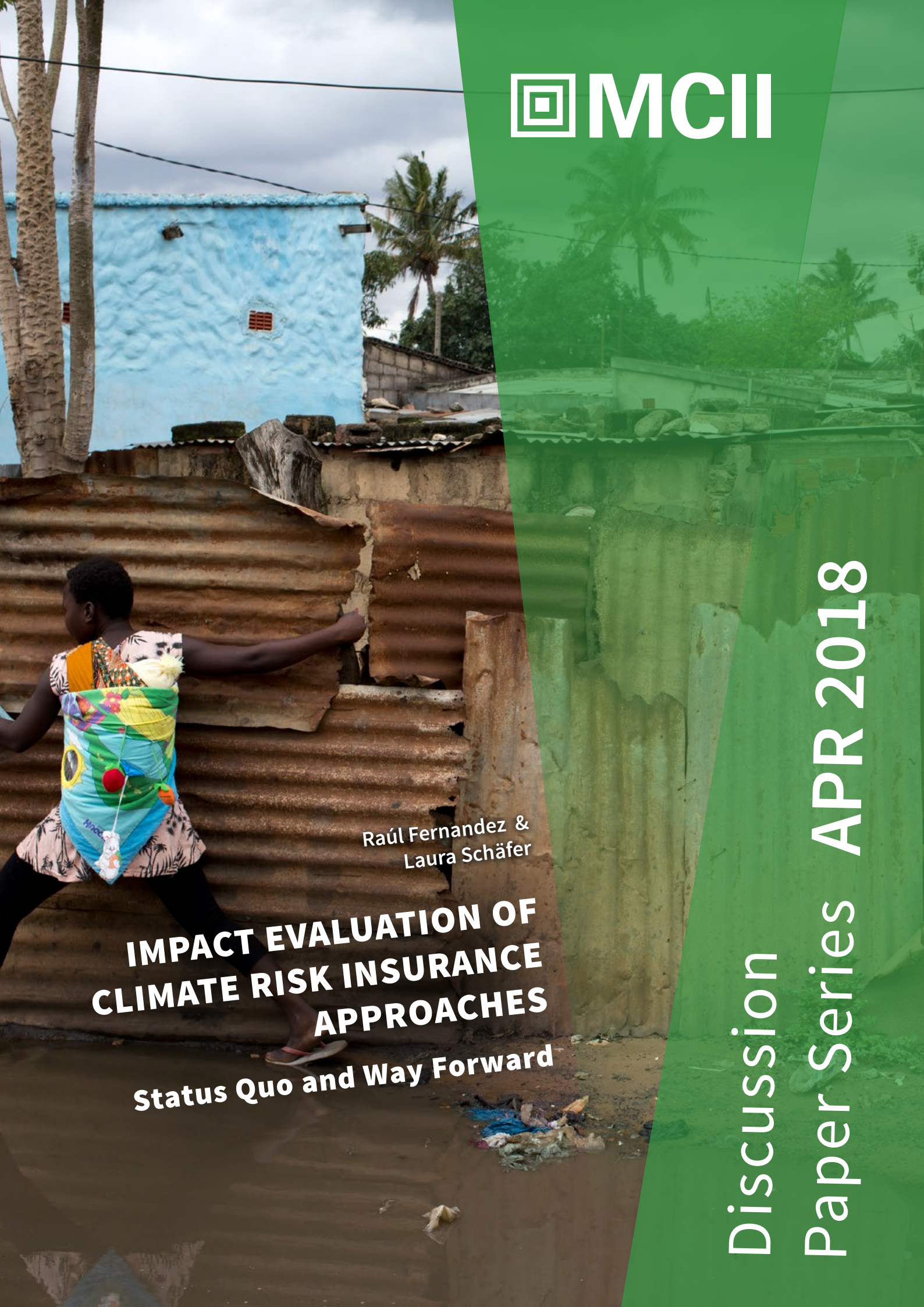

MCII

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IMPACT EVALUATION OF CLIMATE RISK INSURANCE APPROACHES

Status Quo and Way Forward

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This discussion paper is a preparatory step for an impact evaluation of climate risk insurance products on the micro level that the Munich Climate Insurance Initiative (MCII) will conduct for the InsuResilience Initiative. The main purposes of this paper are:

1. To show and discuss existing empirical evidence of impacts of climate risk insurance (CRI)
2. To identify best practices and knowledge gaps from past impact evaluations in the CRI context
3. To outline the MCII approach to evaluate the impact climate risk insurance has on resilience

KEY MESSAGE 1	KEY MESSAGE 2	KEY MESSAGE 3
Climate risk insurance has so far mostly been utilized and evaluated in agricultural contexts, where it has proved a great efficacy in boosting investments aimed at increasing productivity	There is a lack of evidence regarding the impact of insurance on the overall resilience of vulnerable households. So far, no impact evaluation has used an index for resilience measurement, looking at the capacities to anticipate, absorb and adapt.	Resilience measurement requires the use of mixed methods and adopting longer time frames.

1. Introduction and background

An important aspect of climate-resilient development is managing the risks from growing climate stress and extreme weather events, which pose a threat to both short-term economic stability and long-term sustainable development. According to Munich Re's NatCatSERVICE database[1], the number of weather-related loss events has tripled globally since 19801, and 2017 has set a new record on extreme weather related losses. As stated by the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), the risks associated with these extreme weather events will further increase with ongoing global warming[2]. Worldwide, the poorest people bear a disproportionate burden of climate stress and are least able to prevent, cope with and adapt to the rising risks.

It is therefore essential to develop tools and policies that enhance the climate resilience of poor people[a]. One instrument gaining significant interest from policy makers is climate risk insurance (CRI). The relevance of insurance as a tool within comprehensive climate risk management has been recognized by policymakers and practitioners around the world. It is argued that CRI can foster the ability of people to anticipate, cope and adapt to extreme weather events, eventually enabling resilient development pathways.

Many actors are currently investing resources in developing and supporting CRI schemes, and are looking for ways to implement insurance on a larger scale - many of these efforts are specifically targeted at covering the poor and most vulnerable in developing countries. As part of its global commitment, the G7 created the InsuResilience Initiative, which has the goal of increasing insurance coverage to provide basic insurance for up to 400 million additional poor and vulnerable people against climate change related risks. As its ultimate objective, the G7 wants to "intensify [their] support particularly for vulnerable countries' own efforts to manage climate change related disaster risk and to build resilience[3]".

Following the definition used by Christophe Béné, we understand resilience as "any capacity and skills, action, strategy, investment and anticipation, which helps individuals, households and communities to anticipate, absorb, accommodate, or recover from the impacts of a particular adverse event (shock, stress, or (un)expected changes" (Béné, 2013; p.11)[4]. In relation to the different temporal frameworks in which households address the effects of climate hazards, a set of three capacities has been identified: anticipative, absorptive and adaptive (see section 3 & 4 for a more detailed explanation).

However, so far there is a lack of adequate tools to measure the resilience impact of CRI schemes. This is critical, as the extension of CRI to these populations may have unintended consequences if schemes are poorly designed/implemented (e.g. it may reduce incentives for risk reduction[5], increase moral hazard and potentially lower resilience). In light of the political momentum around CRI, the need to develop appropriate tools to monitor and evaluate the impact of such insurance programs becomes apparent.

This paper aims at contributing to the ongoing discussion of how to best measure the impact of CRI schemes by:

- **Summarizing the existing empirical evidence on CRI impacts:** Evidence is scant but growing, and we group the statistically significant effects reported in the analyzed literature in three categories: production strategies, coping strategies and wellbeing.

[a] Based on a study by the Munich Climate Insurance Initiative (MCII), the target group of the InsuResilience Global Partnership is defined as follows:
1. Extremely poor: people living on less than 1.9 USD PPP / day
2. Moderately poor: people living on 1.9 to 3.1 USD PPP / day
3. Vulnerable: people living on 3.1 to 15 USD PPP / day

- **Identifying gaps in the existing literature:** We find that so far, impact evaluations of insurance products have focused on single effects in the short term (e.g. investment decisions or wellbeing effects). However, a comprehensive analysis from a resilience perspective is missing.
- **Introducing an MCII approach to impact evaluation:** A framework for the measurement of resilience changes in the context of CRI at the micro level which is both methodologically rigorous and feasible during the actual implementation of a CRI project.

2. Empirical evidence on climate risk insurance impacts

Analyzing existing empirical evidence is a necessary first step towards developing adequate tools to measure the resilience impact of CRI schemes. The aim of this literature research has been to identify studies assessing the impact of insurance on the behavior and wellbeing of policyholders. A systematic review was conducted using the two largest online scientific libraries (Web of Sciences and Google Scholar search engines) and specific bibliographic entries[b]. The studies were filtered so as to qualify as rigorous impact evaluations and contextually relevant. A total of 17 studies fulfilled these criteria[c]. It is important to highlight that all the available studies relate to rural and agricultural settings, which facilitate the drawing of lessons, but limits our capacity to extrapolate these findings to other contexts, and to CRI products in general. This aspect will be re-visited in the next section.

[b] "index insurance/impact"; "weather insurance/impact"; "agricultural index insurance/impact", "index based livestock insurance/impact" and "climate insurance/impact". The idea of using weather-index insurance products in development contexts is relatively new. Due to the emergent character of this literature body, there is no consensus on the terminology used to define insurance.

[c] The studies were manually filtered applying desirable criteria that would qualify them as rigorous impact evaluations and thematically relevant: use of household survey data; quantitative analysis through econometric methods; insurance payout should be indexed to a weather related shock (livestock mortality, if related to weather, is accepted as such); and the study has focused on developing countries. Articles that referred to the same research in different stages of publication were removed. Furthermore, we have excluded lab in the field studies, restricting our search to pilot or scaled up schemes. After that, our search was limited to 17 studies.

In general, the empirical evidence shows that over the last years, the impact of CRI is growing[d]. Table 1 in the Annex offers an overview of the studies analyzed including a summary of methodological issues and significant effects. We have grouped the different effects reported in the literature in three categories: **production strategies, coping strategies and wellbeing**[e]. The reported effects will be summarized subsequently for each group:

2.1 Production strategies

There is evidence showing that risk perceptions leading to uncertainty alter wellbeing outcomes by forcing households to opt for suboptimal investment and consumption decisions[6, 7]. We define production strategies as behavioral changes of the insured, regarding their productive activities. The findings in the literature show that:

1. **CRI can be a useful tool in the promotion of agricultural intensification processes** – (this is inferred because there is a bias of studies in agricultural contexts). This argument is supported by evidence pointing to:
   - an increase on the cultivated surface[7,8,9,10]
   - an increase in overall use of agricultural inputs[7,8,11,12,13], be it in the form of seeds[9,14,15,16], fertilizer[9,11,14,15,16], irrigation[15] or labor[13,17,f].
2. When index insurance is focused on livestock, it can be used to **hedge climate risks, enabling commercially oriented approaches**[20, 21]. This argument is supported by the evidence pointing to:
   - higher production levels[18,19];
   - higher investments in animal healthcare[21].
3. When insurance is used as a tool to promote agricultural intensification or is linked to specific crops, **it fosters specialization and increases commercial agriculture** [7,8,16,22]. However, this may be at the expense of production diversity[22].
4. In contexts where insurance is accompanied by livelihood strengthening activities, **insurance can unlock pathways for investment diversification**, materializing in different income sources[14].

[d] However, only few of these results have been published in peer-reviewed journals.
[e] Studies looking at demand patterns of CRI products were therefore excluded and not considered in the literature review.
[f] Tobacman et al. (2017) find negative effects.

2.2 Coping strategies

Coping strategies refer to strategies employed by households when they are facing livelihood stressors, in this case, as a result of extreme climatic conditions. In the context of insurance, the coping support would be related to triggered payouts. The evidence in this aspect is still is scarce, however, there are hints that payouts can have immediate positive effects. Findings in the literature show that:

1. The liquidity provided by payouts can allow households to **maintain higher levels of food security during crises**[7, 11, 21].
2. **Insurance payouts also allow households to deal with immediate effects**, for example with their existing savings[11], without otherwise having to sell household assets such as livestock, or resort to inefficient herding strategies[19, 21].
3. In financial terms, **the presence of insurance may relax constraints in accessing credit**[19, 22]. The effects on savings can respond differently depending on the broader context in which insurance is embedded - either fostering the build-up of reserves[14] or incentivizing households to save less[13, 22].
4. Lastly, one study found that **payouts can make households less dependent on support from relatives out of their villages** to cope with negative climatic effects[10].

2.3 Wellbeing[g]

In terms of wellbeing, the evidence gathered shows the efficacy of insurance in contributing to productivity increase. The following effects were found by different studies:

1. There is a large consensus pointing to the **positive effects of insurance on overall farm revenue and output levels**[7, 15, 16, 17], which is mirrored in livestock contexts[18, 19]. However, this comes at the expense of higher financial burdens[7, 13], intrinsic to the more extensive use of agricultural inputs.
2. General measures of household welfare such as **income**[10, 20], **expenditures**[7, 10, 12] **or wealth**[7, 9] **reflect positive impacts of insurance**.
3. There are hints that **food security is improved through insurance** products[18, 21, h].

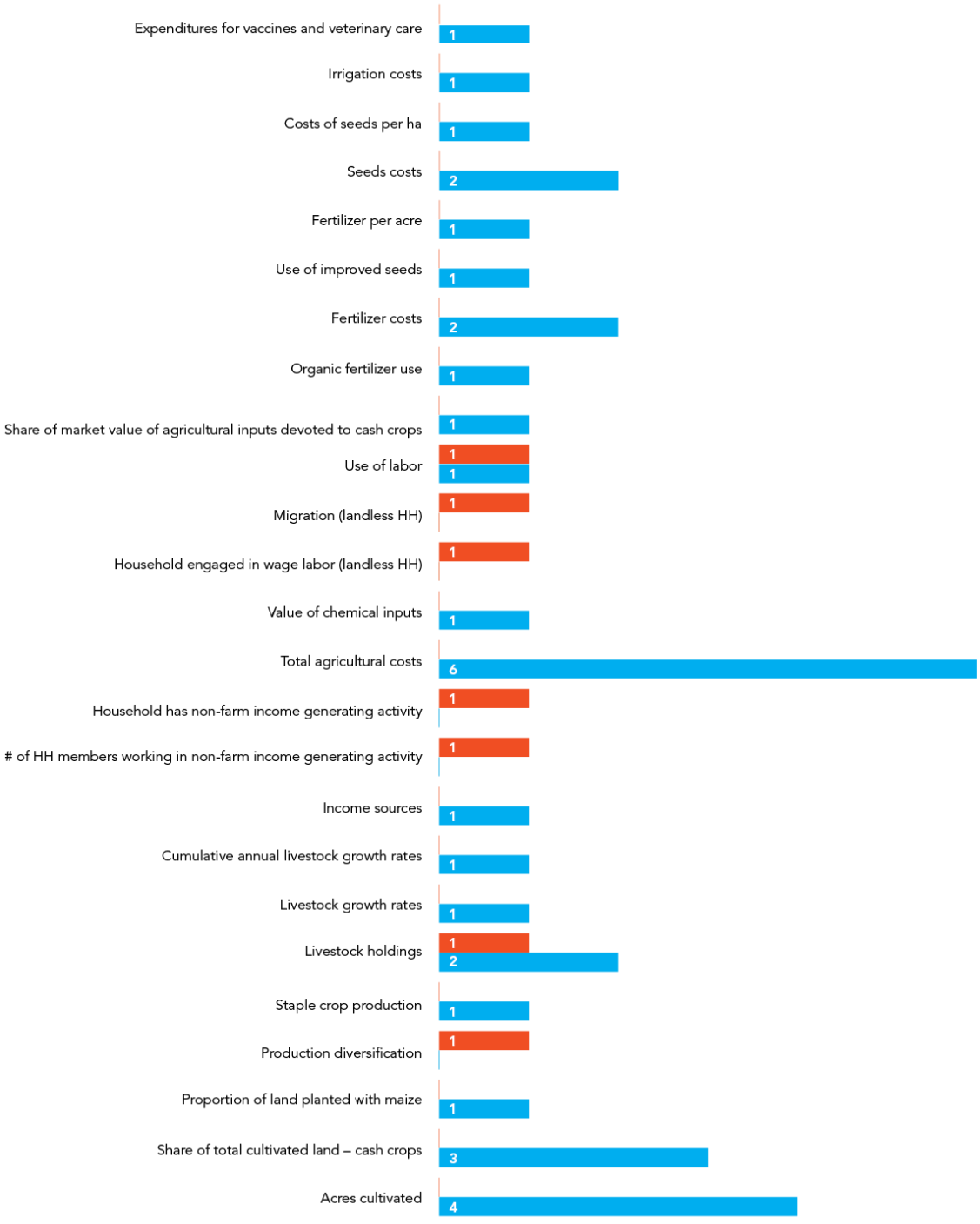
[g] We have relaxed our notion of wellbeing to also include aspects related to asset accumulation or other financial variables, as this approach is more consistent with the proposed clusters of indicators.
[h] Both refer to the same case study.

4. One study[23] analyzes the impact of insurance coverage on **subjective perceptions of wellbeing**, indicating a positive relation.

On the **negative side**, there is one study in India reporting negative effects of insurance on multiple wellbeing variables. This research[13] is characterized by the richness of data and long timespan (8 years). However, and although payouts during the research timeframe have been modest[i], the results show a negative impact on total farm revenue; expenditure events; financial situation; value of gifts/transfers received; and child anthropometry measures.

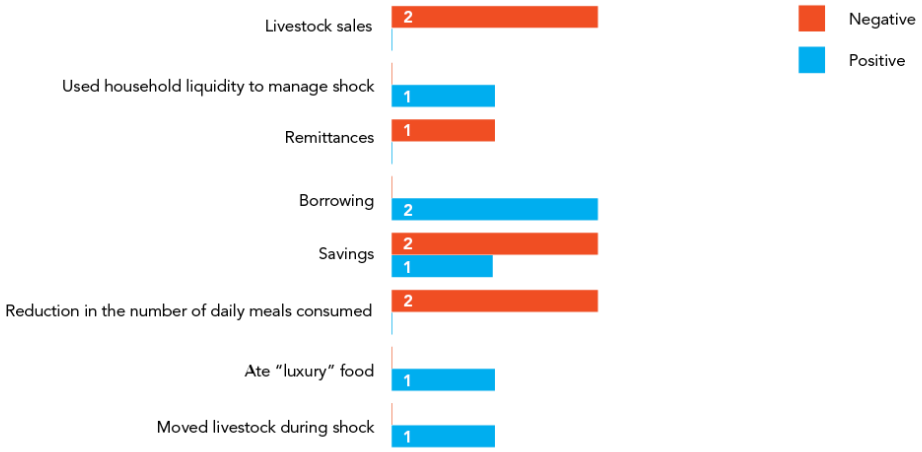
[i] Authors offer several hypotheses to explain why farmers may not have adopted different productive strategies which materialize in enhanced wellbeing. For example, adopters being at the margin of subsistence; slow learning processes; adopters operating with the expected-profit-maximizing technology; adverse realization of basis risk; or moral hazard.

Chart 1: Summary of insurance related effects[j]



[j] The original variables in the different studies have been clustered in order to increase the explanatory power of the table. For the original variables and their respective studies, see Table 2 in Annex The horizontal axis indicates the number of times that the effects have been reported in the literature.

COPING STRATEGIES



WELLBEING

3. Knowledge gaps

3.1 The resilience gap

In the previous literature review, it was found that a great number of studies in the past have focused mostly on household production strategies related indicators. This reflects the fact that insurance has been usually conceived as a tool to increase agricultural productivity. Therefore, the indicator selection reflects the underlying theories of change for these projects. Table 1 shows that research has produced sufficient evidence to support the claim that insurance can alter production strategies in agricultural and livestock settings. However, not all studies have been able to capture payout effects, perhaps due to the lack of significant payouts in the researched time frames. Thus, it is not so well researched how payouts after extreme climate events may affect shock management strategies and wellbeing outcomes in the medium to long run. This challenge is intrinsic to index insurance, as the regularity of triggered events can fluctuate at least between 10 or 20 years. Furthermore, few studies have assessed whether insurance may foster a more conscious behavior in risk management, for example through income diversification[14] or risk preparedness. However, as the use of CRI for adaptation purposes advances, the risk of maladaptive outcomes should be accounted for, and more holistic notions of M&E systems should be encouraged. Therefore, it is important to go beyond notions such as agricultural productivity, integrating a socioecological perspective in measurement frameworks, as well as gaining longer term perspectives.

The literature review revealed that the operationalization and measurement of the resilience concept in the context of impact evaluations remains challenging. We thus find a lack of evidence regarding the impact of insurance on the overall resilience of households. From the analyzed studies, only one study in the context of the Index Based Livestock Insurance in Kenya[18] incorporates the resilience rhetoric. This is being done via developing a methodological framework that captures the dynamic nature of resilience. Using proxy indicators, such as herd size and food security measures, the results hint at positive effects of CRI on wellbeing over time in relation to climate shocks. So far, no impact evaluation has opted to use an index for resilience measurement. This is due to the multilevel and dynamic nature of resilience, and the data requirements derived from its multidimensional character.

In the last years, the concept of resilience has gained traction among academics and practitioners[25]. Thus, substantial progress has been made in the application of this concept for measuring the impacts of climate

adaptation projects[26, 27]. However, the applicability of these measurement frameworks remains limited, and is usually confined to pilot projects or flagship initiatives.

In 2016, MCII[28] conducted desk-based research as a first step to frame the impacts of CRI on the resilience of vulnerable populations. This report was based on an analysis of existing literature, and interviews with project and evaluation managers of CRI schemes at the macro, meso and micro level[k]. The results identified positive changes in some indicators of resilience as an effect of CRI, which were categorized according to the *resilience capacities* framework (figure 1).

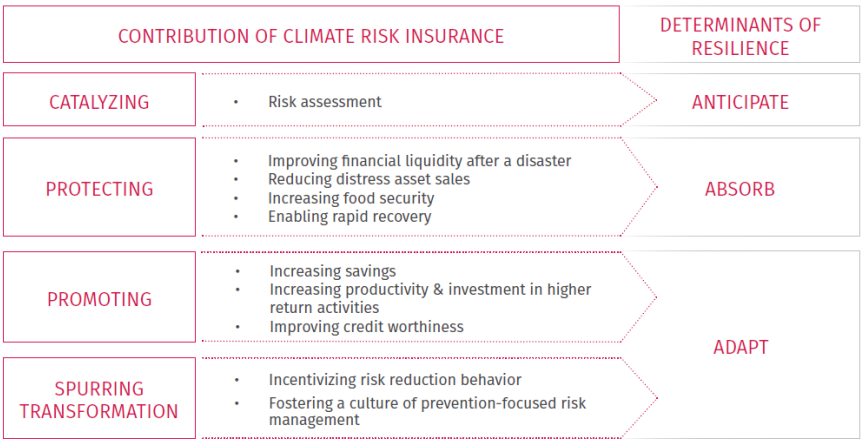


Figure 1: Impacts of climate risk insurance on resilience capacities (Source: Schaefer and Waters 2016)

Alternatively, this research revealed a shortage of rigorously designed studies examining how CRI influences resilience and measures of wellbeing, such as food security and transitions from poverty. Furthermore, it showed a significant uncertainty around which indicators should be used in the monitoring and evaluation of insurance initiatives to account for impacts on resilience. Focusing on the micro level, this discussion paper is a next step in placing resilience at the forefront of M&E debates in the CRI community of practice.

3.2 Other literature gaps: Gender analysis, experimental settings and rural bias

The literature analysis also revealed gaps in three areas that are described as follows:

[k] Macro schemes are the ones in which the national governments act as policyholders. In micro schemes, individuals hold insurance rights. Meso schemes refers to those situations in which an institution, acting as risk aggregator, purchases an insurance policy to protect itself from losses experienced from individuals.

- **Gender analysis**: Climate adaptation and the building of resilience among vulnerable populations pose a new challenge in the struggle for gender equity. In many contexts, women lack access to natural resources or are confined to secondary roles in decision making processes and economic activities[29]. Most studies reviewed have used the household as a unit of analysis. This obscures the differential impacts that insurance take up could imply across genders. Delavallade et al.[11] provide a gendered view on index insurance, but no analysis of the impact of insurance on wellbeing[l]. Future studies should ideally include larger sample sizes, or oversample female-headed households to ascertain unequal impacts. Alternatively, one could use qualitative methods that highlight the insurance, resilience and gender nexus.

- **Experimental settings**: A majority of existing studies was conducted in pilot phases, where researchers in many cases could influence the conditions in which insurance products were marketed. This influence includes the control of areas where populations can buy insurance, the introduction of vouchers, or triggering artificial payouts. While very much needed, these experimental studies apply methods that may not be realistic to evaluate fully scaled-up insurance schemes. In the context of the InsuResilience initiative, methodologies applied in scaled-up schemes[10, 19, 22] using secondary or recall data and quasi-experimental econometric methods are good examples of research designs tailored to the complexities of projects driven by commercial interests.

- **Rural bias**: All existing studies analyzed are framed in rural settings and relate to agricultural and livestock activities. This is logical considering that rural livelihoods are supposedly most affected by extreme weather conditions. Furthermore, the idea of index insurance was initially conceived to further develop agricultural insurance markets in developing countries. Hence, only in recent years has the concept been taken up by the disaster risk management community with ramifications for broader economic sectors and urban contexts. Future impact evaluations in these contexts should use indicators that reflect the complexities of urban livelihoods and the variety of economic sectors in which urban dwellers develop their activities.

[l] They conclude that women were less likely to purchase agricultural insurance and more likely to invest in savings for emergencies. They argue that women may perceive a higher basis risk in insurance as compared to savings. This is due to additional risks posed by maternity and child care. In the context of the R4 evaluation in Senegal, a similar pattern in women's demand for insurance is found.

4. MCII approach to climate risk insurance impact evaluation

This discussion paper is part of a broader endeavor, in which the InsuResilience Secretariat has commissioned MCII to design and implement an impact evaluation of CRI products. The long term objectives of this evaluation are to:

1. **Develop an adequate and feasible framework to measure resilience impacts in the frame of CRI schemes;**
2. **Propose an integrated (qualitative/quantitative & objective/subjective) framework for the evaluation of CRI on the resilience of most vulnerable populations that can be replicated in different settings by practitioners in the field of CRI;**
3. **Test the developed framework in at least one case study;**
4. **Contribute to developing the resilience component of the InsuResilience M&E framework.**

For this purpose, MCII – in charge of developing the objective component of resilience measurement– has teamed up with the Grantham Research Institute at the London School of Economics to further investigate the role of subjective components. This work will be conducted under the ERICI project[m], led by the Grantham Research Institute, and will develop and test subjective resilience measurement tools for insurance.

4.1 The resilience lens: A multidimensional index

According to the resilience conceptualization advocated by MCII, CRI can induce sustained and aggregated behavioral changes, which in resilience terms would be manifested through household enhanced capacities. Based on the 3A capacities framework introduced in the BRACED resilience study[31], we argue that immediate or direct effects of insurance uptake can be better categorized in anticipative, absorptive and adaptive capacities (Schaefer and Waters, 2016).

[m] http://www.lse.ac.uk/GranthamInstitute/evaluating-the-resilience-impact-of-climate-insurance-erici/

RESILIENCE CAPACITIES		
ANTICIPATE	**ABSORB**	**ADAPT**
Ability to estimate the impact of weather events on individuals and countries and the response measures and costs required to adequately address the impacts.	Ability to cope with the impacts of an extreme weather event and absorb the effects of the event.	Ability to adjust to actual or expected extreme weather events and its effects. Adaptation seeks to moderate or avoid harm or exploit beneficial opportunities.

Source: Schaefer and Waters, 2016

In this context, we think of insurance as a catalyst in the performance of households to deal with the effects of climate change. The framework is drawn directly from the work developed by the Food Security Information Network[33], and it is tailored to the CRI theory of change. In this concept, insurance would act in different phases:

- **Insurance coverage provides the incentives to be better prepared in the eventuality of an extreme weather event.**
- **Insurance payouts provide with the means to cope with the short term effects of extreme weather events.**
- **Insurance coverage provides a framework upon which to build robust livelihood strategies suited to the new climatic conditions over the long run.**

These enhanced capacities, through insurance, allow households to attain superior wellbeing effects when an extreme climate strikes. Over time, this will result in more resilient livelihood trajectories. From a measurement perspective, we suggest the use of a multidimensional index to track these changes. Sustained and aggregated behavioral changes at the household level – manifested through household enhanced capacities – and their interactions across the socioecological continuum can bring about a transformation[n]. Furthermore, certain insurance schemes could implicitly foster collective action at the community level or create new business models that lead to new social structures. Such is the case with insurance linked to contract farming or community works. However, it is expected that transformative effects may occur as a result of several loops and spillover effects (impacts from beneficiaries to non-beneficiaries), which may be difficult to measure with a traditional impact evaluation[30]. This caution is confirmed in light of the impact evaluation conducted for the R4

[n] Maintaining a focus on the household level, we exclude transformation from the capacity framework. However, we consider that CRI schemes reaching a sufficient scale and linked to other services can foster a transformative process, which could be better analyzed at the community level.

project led by OXFAM in Ethiopia[14], which failed to identify transformational changes even though the intervention addressed resilience building in a holistic way.

4.2 Analysis at the household level

The primary objective of this research framework is measuring how CRI at the micro level impacts these capacities and subsequent wellbeing levels. Based on the previous arguments, we suggest that the optimal unit of analysis to measure impacts on capacities would be the household. Thus, the transformational component of resilience would focus on superior levels, such as the village or council, and it would rely on the use of integrated methods (combination of qualitative and quantitative analysis, GIS or modelling). Evaluating such impacts will require time frames that exceed those usually stipulated in past studies.

4.3 Mixed methods and longitudinal study

The intended approach to an impact evaluation would require a longitudinal study. Indicators are proposed through a literature research, and are subsequently validated through a vulnerability assessment in selected communities. This process relies on secondary data relevant to the case study area and qualitative and participatory methods. Building on that, a household survey questionnaire is developed and tested, thus ensuring data collection feasibility. After the marketing of insurance products and before the climate hazard season occurs, baseline data in the form of a household survey is collected. The baseline provides vulnerability information for the households in the sample and serves as the base for the development of a multidimensional resilience index that enables the objective tracking of changes in resilience. The literature provides examples on the development of multidimensional resilience indexes[26, 27]. As highlighted in 4.1, MCII proposes adapting these approaches to better capture the impacts of CRI. This information is supplemented with a wellbeing benchmark, such as food security or poverty measures, which could ultimately be used as dependent variable that is mediated by resilience. Follow-up data will be collected once households have undergone climate stressors critical to their livelihood sustainability. This data includes a new household survey round and qualitative data through focus group discussions and semi-structured interviews. A mixed method approach will allow the triangulation of findings. While quantitative analyses would quantify changes on resilience, qualitative information would shed light on causal mechanisms. Quantitative analyses through econometric tools ought to be adapted to the prevalent conditions in the selected case study, thus depending on data availability and insurance marketing strategies. For an overview of methods, see World Bank Group[33] and GIZ[24] guidelines.

4.4 Subjective measurement of resilience

While resilience can be associated with certain behaviors or capital endowments, which are measurable with indicators, perceptions about self-efficacy or risk also have an effect on the resilience of households and communities[34,35]. A number of studies already incorporate subjective measures of resilience[33]. Furthermore, subjective measures of resilience can facilitate the work of researchers and project practitioners[34]. The usefulness of this approach lies in the ease of obtaining information from the interviewee. For that, it assumes that an individual has the capacity to reflect and synthesize this information in a given measurement scale, as opposed to the need to collect information on various parameters. Thus, the combination of subjective and objective measures of resilience can facilitate monitoring tasks and provide insights to better tailor interventions and target beneficiaries, respectively.

4.5 Randomization and feasibility

As it has been argued in this report, evaluating scaled up insurance projects with a dominant commercial logic makes the use of randomized control trials very difficult. Therefore, it is possible to anticipate that in the selected case study, MCII will seek alternative methodological approaches, such as quasi-experimental methods. However, previous impact evaluations have shown how marketing elements can introduce an element of randomization that enhance the rigor of quasi-experimental methods. Such approaches require an agreement and close cooperation with project actors, the most important being the insurer. Furthermore, the measurement of resilience through a multidimensional index can be demanding in terms of data collection. In order to be successful, this would require the collaboration of researchers and private sector at the inception stage; a high degree of research skills on the ground; a considerable amount of financial resources; and the collaboration of beneficiaries and non-beneficiaries.

5. Way forward

This discussion paper has discussed some of the effects that CRI can have on potential beneficiaries. The launch of the InsuResilience Global Partnership during COP23 is just one example of how insurance based solutions are regarded as one of the possible tools to increase the resilience of vulnerable populations. However, critical voices ask policymakers for caution. They argue that the evidence of positive impacts is scant and demand the creation of more robust M&E systems that track the impacts of CRI. This paper shows that there is evidence pointing to positive effects on coping strategies and wellbeing measures. Nevertheless, some impact evaluations in the past have been shortsighted. In other cases, studies have foregone tracking the effects of insurance on relevant dimensions for the purpose of climate change adaptation. Climate adaptation goes well beyond economistic notions that have been dominant in the development community until recently. Therefore, M&E systems ought to reflect the intricate complexity of these processes.

To fill this gap, this discussion paper has presented the research endeavor that MCII is currently pursuing for improving measurement and evaluation of insurance activities, collaborating with the Grantham Research Institute at the London School of Economics under the ERICI project. The proposed impact evaluation framework is characterized by the integrated measurement of resilience through subjective and objective measures, with a multidimensional index. From a methodological standpoint, a mixed method approach will be implemented, and quasi-experimental methods are favored to accommodate research activities to the commercial realities on the ground. The case study, to be selected, will be implemented during the period 2018-2020[o].

[o] Currently, other impact evaluations are ongoing or planned. At the macro level, Oxford Policy Management is conducting a 10 year evaluation of the African Risk Capacity. At the micro level, GIZ plans an impact evaluation of an NWK led insurance scheme in Zambia; MiCRO plans an evaluation of a direct scheme implemented in Guatemala; and WFP R4 is planning evaluations in Senegal and Ethiopia.

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Annex

Table 2: Overview of past impact evaluations [p]

Study	Location	Dataset & Sample	Experimental	Weather Shock	Methodology	Significant effects on Outcome Indicators
Janzen & Carter, 2013	Kenya (IBLI)	B + 2F N=634	Yes	Rainfall/Drought	Incentive randomization Local Average Treatment Effects Two-Stage least squares (IV: randomized discounts)	Livestock sales (-); reduction in the number of daily meals consumed (-)
Mobarak & Rosenzweig, 2013	India	Secondary data + Cross Section N=4,667	Yes	Rainfall/Drought	Randomization of treatment offer across villages and castes Price incentive randomization	Farm output (+); (landless HH) wage labor (-); (landless HH) migration (-); use of labor (+)
Madajewicz et al., 2013	Ethiopia R4	B + 2F N=360	Yes/No Pilot Gov.	Rainfall/Drought	Randomization of treatment across villages Treatment and control villages Difference-in-difference	Use of improved seeds (+); organic fertilizer (+); savings (+); livestock holdings (+); income sources (+)
Karlan et al., 2013	Ghana	B + 2F B N=502 F1 N=1,087	Yes	Rainfall/Drought	Random allocation to treatment group Y1 Price incentive randomization Y2 & Y3	Land preparation costs (+); # of acres cultivated (+); value of chemical inputs (+); total costs (+); proportion of land planted with maize (+); value of harvest (+); average weekly orchard income (-); household has

[p] Significant effects: P-value ≥ 0.9

		F2 N=1,252			Local Average Treatment Effects Two-Stage least squares (IV: price insurance)	non-farm income generating activity (-); # of HH members working in non-farm income generating activity (-); total farm revenue (+); post-harvest assets (+); household reports missing meal in past 12 months (-); utility expenses in past 12 months (+)
Cole et al., 2013	India	B + 2F N=1,479	Yes	Rainfall/Drought	Random allocation to treatment group Local Average Treatment Effects Probit regression estimates	Dummy agricultural inputs were used during the monsoon (+); log acres of land sown (+); log of the market value of agricultural inputs used (+); share of total cultivated land – cash crops (+); share of market value of agricultural inputs devoted to cash crops (+)
Cai, 2013	China	1B + 6F N=6548	No	Heavy rain, flood, windstorm, extremely high/low temperature, and drought.	Insurance take-up mandatory Difference-in-difference (DD) and triple difference (DDD) estimators	Cash crop production (+); production diversification (-); borrowing (+); saving (-)
Delavallade et al., 2015	Senegal/ Burkina Faso	B + 2F N=804	Yes	Rainfall/Drought	Random allocation to treatment group Intention to treat and Local Average Treatment Effects Two-Stage least squares (IV: sequential ordering of marketing sessions)	Investment in farm inputs (+); fertilizer per acre (+); yields (+); ate "luxury" food (+); used household liquidity to manage shock (+)

Elabed & Carter, 2015	Mali	B (recall data) + 1F N = 981	Yes	Rainfall/Drought Area-yield index	Treatment randomized at cooperative level Intention to treat effects Two-Stage least squares (IV: insurance status awareness)	Hectares sowed (+); seeds costs (+); fertilizer cost (+), cost of seeds per ha (+); land owned (+)
Tafere et al., 2015	Ethiopia (IBLI)	B + 2F N=510	Yes	Rainfall/Drought	Price incentive randomization Two-Stage least squares (IV: sensitization and vouchers)	Subjective wellbeing (+)
Dalberg, 2016	Senegal R4	B + 2F N=1,618	Yes/No Pilot Gov.	Rainfall/Drought	Randomization of treatment across villages Treatment and control villages Difference-in-Difference	Staple crop production (+); input costs (+); expenditure (+)
De Janvry et al., 2016	Mexico	Panel data 8 waves N=976 (municipalities)	No	Rainfall/Drought	Regression discontinuity design Fuzzy RD Two-stage least squares.	Hectares sowed (+); log expenditures p.c. (+); log income p.c. (+); remittances (-)
Cissé & Ikegami, 2016	Kenya (IBLI)	B + 5F N=924	Yes	Rainfall/Drought	Price incentive randomization Poisson Maximum Likelihood Estimator and Two-Stage least squares (IV: randomized discounts)	Household livestock holdings in TLU (+); child anthropometry (+)
Tobacman et al., 2016	India	B + 8F	Yes	Rainfall/Drought	Treatment randomized at village level	Expenses on agricultural inputs (+); hired labor (-); Financial costs and revenues (+);

		N=700			Two-Stage least squares (IV: policy units sold)	farm profit (-); Expenditure events (-); Savings (-); Food sufficiency for child (-); financial situation(self-reported 1 to 10) (-); Value of gifts/transfers received (-)
Hill et al., 2017	Bangladesh	B + 1F N= 2,300	Yes	Rainfall/Drought	Randomization of treatment offer. Intention to treat effects. Difference in Difference estimator.	Irrigation costs (+); fertilizer costs (+); purchased seeds (+); total rice harvested (+)
Jensen et al., 2017	Kenya (IBLI)	B + 3F N=924	Yes	Rainfall/Drought	Price incentive randomization Local Average Treatment Effects Two-Stage least squares (IV: randomized discounts)	Livestock sales (+); herd size (-); expenditures for vaccines and veterinary care (+); amount milk produced (+); livestock losses (-); monthly income (+); mid-upper arm circumference (+)
Sibiko & Qaim, 2017	Kenya (Kilimo Salama)	Cross Section (recall data) N=386	No	Rainfall/Drought	Two-Stage least squares (IV: weather index insurance training)	Chemical fertilizer log kg/acre (+); improved seeds log Ksh/acre (+); maize yields (+)
Huemmer & Kraehnert, 2017	Mongolia	B + 2F N= 667	No	Livestock loss rates above the 6% threshold due to extremely cold temperatures and excessive snowfall	Bias-corrected Matching Estimator	Log livestock (+); livestock growth rates (+) cumulative annual livestock growth rates (+); sold livestock (-); moved livestock during shock (-); borrowed money (+)

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The Munich Climate Insurance Initiative was initiated as a charitable organization by insurers, research institutes and NGOs in April 2005 in response to the growing realization that insurance solutions can play a role in adaptation to climate change, as suggested in the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. This initiative is hosted at the United Nations University Institute for Environment and Human Security (UNU-EHS). It is focused on bringing solutions for the risks posed by climate change to poor and vulnerable people in developing countries. MCII provides a forum and gathering place for insurance-related expertise applied to climate change issues.

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