by the weather event. This last option carries the potential to decrease the individual-level basis risk associated with index-based insurance. Either existing groups, such as savings groups or self-help groups, or newly formed groups, could be used for this purpose.

Second, combining the rollout of insurance products with agricultural extension programmes and financial literacy training is likely to increase both take-up and impact of products sold. Another policy combination that is already being tried out in the field is combining the sales of insurance policies with loans. These loans could be used to either finance the premium or the purchase of inputs.

It is important to note that while the focus of all the papers reviewed has been on the farmer or borrower as beneficiaries of insurance, index-based insurance from the lender's standpoint is an attractive way to mitigate default risk, and thus it can become an effective risk management tool with the potential of increasing access to credit in agriculture at lower prices.

6.3 Research recommendations

The review has revealed substantial evidence gaps in the literature on take-up and impact of index-based micro-insurance. Roughly half of the studies included in the review analyse hypothetical contracts. Even if these offer valuable insights on interest and factors affecting the demand for these products, actual take-up rates are much lower than those observed in lab experiments or hypothetical exercises. The field is in urgent need of evaluations analysing take-up and impact of marketed products as well as qualitative studies to understand the circumstances under which poor farmers are likely to purchase weather insurance.

To ensure completeness and ease of comparison between evaluations of different index-based insurance products, it is important that reports and publications carefully explain the design and marketing of the insurance product, including the loading factor, trigger level, indemnity prices and specific marketing strategies used, if the insurance company is willing to share this information.

Even though most studies included in this review analyse determinants of take-up, several evidence gaps on this topic exist. Additional analysis on the relationship between risk aversion and take-up would be useful to understand if the observed negative relationship holds more broadly and, if so, why. Possible explanations for the apparent negative relationship between risk aversion and take-up are the fact that risk-averse customers might be more sensitive to basis risk, and incomplete understanding of the product when first advertised. Second, analysing why higher-income levels appear to be associated with higher levels of take-up might generate interesting insights into the barriers to household adoption. Third, little is known about the impact of weather insurance on changing poverty outcomes In order to inform large-scale implementation strategies it will be useful to understand the

extent to which holding such insurance improves income and consumption outcomes for smallholder farmers. Finally, analysis of the level of basis risk faced by insurance takers and the relationship with both take-up and impact of insurance coverage is a key, and largely missing, component in our understanding of the effectiveness of index-based micro-insurance.

Another fruitful area of research would be to test specific aspects of product design, and how they relate to take-up. More evaluations should consider piloting or offering different versions of the insurance product to facilitate comparative analysis of important product design features. Permutations could include offering different trigger levels, periods of coverage, proximity to weather stations and coverage for different types of weather events.

However, at this stage, research on the impact of index-based insurance should be the key priority. It cannot be emphasised enough that very few empirical evaluations of marketed index-based micro-insurance programmes exist. Research on how access to insurance affects input usage, crop selection and other agricultural investment choices has the potential to contribute important evidence in the technology adoption, risk management and broader development literatures. Research on how insurance, through lower income variability and higher consumption smoothing, affects decisions made in relation to education, health and other important aspects of household well-being is another key, and so far underexplored, area of research on index-based micro-insurance.

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Appendices

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Conflicts of interest

None of the team members has a financial interest in this project that would constitute a conflict of interest. The Lead Reviewers have been involved in the development of relevant interventions and primary research on this topic. However, all authors of the study, including the reviewers, have adhered to the highest standards of scientific research.

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Appendix 2.1: Coding instrument

A. EXCLUSION CRITERIA

A.1. Study should be excluded: please give reason below:

- A.1.1. Exclude on time
- A.1.2. Exclude on geographical location
- A.1.3. Exclude on scope (does not assess either impact, take-up or project design of (i) weather insurance, or (ii) area-yield crop insurance). Give specifics below:
  - A.1.3.1. Looks at non index-based crop insurance
  - A.1.3.2. Analyzes the impact of lack of access to insurance
  - A.1.3.3. Other: please describe
- A.1.4. Exclude on study design
  - A.1.4.1. Based on macro evidence/discussion
  - A.1.4.2. Based on micro evidence/discussion but is a general discussion paper/review which doesn't analyze primary data on impacts
  - A.1.4.3. Based on micro evidence/discussion but is a theoretical paper which doesn't analyze primary data on impacts
  - A.1.4.4. Does not assess outcomes that can be categorized as either (i) household investment, (ii) household well-being, (iii) consumption smoothing or (iv) take-up
  - A.1.4.5. Study has unclear identification strategy, e.g. no control group or impact evaluation comparing individuals who purchased insurance to those who did not: please describe

B. RESEARCHER AND STUDY CHARACTERISTICS

B.1. What year was the primary document published?

B.2. How many documents were considered in coding this study?

B.3. What was the type of document?

- B.3.1. Journal (peer reviewed)
- B.3.2. Unpublished working paper
- B.3.3. Report
- B.3.4. Other: please describe

B.4. In what country did the evaluation take place?

B.5. World Bank country classification at time data were collected

- B.5.1. Lower-income
- B.5.2. Lower middle-income
- B.5.3. Upper middle-income
- B.5.4. High-income

B.6. What type of index-insurance program is being studied?

- B.6.1. Weather
- B.6.2. Area yield
- B.6.3. Other index-based insurance

B.7. What was the occupational and academic background of the team conducting the study?

C. STUDY CONTEXT

C.1. Is the report an independent evaluation (i.e. the implementing and evaluating organizations are separate entities)?

C.2. Who funded the study?

C.3. Was there any information about product design? What was discussed?

C.4. Was there any discussion of operational implementation? What was discussed?

C.5. Was there any information about existing insurance options (both formal and information)? What was discussed?

C.6. What other information was provided on the context for the evaluation? Please describe.

D. STUDY METHODS AND METHODOLOGICAL QUALITY

D.1. Type of Study

- D.1.1. What type of research method is utilized?
  - D.1.1.1. Randomization/RCT

D.1.1.2. Quasi-experimental
D.1.1.3. Observational/econometric that does not use any random assignment
D.1.1.4. Descriptive/qualitative study (to inform the context of the rest of the studies for the research group)

D.2. Randomization/RCT
D.2.1. Was random assignment used to assign groups?
D.2.1.1. Yes
D.2.1.2. No
D.2.2. At what level was randomization conducted?
D.2.2.1. Individual
D.2.2.2. Village
D.2.2.3. Community organization (e.g. Self-help group)
D.2.2.4. Other
D.2.3. Describe the process of randomization in as much detail as possible given the information in the study.
D.2.4. Were baseline outcome measurements for treatment and control groups similar?
D.2.4.1. Yes
D.2.4.2. No: please describe
D.2.4.3. Unclear
D.2.5. Were baseline characteristics similar?
D.2.5.1. Yes
D.2.5.2. No: please describe
D.2.5.3. Unclear
D.2.6. Were there any randomization problems noted, including but not limited to issues such as balancing of the treatment and control groups?
D.2.6.1. Yes: please describe
D.2.6.2. No

D.3. Quasi experimental study
D.3.1. Which quasi-experimental method was used to equate groups?
D.3.1.1. Regression discontinuity
D.3.1.2. Propensity score matching
D.3.1.3. Interrupted time series
D.3.1.4. Instrumental variables
D.3.1.5. Other: please describe
D.3.2. Describe the criteria for selecting the comparison group.
D.3.3. Describe what is causing the variation in the data.
D.3.4. At what level was non-random assignment made?
D.3.4.1. Individual
D.3.4.2. Village
D.3.4.3. Community organization (e.g. Self-help group)
D.3.4.4. Other
D.3.5. Were baseline outcome measurements similar?
D.3.5.1. Yes
D.3.5.2. No: please describe
D.3.5.3. Unclear
D.3.6. Were baseline characteristics similar?
D.3.6.1. Yes
D.3.6.2. No: please describe
D.3.6.3. Unclear
D.3.7. Were any substantive differences in pre-tests of group equivalence noted by authors?
D.3.7.1. Yes: please describe
D.3.7.2. No
D.3.8. Were any substantive differences in pre-tests of group equivalence noted by reviewer?
D.3.8.1. Yes: please describe
D.3.8.2. No

D.3.9. Were there any problems with the method (including instruments) or the sample noted by authors?
D.3.9.1. Yes: please describe
D.3.9.2. No
D.3.10. Were there any problems with the method (including instruments) or the sample noted by reviewer?
D.3.10.1. Yes: please describe
D.3.10.2. No

D.4. Observational/econometric [not using any form of random assignment]
D.4.1. Which observational/econometric method was used?
D.4.1.1. Cross-section
D.4.1.2. Panel
D.4.1.3. Time series
D.4.1.4. Other: please describe
D.4.2. What identification strategy, if any, have the authors proposed to circumvent the observational nature of the data?

D.5. Generic questions applicable to both random and quasi experimental studies
D.5.1. Describe the sampling strategy and rationale for selecting treatment and control groups.
D.5.2. Were statistical power calculations noted? If yes, record the details.
D.5.2.1. Were rates of compliance noted?
D.5.2.2. Yes: please describe
D.5.2.3. No
D.5.3. Were there any overall attrition problems noted? (Especially the magnitude of attrition, both from original sample and differentially between treatment and control groups.) If several references to attrition available, report the rate for the most recent follow-up.
D.5.3.1. Yes: please describe
D.5.3.2. No
D.5.4. How were attrition problems dealt with by investigators?
D.5.4.1. Were intra-cluster correlation coefficients noted?
D.5.4.2. Yes: please describe
D.5.4.3. No

D.6. Qualitative study
D.6.1. What type of new evidence was presented?
D.6.1.1. Interviews with participating households
D.6.1.2. Interviews with on-the-ground staff
D.6.1.3. Interviews with policy-makers
D.6.1.4. Other: please describe
D.6.2. Were participants chosen randomly?
D.6.2.1. Yes
D.6.2.2. No
D.6.2.3. Unclear
D.6.3. Were any selection problems noted by author?
D.6.3.1. Yes: please describe
D.6.3.2. No
D.6.4. Were any selection problems noted by reviewer?
D.6.4.1. Yes: please describe
D.6.4.2. No
D.6.5. What were the characteristics of the sample? Please describe

E. CAUSAL THEORY

E.1. Did the paper address program theory or causal mechanisms?
E.1.1.1. Yes (please specify below if possible)
E.1.1.2. No

E.2. The paper addressed mechanism 1 (take-up). Please describe below
E.2.1. Liquidity
E.2.2. Perceived risk
E.2.3. Financial literacy
E.2.4. Trust

E.2.5. Inadequate risk sharing mechanisms
E.2.6. Other

E.3. The paper addressed mechanism 2 (investment decisions). Please describe

E.4. The paper addressed mechanism 3 (investment in well-being). Please describe

E.5. The paper addressed other aspect of program theory or causal mechanisms. Please describe

F. INTERVENTION AND CONTROL CONDITIONS

F.1. Number of groups in the study?

F.2. List excluded study groups with brief description.

F.3. Describe the intervention, with particular attention to the 'dosage' of the treatment.

F.4. What is the control or comparison condition?

F.4.1. Zero treatment group
F.4.2. Treatment as usual group
F.4.3. Lesser but innovative treatment

F.5. Describe the control or comparison condition (including 'dosage' if applicable).

F.6. How many participants were randomized to the different groups? Please describe.

F.7. Were program implementation problems described by investigators?

F.7.1. Yes: please describe
F.7.2. No

F.8. Detail fidelity problems below (i.e. problems relating to the construction of treatment and control groups, or their implementation, that render interpretation of treatment effects problematic).

G. PARTICIPANTS IN THE STUDY

Provide summary statistics where available.

G.1. What is the social profile

G.1.1. Gender
G.1.2. Age group
G.1.3. Education level
G.1.4. Occupation
G.1.5. Location

G.2. Economic profile

G.2.1. Income level
G.2.2. Assets
G.2.3. Insurable Assets

H. OUTCOMES

H.1. Please record all **treatment effects and econometric results** in the outcomes table.

Appendix 2.2: Categorisation of countries

The following list has been retrieved from the World Bank (http://data.worldbank.org/about/country-classifications). This is a representative list for 2010, but the relevant list depending on the year in which the study was conducted was used for the actual classification.

(http://data.worldbank.org/about/country-classifications)

Low-income economies (Per capita income US$995 or less)

Afghanistan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Kenya, Democratic People's Republic of Korea, Kyrgyz Republic, Lao Democratic People's Republic, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sierra Leone, Solomon Islands, Somalia, Tajikistan, United Republic of Tanzania, Togo, Uganda, Zambia, Zimbabwe.

Lower middle-income economies (Per capita income $996 to $3,945)

Angola, Armenia, Belize, Bhutan, Bolivia, Cameroon, Cape Verde, China, Republic of the Congo, Côte d'Ivoire, Djibouti, Ecuador, Egypt, El Salvador, Georgia, Guatemala, Guyana, Honduras, India, Indonesia, Iraq, Jordan, Kiribati, Kosovo, Lesotho, Maldives, Marshall Islands, Micronesia, Moldova, Mongolia, Morocco, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Paraguay, Philippines, Samoa, São Tomé and Principe, Senegal, Sri Lanka, Sudan, Swaziland, Syrian Arab Republic, Thailand, Timor-Leste, Tonga, Tunisia, Turkmenistan, Tuvalu, Ukraine, Uzbekistan, Vanuatu, Vietnam, West Bank and Gaza, Yemen.

Upper middle-income economies (Per capita income $3,946 to $12,195)

Albania, Algeria, American Samoa, Antigua and Barbuda, Argentina, Azerbaijan, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Fiji, Gabon, Grenada, Iran (Islamic Republic of), Jamaica, Kazakhstan, Lebanon, Libya, Lithuania, Macedonia, Malaysia, Mauritius, Mayotte, Mexico, Montenegro, Namibia, Palau, Panama, Peru, Romania, Russian Federation, Serbia, Seychelles, South Africa, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Turkey, Uruguay, Venezuela.

Appendix 2.3: Search sources and method

Electronic Databases

- **Keyword Search:** AgEcon Search, University of Minnesota; Agricola; British Library of Development Studies; EBSCO Business Source Premier; Econlit; Econpapers; Google, Google Books, and Google Scholar; Handbooks in Economics; JSTOR; SpringerLink; Oxford Scholarship Online; ProQuest; Social Science Research Network (SSRN); Wiley Interscience; World Bank and IMF's Joint Libraries Information System (JOLIS); World Bank e-Library.

Journals/Working Papers

- **Keyword Search:** *Agricultural Finance Review*; *Agricultural Economics*; *American Economic Review*; *American Journal of Agricultural Economics* (through EBSCO and JSTOR); *Journal of Agricultural and Resource Economics*; *Journal of Agricultural Economics*; *Journal of Development Economics*; *Journal of Development Studies*; *Journal of Finance*; NBER (US National Bureau of Economic Research) Working Papers; *Oxford Review of Economic Policy*; *Review of Financial Studies*; *World Bank Economic Review*.
- **Manual Search:** *International Journal of Agricultural Economics*; Reserve Bank of India; United Nations Development Programme (UNDP); *World Bank Research Observer*.

Other Sources

- **Keyword Search:** Australian Agricultural and Resource Economics Society; Australian International Development Agency (AusAID); Bill and Melinda Gates Foundation; Commodity Risk Management Group at the Consultative Group to Assist the Poor (CGAP); *European Review of Agricultural Economists*; Inter-American Development Bank (IADB).
- **Manual Search:** African Development Bank (AfDB); Asian Development Bank (ADB); Center of Evaluation for Global Action, University of California, Berkeley; China Economic Network; CCER (China Center for Economic Research) Finance Database; Innovations for Poverty Action (IPA); International Food Policy Research Institute (IFPRI); International Labour Organization's Micro-insurance Innovation Facility; Jameel Poverty Action Lab (JPAL); Micro-Insurance Centre; Micro-Insurance Network; Munich Climate Insurance Initiative (MCII); National Insurance Academy, Pune, India; Organisation for Economic Co-operation and Development (OECD); UK Department for International Development (DFID); USAID (US Agency for International Development) Microlinks; Annual Bank Conference on Development Economics proceedings.

Appendix 2.4: Examples of keywords used in search

Name	Search Phrase(s)
African Development Bank (AfDB) www.afdb.org/en/	Handsearch through documents on agriculture and agro-industries, climate change, environment, food production and poverty reduction
AgEcon Search, University of Minnesota http://ageconsearch.umn.edu/	"((risk OR insurance) AND (crop OR weather OR rain* OR index* OR climat* OR precipitation) AND (rural OR developing* OR low?income OR poor OR third?world OR emerg* OR under?developed)) in whole entry"
Agricola http://agricola.nal.usda.gov/	"insurance and ((crop and (area?yield or area?based)) or (weather or rain*) or index*)"
Agricultural Economics www.iaae-agecon.org/journal/journal.html	"insurance OR risk"
Agricultural Finance Review http://afr.dyson.cornell.edu/	• "insurance in IDEAS" • "insurance OR risk" [In Google Scholar]
American Economic Review www.aeaweb.org/aer/index.php	• "insurance OR risk" • "weather" • "crop"
American Journal of Agricultural Economics www.aaea.org/publications/ajae/	[Covered in JSTOR and EBSCO]
Annual Bank Conference on Development Economics proceedings	Handsearch
Asian Development Bank (ADB) www.adb.org/	Handsearch
Australian Agricultural and Resource Economics Society www.aares.info/	insurance OR risk **NOTES:** • Also searched through IDEAS and Google Scholar

Australian International Development Agency (AusAID) www.ausaid.gov.au/	• Database Search Terms
	  ○ "risk"
	  ○ "weather"
	  ○ "insurance"
	  ○ "rainfall"
	  ○ "crop"
	• Handsearch

Bill and Melinda Gates Foundation www.gatesfoundation.org/Pages/home.aspx	"insurance"
British Library for Development Studies http://blds.ids.ac.uk/	"insurance AND crop, insurance AND weather, insurance AND rain*, insurance AND index*, insurance AND climat*, insurance AND precipitation, risk AND crop, risk AND weather, risk AND rain*, risk AND index*, risk AND climat*, risk AND precipitation" **NOTES** • All-field search of documents published between 1990 and 2010
CCER (China Center for Economic Research) Finance Database http://en.ccer.edu.cn/index.asp	Handsearch
Center of Evaluation for Global Action, University of California, Berkeley http://cega.berkeley.edu/	Handsearch
China Economic Network www.cenet.org.cn/	Handsearch
Commodity Risk Management Group at Consultative Group to Assist the Poor (CGAP) www.cgap.org/p/site/c/	• "insurance" • "risk"
EBSCO Business Source Premier www.ebscohost.com/	"(insurance or risk) AND ((crop AND (area?based OR area?yield)) OR weather OR rain* OR index* OR climat* OR precipitation) AND (rural OR developing* OR low?income OR poor OR third?world OR emerg* OR under?developed)" **NOTES** • In All text, limited by 1990-2010 and English language • Searching Academic Search Complete, Africa-Wide Information, Business Source Alumni Edition, Business Source Complete, EconLit, Family and Society Studies Worldwide, GreenFILE, Middle Eastern and Central Asian Studies, Public Administration Abstracts, Social Work Abstracts, SocINDEX with Full Text, Environment Complete, Sustainability Reference Center. • Relevancy ends around result #450
Econlit www.aeaweb.org/econlit/index.php	"(risk OR insurance) AND ((crop AND (area?based OR area?yield)) OR weather OR rain* OR index* OR climat* OR precipitation) AND (rural OR developing* OR low?income* OR poor OR third?world OR emerg* OR under?developed)" **NOTES** • Searched abstracts of all hits from January 1990 - October 2010 • Searched through EBSCO

European Association of Agricultural Economists www.eaae.org/	"*insurance"
Google www.google.com/	"(risk crop OR weather OR rain* OR index* OR climat* OR precipitation), (insurance crop OR weather OR rain* OR index* OR climat* OR precipitation)" **NOTES** • Relevancy ends at result #120
Google Books http://books.google.com	"(risk crop OR weather OR rain OR index OR climat* OR precipitation), (insurance crop OR weather OR rain OR index OR climat* OR precipitation)" **NOTES** • Relevancy ends at result #100
Google Scholar http://scholar.google.com	"index-based insurance" "micro-insurance" "rainfall-insurance" "area-yield insurance" "(insurance OR risk) AND ((((crop AND OR (area?based) OR (index?based)) AND (rural OR developing* OR low?income* OR poor) AND (*africa OR *asia) AND (1990…2010)" **NOTES** • Several journals were also covered through Google Scholar searches, implicitly raising the total number of search strings used to several hundred
Handbooks in Economics www.elsevier.com/locate/inca/BS_HE	"insurance"
Innovations for Poverty Action (IPA) http://poverty-action.org/	Handsearch
Inter-American Development Bank (IADB) www.iadb.org/?lang=en	"insurance"
International Food Policy Research Institute (IFPRI) www.ifpri.org/	"insurance" in any word field of IFPRI Library Catalog and Publications
International Labour Organization's Microinsurance Innovation Facility www.ilo.org/public/english/employment/mifacility/	Handsearch of publications
Jameel Poverty Action Lab (JPAL)www.povertyactionlab.org/	"insurance"

Journal of Agricultural and Resource Economics http://agecon.uwyo.edu/jareonline/	"(insurance OR risk) AND ((crop AND ((area?yield) OR (area?based)) OR weather OR climat* OR precipitation OR index OR index?based OR rain*)) AND (rural OR developing* OR low?income* OR poor OR Africa OR Asia OR India OR emerging*)"
Journal of Agricultural Economics www.aes.ac.uk/index.php?do=jae	"insurance"
Journal of Development Economics www.elsevier.com/locate/devec	"(insurance OR risk) AND ((crop AND ((area?yield) OR (area?based)) OR weather OR climat* OR precipitation OR index OR index?based OR rain*)) AND (rural OR developing* OR low?income* OR poor OR Africa OR Asia OR India OR emerging*)"
Journal of Development Studies www.tandf.co.uk/journals/titles/00220388.asp	"(insurance OR risk) AND ((crop AND ((area?yield) OR (area?based)) OR weather OR climat* OR precipitation OR index OR index?based OR rain*)) AND (rural OR developing* OR low?income* OR poor OR Africa OR Asia OR India OR emerging*)"
Journal of Finance www.afajof.org/journal/browse.asp	"insurance" "crop" "rainfall" "weather"
JSTOR www.jstor.org/	"(((risk OR insurance) AND ((crop AND (area-based OR "area based" OR area-yield OR "area yield")) OR weather OR rain* OR index* OR climat* OR precipitation)) AND (rural OR developing OR low-income OR "low income" OR poor OR third-world OR "third world" OR emerging OR under-developed OR "under developed")) AND (year:[1990 TO 2010]) AND la:(eng)" **NOTES** • Full text search in Finance, Economics, Sociology, and Public Policy and Administration journals • Relevancy ends at result #805
Micro-Insurance Centre www.microinsurancecentre.org/UI/Home.aspx	Handsearch of all English resources documents
Micro-Insurance Network www.microinsurancenetwork.org/	Handsearch of publications
Munich Climate Insurance Initiative (MCII) www.climate-insurance.org/front_content.php	Handsearch of publications
National Insurance Academy, Pune, India www.niapune.com/	Handsearch of publications

NBER (US National Bureau of Economic Research) Working Papers www.nber.org/papers.html	"(insurance OR risk) AND (crop OR weather OR rain* OR index* OR climat* OR precipitation)" **NOTES** • Relevancy ends at article #200
Organisation for Economic Co-operation and Development (OECD) www.oecd.org/	Handsearch of publications
Oxford Review of Economic Policy http://oxrep.oxfordjournals.org/	"(insurance OR risk)" **NOTES** • Searched in title or abstract • Dates restricted to 1/1990 - 10/2010
Oxford Scholarship Online www.oxfordscholarship.com/oso/public/index.html	"risk OR insurance"
ProQuest www.proquest.co.uk/en-UK/	"(insurance OR risk) AND ((crop AND (area?based OR area?yield)) OR weather OR rain* OR index* OR climat* OR precipitation) AND (rural OR developing* OR low?income OR poor OR third?world OR emerg* OR under?developed)" **NOTES** • Search in citation or abstract English from 1/1/1990 to 10/1/2010 • Searching ABI/INFORM, Banking Information Source, Canadian Newsstand, CBCA Complete, Dissertations and Theses, Entrepreneurship, Ethnic Newswatch, Latin American Newsstand, Proquest Asian Business and Reference, ProQuest Central, Proquest Dissertations and Theses - UK and Ireland, ProQuest European Business, Proquest Social Science Journals, Research Library. • Relevancy ends at page 27 with 30 citations per page for scholarly journals (on page 28, not a single article looked relevant) and at page 3 with 30 citations per page for dissertations and at page 2 with 30 citations per page for working papers.
RePEc Econpapers: http://econpapers.repec.org/ IDEAS: http://ideas.repec.org/	"(insurance OR risk) AND ((crop AND (area?based OR area?yield)) OR weather OR rain* OR index* OR climat* OR precipitation) AND (rural OR developing* OR low?income OR poor OR third?world OR emerg* OR under?developed) (maximum of 2000 hits returned)" **NOTES** • Relevancy ends at result #900
Reserve Bank of India and other developing country Central Banks that have active research programmes www.rbi.org.in/home.aspx	Handsearch of publications

Review of Financial Studies http://rfs.oxfordjournals.org/	"(insurance OR risk) AND (crop OR weather OR rain* OR index* OR climat* OR precipitation)" **NOTES** • Searched in full text • Dates restricted to January 1990 through November 2010
Social Science Research Network (SSRN) www.ssrn.com/	• "weather insurance" • "area-yield insurance" • "crop insurance" • "rainfall insurance"
SpringerLink www.springerlink.com/	• "weather insurance" • "area-yield AND insurance" • "rainfall insurance" • "micro-insurance"
UK Department for International Development (DFID) www.dfid.gov.uk/	Handsearch
United Nations Development Programme (UNDP) www.undp.org.in/	Handsearch through publications on poverty reduction, crisis prevention and recovery, and environment and energy
USAID Microlinks www.microlinks.org/ev_en.php	Handsearch of publications
Various university working papers	[Covered through Google Scholar]
Wiley Interscience http://onlinelibrary.wiley.com/	• "insurance AND weather" • "insurance AND crop" • "insurance AND rainfall" • "insurance AND area-yield" • "microinsurance"
World Bank and International Monetary Fund (IMF) Joint Libraries Information System (JOLIS) http://jolis.worldbankimflib.org/e-nljolis.htm	"(insurance OR risk) AND ((crop AND ((area?yield) OR (area?based)) OR weather OR climat* OR precipitation OR index OR index?based OR rain*)) AND (rural OR developing* OR low?income* OR poor OR Africa OR Asia OR India OR emerging*)"
World Bank e-Library http://elibrary.worldbank.org/	• "insurance AND crop or area-yield or weather" • "insurance"
World Bank Economic Review http://wber.oxfordjournals.org/	"(insurance OR risk) AND (crop OR weather OR rain* OR index* OR climat* OR precipitation)" **NOTES** • Searched in full text

	• Dates restricted to January 1990 through November 2010
World Bank Research Observer http://wbro.oxfordjournals.org/	Handsearch

Appendix 2.5: Methodology of studies included in the review

Short title	Method	Identification strategy	Analysis	Unit of analysis	Sample size
Chantarat et al. (2009)	Econometric analysis of hypothetical insurance contracts	Variation in product design, preferences, loss experience, wealth, familiarity with financial transactions and household and herd characteristics used to identify determinants of WTP.	Heckman's two-step (Heckit)	Household	207
Cole (2010)	Randomised field experiment with marketed insurance product	Randomisation of liquidity constraints, trust levels, financial education and psychological manipulations such as marketing are used to identify determinants of WTP.	Linear probability	Household	Andhra Pradesh: 1,047 Gujarat: 2391.
Gaurav et al. (2010)	Randomised field experiment with marketed insurance product	A financial literacy and insurance education module was randomly assigned to households and its impact on insurance take-up estimated.	Ordinary least squares	Household	597
Giné and Yang (2009)	Randomised field experiment with marketed insurance product	Households randomly assigned to be offered either an insured or uninsured loan for hybrid seeds. Firstly, the effect of being offered the insured loan on take-up of the hybrid seed loan is estimated. Secondly, the determinants of take-up are estimated.	Ordinary least squares	Household	787
Giné et al. (2008)	Econometric analysis of marketed insurance product	Variation in household characteristics including trust, networks, wealth and familiarity with insurance used to identify determinants of take-up.	Weighed probit	Household	752
Hill and Robles (2010)	Econometric analysis of marketed insurance product	Variation in amount of insurance purchased used to estimate the importance of characteristics. The majority of insurance decisions ended up being taken at the group level, however, limiting the number of effective observations to 34.	Unclear	Individual/ Group	480
Hill and Viceisza (2010)	Randomised field experiments simulating impact of hypothetical insurance contracts	Variation in cost of insurance, understanding of insurance, risk aversion and variation as well as experience with fertiliser used to determine impact of insurance on purchases of fertiliser.	Difference in difference	Individual	744
McCarthy (2003)	Econometric analysis of hypothetical insurance contracts	Uses variation in human capital, physical assets, risk management techniques and risk structure to identify determinants of WTP.	Multivariate probit	Household	48
Sarris et al. (2006)	Econometric	Uses variation in types of contracts, household characteristics and crop production to identify determinants of WTP.	Contingent valuation	Household	Kilimanjaro: 957 Ruvuma: 892
Seth et al. (2009)	Econometric analysis of hypothetical weather derivative	Uses variation in household characteristics including insurance awareness, risk structure and product design to	Linear random	Household	536

	contracts	identify determinants of WTP.	utility probit and logit		
Stein (2010)	Econometric	Uses variation in payout levels and rainfall patterns to identify determinants of WTP.	Ordinary least squares	Household	10,997
Turvey and Kong (2010)	Econometric	Uses variation in production and household characteristics as well as existing informal risk sharing to identify determinants of WTP.	Maximum likelihood generalised linear model (GLM)	Household	897
Vandeveer (2001)	Econometric analysis of hypothetical insurance contracts	Uses variation in household characteristics to identify determinants of Take-up.	Binomial logit	Household	1,200

Appendix 3.1: Mechanisms of studies

Study short title	Intervention description	Product and/or intervention design	Operations and implementation (includes marketing strategy)
Chantarat et al. (2009)	The study elicits WTP for Index-Based Livestock Insurance (IBLI) of the poorest households in Kenya by offering hypothetical contracts in a game setting. The study includes a survey, an educational module, and a game eliciting WTP.	An indicator of vegetative cover on rangelands, the Normalised Differential Vegetation Index (NDVI) is used to predict covariate herd mortality, which is then used to calculate trigger levels for indemnity payments.	The product has not been officially offered yet. Results from hypothetical setting are intended to provide helpful information on WTP pre-pilot.
Cole (2010)	This study investigates differences in take-up rates with different marketing treatments (household visits, flyers, or video messages) in Andhra Pradesh and Gujarat, India	The product offered uses observable, local rainfall gauges as an index to design insurance policies. The policy divides the monsoon season into three phases: sowing, flowering and harvest, offering different premiums and trigger levels for each phase.	Local microfinance institutions and NGOs administer insurance payouts.
Gaurav et al. (2010)	The study examines the effect of financial literacy treatments and varying marketing treatments on take-up of a rainfall insurance product in Gujarat.	Training sessions were completed prior to marketing in villages. The first half provided general lessons on personal financial management, savings, credit management and insurance using custom designed training materials. In the second session, the participants played a set of two interactive simulation games to learn the insurance mechanism. In addition to the training, six additional orthogonal marketing manipulations, which included money-back offers, mm demonstrations and weather forecasts, were also tested.	In each taluka, two NGO employees were offered a rigorous two-day training session conducted by one of the principal investigators. These trainers then carried out the actual training of the farmers in their respective talukas under supervision of the field staff. They also conducted surprise visits and checks on the attendance rolls to ensure compliance and prevent the contamination of the financial literacy treatment.

Study short title	Intervention description	Product and/or intervention design	Operations and implementation (includes marketing strategy)
Giné and Yang (2009)	The paper explores whether offering a bundled loan and insurance package leads to higher use of high-yielding variety (HYV) seeds in rural Malawi.	The weather insurance policy was based on millimetres of rainfall and had two trigger levels, with the level of compensation gradually increasing between the two levels of rainfall and a set payment being given at crop failure level or lower. Farmers in the treatment group had to take the insurance in order to get access to the loan; the insurance policy would partially or fully forgive the loan in case of poor rainfall.	NASFAM (National Smallholder Farmers Association of Malawi) is the largest NGO/organisation in Malawi to provide technical assistance to farmers. NASFAM field officers disseminated information on loan options to farmers and handled logistics of supplying hybrid seeds purchased on credit.
Giné et al. (2008)	The article studies WTP for a rainfall insurance product in Andhra Pradesh, India, which is cheap enough to be accessible for farmers with modest incomes.	Insurance was designed for two crops: castor and groundnut. The product covers the kharif season, from June to September. The contract divides the kharif into three phases: sowing, flowering and harvest. There is a designated upper and lower threshold of payout for each phase. The policy pays zero if accumulated rainfall exceeds the upper threshold. Otherwise, a fixed amount is paid until the lower threshold is reached. If below the lower threshold, the policy pays a higher, fixed payout. Total payout is the sum of payouts across the three phases.	A local microfinance institution, BASIX, was used for distribution and marketing purposes. Using BASIX, a trusted local organisation, should increase take-up. BASIX's main strategy was to explain the insurance product to a trusted leader who would act as a motivator informing other households of a marketing meeting scheduled for a few days later. Policies were sold at the marketing meeting where a general introduction to the policy was given. Policies were also sold at individual household visits.
Hill and Robles (2010)	The paper addresses the effectiveness of providing multiple weather securities rather than more standard weather insurance as a way to increase take-up.	The product offered is a system of weather securities, where farmers can choose different levels of insurance for different time periods, with no limitations as to what crop it applies to. This flexibility in coverage should make the product simpler and more inclusive.	The paper compares the pilot with the first year of implementation. The pilot experimental game was conducted in 'real time' i.e. real amounts of time (months) were allowed to pass between different stages of the game. Even so, the results and predicted rates of take-up from the pilot differ substantially from actual take-up recorded in the first year. One reason is that the cost of the insurance product was larger in the first year of implementation compared to the pilot.

Study short title	Intervention description	Product and/or intervention design	Operations and implementation (includes marketing strategy)
Hill (2010)	The study assesses the impact of weather insurance provision on fertiliser purchases and perceptions of the costs and benefits of fertiliser purchases in rural Ethiopia.	The intervention was a lab experiment that randomly provided subjects with insurance to see whether they would buy fertiliser and how much post-insurance. The return to the fertiliser depended on stochastic weather draws made in each round of play. All groups started with no insurance, but the treatment group was mandated insurance in the final rounds.	Researchers discuss the importance of maintaining experimenter control and consistency over the explanation provided to respondents. To facilitate this, the same experimenter and assistant conducted all sessions. The translator also remained the same for all sessions.
McCarthy (2003)	The study elicits WTP for a hypothetical rainfall-indexed insurance product in four provinces in Morocco.	Local rainfall stations were used as the index based on which indemnity payments were calculated. Six contracts were estimated using historical rainfall data in 1970-99, with variations in trigger levels and coverage levels. The 50% trigger is based on median rainfall, with an expected payout every other year, the 33% trigger is the rainfall corresponding to an expected payout every third year, and the 25% trigger, rainfall corresponding to an expected payout every fourth year. Coverage levels were also varied: the 100% coverage contract provided coverage for average revenue per hectare, and the 80% coverage contract provided coverage for 80% of average revenue per hectare.	No implementation issues discussed, as product was not actually sold.
Sarris et al. (2006)	This paper elicits WTP for hypothetical rainfall-based insurance for farmers in the Kilimanjaro and Ruvuma regions of Tanzania.	Hypothetical contracts were generated for a 10% and a 33% decline in normal rainfall. Three contracts were designed for each scenario offering a progressively higher indemnity with correspondingly higher premiums. Each farmer was offered six contracts, each with five different premium options based on an estimated actuarially fair price.	No implementation issues discussed, as product was not actually sold.

Study short title	Intervention description	Product and/or intervention design	Operations and implementation (includes marketing strategy)
Seth et al. (2009)	The study elicits WTP for hypothetical weather derivatives using surveys and bidding games in Rajasthan, India, in 2007.	A weather derivative was offered with a maximum payout of Rs. 1,000. A bidding game was conducted asking whether farmers would be willing to pay 10%, 8%, 5%, 3% and 2% of the expected amount. The bidding ceased with an affirmative answer.	Focus group discussions were held with people who had and had not purchased crop insurance before to improve design issues by enlisting concerns.
Stein (2010)	The paper explores the effect of previous payouts on the current purchase of weather insurance policies in an effort to understand low take-up in Andhra Pradesh and five other states, India.	Monsoon rainfall insurance underwritten by ICICI-LOMBARD, and sold by BASIX. Policies insure against excess and deficit rainfall and are calculated based on rainfall measured at a stated weather station. Policies are divided into three phases based on the phases of the growing season: planting, budding/flowering, and harvesting. Policies have a dynamic start date. Premium is around 10% of maximum payout. Policies across years were not exactly the same. In 2007, BASIX required that all customers purchase insurance coverage with a maximum payout of at least Rs. 3,000.	During marketing, BASIX first calls a group meeting in each village. They show the village members a video about rainfall insurance and other BASIX products. There is a Q&A session. Then the BASIX team follows up by conducting door to door household visits. However, there is no data on specific marketing practices in each village.
Turvey and Kong (2010)	The study elicits demand for a theoretical weather insurance product in China's Shaanxi and Gansu provinces.	This product would cover the type of drought that happens one in ten years and would pay out 500 yuan/mu if this type of drought occurred.	

Study short title	Intervention description	Product and/or intervention design	Operations and implementation (includes marketing strategy)
Vandeveer (2001)	The paper tests out a hypothetical crop insurance programme for litchi producers in Vietnam.	The yield guarantee levels were set at 85% or 90%. Three indemnity prices were used: 15K, 25K, and 35K per kilogram. Indemnity payments were defined as (indemnity price) × (difference between actual area yield and the area-yield guarantee when actual yield is below the guaranteed yield). Two yield guarantee levels and three indemnity prices give six possible coverage combinations. This was done for two premium prices, giving a total of 12 possible contracts. The two premium prices are obtained from two load types added to the actuarially fair premium. A fixed load is set at 5000 dong/sao for the 15,000-indemnity price, with the load increasing proportionally as the indemnity price goes up. After that, an additional 30% load is added, yielding two premiums.	No indication of whether the hypothetical insurance would be provided through a private company or government agency is given.

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