

Changing Climate – Changing Behaviour

How agricultural microinsurance
can help smallholders
reduce their risk of
climate-related disaster

OUR NEXT ENDEAVOUR

Florent Baarsch⁰¹

Johanna Huppert⁰²

Christina Tewes-Gradl⁰³

01. Florent Baarsch (Climate Analytics gGmbH),
florent.baarsch@climateanalytics.org
02. Johanna Huppert (endeava),
j.huppert@endeava.org
03. Christina Tewes-Gradl (endeava),
c.gradl@endeava.org



About

02

Acknowledgements

We would like to thank the representatives of the microinsurance scheme examples featured in this paper for sharing their insight: Sobiah Becker (Munich Climate Insurance Initiative), S. Balasubramanian (Peoples Mutual).

We would also like to thank Santiago Gonzales, Martin Herrndorf and Christiane Ströh de Martínez for their contribution to conceptualizing this paper.

Finally, we would like to thank Friederike Lenel (DIW), Karlijn Morsink (University of Oxford – Centre for the Study of African Economies [CSAE]) and Dania Röpke for their review and critical feedback and Ela Smith (Climate Analytics GmbH) for editing this paper.

We assume responsibility for any inaccuracies.

About “Our next Endeavour”

“Our next Endeavour” is Endeava’s working paper series on current issues in enterprise solutions for development. The papers explore topics we consider relevant and topical for inclusive business. The papers are based on research and analysis. They are targeted at practitioners from companies, development agencies and NGOs. With this, “Our next Endeavour” aims to inspire forward thinking, stimulate dialogue and spark new collaborations.

If you wish to comment on this paper, please write to Christina Gradl (c.gradl@endeava.org)!

We are keen to hear your reactions.

About the authors

Florent Baarsch is a researcher and policy analyst at Climate Analytics, focusing on adaptation and following the UNFCCC negotiations since 2008. He holds a Masters in Development Economics and is author of the World Bank Turn Down the Heat report (June 2013) and the UNEP Africa’s Adaptation Gap Report (October 2013). His research focuses on adaptation, impacts and insurance mechanisms.

Johanna Huppert works as a junior consultant for Endeava. She holds a Bachelor’s degree in International Economics and Development and is currently pursuing an International Master in Rural Development at the University of Ghent, Belgium. She has been working on microfinance topics during an internship with PlaNet Finance in 2012 and is keen to explore this subject in more detail from an agricultural perspective in the future.

Christina Tewes-Gradl is a Co-Founder and Managing Director of Endeava. She co-authored the report “Learning to Insure the Poor” for Allianz in 2009 and is fascinated by the potential of insurance to incentivize certain behavior. She has been working on inclusive agribusiness since 2005, e.g. with rice smallholders in Madagascar and with the study “Growing Business with Smallholders”, and is concerned about the impacts of climate change for smallholders.

WRITTEN BY:

Florent Baarsch
Johanna Huppert
Christina Tewes-Gradl

LAYOUT & TYPESETTING:

derMarkstein.de
Berlin

PUBLISHED BY:

endeava UG
Brunnenstraße 192
10119 Berlin
Germany

Executive Summary

03

Agricultural microinsurance is currently being tested in a wide variety of settings to support smallholder farmers in developing countries in coping with the effects of climate change, such as droughts, floods, or increased frequency and severity of infestations. This paper shows that microinsurance can also help smallholders to adapt to climate change.

Four mechanisms inducing disaster risk reduction adopted by microinsurance schemes were identified: (1) rewarding risk reducing behaviour, (2) paying for implementing disaster risk reduction measures; (3) informing about approaching weather events; and (4) paying out in anticipation of the occurrence of the event.

Examples of microinsurance schemes that make use of these mechanisms have been identified for each approach. However, little is known about the effectiveness of these mechanisms in the examples identified in the paper.

Microinsurance schemes could be a cost-effective way to encourage risk-reducing behaviour among smallholders. More research and experimentation is required to fully understand and use the potential of this instrument.

KEYWORDS:

Climate change

Disaster risk reduction

Risk transfer

Smallholder farmers

Agricultural
microinsurance

Introduction

04

Linking microinsurance with disaster risk reduction

Most people in developing countries depend on small-scale agriculture for part of their subsistence and income. In addition, smallholders contribute a large share of the GDP and local food supply at the country level. However, smallholders in developing countries are among those most vulnerable to the adverse effects of climate change. Yet, so far there has been and little effort has been done to reduce their vulnerability. Populations in developing countries are projected to be among the most affected by droughts, floods and other extreme weather events (Schellnhuber et al., 2013). Therefore, implementing cost-efficient strategies to help smallholders to adapt to climate change and reduce risk, is of growing interest for national and international policy-makers, development practitioners and, above all, the farmers themselves.

Agricultural insurance and microinsurance services have been identified as relevant instruments that support smallholders cope with the damages caused by extreme weather events. Insurance services also support farming productivity, as smallholders are more likely to invest in productivity improvements if they know their investment and efforts are covered by insurance (Vargas Hill & Viceiza, 2010). Microinsurance services are also frequently mentioned as mechanisms that can contribute to disaster risk reduction. Yet, apart from risk pricing, it is unclear how microinsurance schemes strengthen disaster risk reduction (DRR) and reduce smallholders' exposure to climate related risks. Indeed, microinsurance could even lead to delays in adaptation, since losses are covered. Therefore, the main objective of this study is to identify the direct mechanisms associated with agricultural microinsurance schemes that induce smallholders to reduce their vulnerability to climate-related risks.

This paper systematically identifies direct mechanisms to induce DRR via microinsurance. It analyses existing agricultural microinsurance products and identifies examples, where these mechanisms have been employed. As a conclusion, the paper encourages further research and experimentation on linking microinsurance more directly with DRR and assessing smallholders' uptake and cost-efficiency of these integrated mechanisms.

Climate-related risks for smallholders

Climate change is projected to alter rainfall patterns and increase frequency and severity of dry spells as well as droughts. These changes are expected to affect agricultural productivity and therefore also the capacity of smallholders to support their livelihoods (Müller et al., 2011). In East Africa, crop yields may decline by 10 to 20% by 2050 (Thornton et al., 2009). Furthermore, droughts will also increase livestock mortality and may force smallholders to sell livestock at disadvantageous prices (Morton, 2012; Thornton & Gerber, 2010; Thornton et al., 2009). Besides, there is evidence that the severity and frequency of pests and diseases of crops increase under climate change (Gregory et al., 2009).

Introduction

Climate change is also projected to affect smallholders' land use. In some regions, such as Northern India, smallholders are likely to face water shortages due to the decreased water supply from snow-caps, increased rainfall seasonality and aridity, which would put strain on their irrigation systems (de Fraiture & Wichelns, 2010; Tao & Zhang, 2013). Salt-water intrusion caused by the projected sea-level rise is likely to pose a severe threat to coastal areas and, specifically, deltaic regions. Sea-level rise have severe effects on coastal areas and specifically deltaic regions, as salt water will intrude further inland. Agricultural activities in deltaic regions are projected to be severely affected by the increased coastal flood depth and landfall tropical storm intensity (USAID, 2013; Wassmann et al., 2004).

Smallholder farmers have a significant share of their revenues depending on their farming activities (high sensitivity) and their capacity to adapt is low due to their lack of access to adequate financial services and other resources such as infrastructure, education, or technology. High sensitivity combined with low adaptive capacity drives developing countries smallholder farmers' vulnerability to climate-related risks (Morton, 2007).

Potential measures to reduce smallholders' exposure to risk

Reducing climate-related risks borne by smallholders in developing countries involves adaptation to climate change and DRR. DRR refers to the measures adopted to reduce exposure to risk. In other words, adaptation and DRR anticipate an actual adverse event, while coping occurs after the occurrence of an event (Parry et al., 2007).

Adaptation and risk reduction efforts for smallholders are expected to be costly. Smallholder farmers, located in rural areas, are often at long distance from communication networks, public services and other infrastructure. Therefore, coupling risk-hedging and risk reduction mechanisms may contribute to make adaptation projects more cost-efficient.

There is a number of solutions and measures smallholders could take, either as individuals or as a community, to reduce their vulnerability to climate-related risks. Smallholders can develop or improve infrastructure, for example by building irrigation systems, storage facilities, protective installations such as dams and basins, or plant trees to limit soil erosion and evapotranspiration. Farmers can diversify crops and choose varieties or species that are more resistant to floods, droughts, pests and diseases. Farmers can also adopt new farming techniques and ultimately diversify their sources of revenues, for example by strengthening roots, late planting of legume crops or developing informal trading activities (Mortimore & Adams, 2001; Eriksen & Silva, 2009). As a last resort, farmers can migrate to a different area that is less exposed to risks (Steinmann, 2012).

// What is DRR?

The IPCC (IPCC, 2012) defines disaster risk reduction as both a policy goal or objective, and the strategic and instrumental measures employed for anticipating future disaster risk; reducing existing exposure, hazard, or vulnerability; and improving resilience. In both adaptation and DRR, projected climate change impacts are anticipated and measures are planned at different levels to reduce exposure and therefore vulnerability to risks. Adaptation to climate change is the process of adjustment to climate change, which includes disaster risk management and reduction for climate-related disasters

The state of agricultural microinsurance

Defining agricultural insurance

Microinsurance is ‘the protection of low-income people against specific perils in exchange for regular payments proportionate to the likelihood and cost of the risk involved’ (Churchill, 2006). Agricultural insurance covers agricultural losses, e.g. loss of livestock, harvest, and the related investment such as seeds, fertilizer, etc. In recent years, microinsurance has been promoted as a tool to help smallholders manage risks and thus be better able to invest in agricultural productivity growth (Steinmann, 2012).

Access to agricultural insurance

Very few smallholders have currently access to agricultural insurance. In 2011, agricultural insurance premiums in developing countries’ markets were estimated at USD 5.2 billion, compared to the global volume of agricultural insurance premiums of USD 23.5 billion (Wong, 2013). In total, the premiums paid for agricultural insurance in developing countries account for less than 20 per cent of the global total of agricultural premiums, even though developing countries’ markets account for nearly 70 per cent of food production worldwide (Roth & Mccord, 2008). Moreover, the share of agricultural insurance premiums paid for catastrophe insurance in particular is only around a third in wealthy countries and drops to only a tenth in higher-middle income countries. In lower-middle and low-income countries the share is only 1 to 2 per cent (NatCatService, 2005). Smallholders in developing countries generally hold the minority of the few existing agricultural insurances.

How agricultural insurance usually works

Most agricultural microinsurance schemes in place in developing countries are index-based. The insurance provider does not assess losses individually, but defines a certain threshold (e.g. of rain or lack of rain) that triggers the payout and determines its value. The value of the payout depends on the threshold and the type of policy held by the insurance holder.

The index-based approach has many advantages, e.g. it reduces moral hazard risk on the farmer’s side and it is more cost-efficient for the insurer to manage. The major drawback of the index-based approach stems exactly from what was formerly described as an advantage: by not assessing losses individually but defining a threshold instead, depending on the threshold defined, farmers run the risk of incurring a loss without receiving a payout. Reciprocally, insurers run the risk of having to give a payout without any loss having occurred.

Besides the index-based approach, the other common procedure to assess losses is to apply an indemnity-based approach. Here, the payout is estimated based on smallholders’ claimed asset losses such as crop or livestock losses. The disadvantages of this approach are the low volume of business and high fixed transaction costs since the system requires extensive networks of claims adjusters in order to reach all clients in rural areas. Beyond that, the risk of moral hazard and adverse selection are inherent to this approach.

Introduction

Links between microinsurance and DRR

Despite the current low insurance coverage rates amongst smallholders in developing countries, a growing number of microinsurance initiatives are tentatively linking DRR and risk transfer. Combining these approaches is common in the mainstream insurance market. Many examples show that insurance schemes induce behaviour change of the insured contributing to reducing risk, a phenomenon particularly studied in the health sector (e.g., Prochaska et al., 2008). In our review, we identified four types of DRR mechanisms that are already associated with agricultural microinsurance schemes in developing countries. They are introduced in the table below (table 1).

#	Type of DRR mechanism	Potential application	Example of MI schemes	Description of the mechanism
#1	Reward risk reducing behaviour	<ul style="list-style-type: none"> • Provide insurance only in case of DRR • Pay rewards for DRR 	Kilimo Salama	<ul style="list-style-type: none"> • Farmers are insured only if they implement DRR • Insurance gets cheaper in case of DRR (risk pricing)
#2	Pay for risk reduction measures	<ul style="list-style-type: none"> • Pay for implementation of DRR infrastructure such as irrigation • Provide information and training about DRR at no cost 	<ul style="list-style-type: none"> • Rural Resilience Initiative (R4 - Harita) • People Mutuals 	<ul style="list-style-type: none"> • Policy holders carry out DRR measures in exchange for insurance protection • Insurer pays for training or other DRR measures
#3	Inform about approaching weather events	Implement early warning systems	Livelihood Protection Policy	Shortly before the occurrence of weather extreme, policy holders receive a warning from the insurer to help them anticipate and prepare
#4	Pay out prior to the weather event	Policy holders receive payments before an event occurs to pay for	<ul style="list-style-type: none"> • DRR • EBII 	Policy holders receive payout before the occurrence of event to implement adequate risk reduction measures

Table 1: Mechanisms aimed at strengthening disaster risk reduction associated with microinsurance schemes

To understand which of these DRR mechanisms are already in use, we inventoried and reviewed existing agricultural microinsurance schemes. In total, we identified and analysed 21 agricultural microinsurance schemes (data available upon request). Five of these schemes already include mechanisms to induce DRR. These schemes are described in the context of the respective mechanism.

Reward risk reducing behaviour: Kilimo Salama

A microinsurance scheme can integrate incentives to make risk reduction more attractive to the policyholders (Suarez & Linnerooth-Bayer, 2008).

The agricultural insurance product **Kilimo Salama** helps Kenyan farmers to cope with risks from changing weather patterns by providing insurance for agricultural inputs, such as certified seeds, fertilizer and crop protection (Mahul et al., 2011). Syngenta Foundation for Sustainable Agriculture in partnership with Safaricom, the largest mobile network operator in Kenya and UAP, a major Kenyan insurance company, developed the insurance scheme Kilimo Salama. However, only the farmers purchasing Syngenta drought-resistant hybrid seeds can benefit from the insurance scheme.

Kilimo Salama uses a very restrictive incentive by requiring smallholders to implement DRR measures to be granted access to insurance coverage. To this end, loans or product prices can be directly bundled with insurance (Steinmann, 2012). By purchasing drought-resistant seeds, small-scale farmers reduce their exposure to the impacts of droughts on crop production (UAP, 2011). Smallholders can insure as little as one kilogram of seeds or agricultural inputs. They thus not only have the ability to invest in adaptation, but are actively encouraged to make investment decisions in line with changing risk patterns.

Another approach is to lower the value of the insurance premiums when DRR measures are taken. The premium would hence be adjusted to the actual risk exposure. Even though no specifically climate-related insurance, which used this mechanism was identified, the “Red Hairy Caterpillar Insurance” offered by People Mutuals in India shows that this approach strengthens the implementation of DRR measures by smallholders. Smallholders pay less for the insurance coverage for caterpillar damage if they plough their fields during summer, a measure that reduces the occurrence of red hairy caterpillars.

Pay for risk reduction measures: R4 and People Mutuals

Microinsurance providers can also pay smallholders directly for implementing DRR measures. There are two important components to DRR for smallholders: understanding the risk situation and changing behaviour to adjust to it; and building or improving appropriate infrastructure such as irrigation systems or dams to adapt to the adverse effects of droughts or floods. The insurer can use different means to pay for these measures:

- The approach developed by People Mutuals is to directly provide smallholders with the required goods or services, e.g. by providing training and information, for example, on water management or agricultural practices.
- A second approach, implemented by the Rural Resilience Initiative Harita (R4), is to accept labour contribution into disaster risk reduction and adaptation measures in exchange for the premium payment.
- A third approach consists in reimbursing smallholders for costs incurred related to DRR. No example was found on the latter approach. This approach is widely used in health insurance, where the insurance pays for sports classes and other measures that maintain one's health.

People Mutuals offers smallholders in India several crop mutual insurance schemes, all based on rainfall indices. Only members of a farming federation can access the services of People Mutuals. The mutual insurance is a joint initiative of the DHAN Foundation, Oxfam Novib, Rabobank Foundation and Achmea reinsurance company (DHAN Foundation, 2011).

To stimulate demand and build capacity, members of farming federations are trained on climate change, drought and water management issues. For this matter, the DHAN Foundation established Village Information Centres (VIC), which provide agricultural extension services for farmers and agricultural labourers (Warner, Bouwer, & Ammann, 2007). Smallholders can use the VIC to learn more about agricultural practices, consult experts and obtain information about the agricultural market.

People Mutuals also supports farmer federations in developing localised crop insurance risk sharing mechanisms, through Mutual Insurance Committees. The committee decides on the risks to be insured and the level of risk retention by the insured farmers. People Mutuals collaborates with the Agricultural Insurance Company, which defines the risk level on the basis of the automatic rain gauge data from villages in the area under consideration (DHAN Foundation, 2010).

The **Rural Resilience Initiative – Harita (R4)** is an integrated risk management framework in Ethiopia, which enables small-scale farmers in drought-prone regions to improve their food and income security through a combination of improved resource management (risk reduction), insurance (risk transfer), microcredit (prudent risk taking) and savings (risk reserves). The project was initiated in 2009

2) Pay for risk reduction measures: R4 and People Mutuals

and is implemented by the World Food Programme, Oxfam America, Swiss Re and other local partners. Small-scale farmers, who do not have the financial means to pay for their insurance coverage can do so by providing their labour for community-identified projects that aim at reducing risk and building climate change resilience, such as improving irrigation or soil management. In effect, the insurance provider, together with the insurance takers, thus pays for DRR measures.

In the event of a seasonal drought, insurance payouts are triggered automatically when rainfall precipitation drops below a predetermined threshold (index-based mechanism). Payouts then enable farmers to afford the seed and inputs necessary to plant in the following season and protect them from having to sell off productive assets to survive. In 2011, the R4 Rural Resilience Initiative had already reached 75,000 farmers in Ethiopia. Due to the success of the pilot scheme, a similar pilot is planned to roll out in 2013 Senegal and two more countries are supposed to be integrated within the next 5 years (WFP & Oxfam America, 2012)

3)

Inform about approaching weather events: Livelihood Protection Policy

Timely information about expected events is critical to help smallholders take preventive measures. For example, in case of expected heavy rainfall, they can harvest early, or they can protect their productive assets and reach a shelter.

The **Livelihood Protection Policy** in Saint Lucia provides smallholders and other low-income individuals with climate-related insurance. The Munich Climate Insurance Initiative (MCII) established Climate Risk Adaptation and Insurance in the Caribbean, a project supported by the German Ministry for the Environment. The project's objective is to reduce and transfer risk in Saint Lucia to support climate change adaptation (Munich Climate Insurance Initiative, 2012). The program provides vulnerable individuals, such as smallholders, who have no stable income streams and would not be supported by any kind of safety net in case of an extreme weather event an index-based insurance scheme, where payouts are triggered by predetermined rainfall and wind speed indices (MCII, 2013). One component of the DRR measures incorporated into this insurance product is an SMS-alert service. Policyholders are warned via SMS, if an extreme rainfall or wind event is about to cross a pre-determined threshold, in order to enable them to take preventive measures.⁰⁴

04. Interview with Sobiah Becker, project manager at Munich Climate Insurance Initiative, February 11, 2013.

Pay out before event: ENSO Business Interruption Index Insurance (EBIII)

In the last DRR mechanism, the payout can be triggered in anticipation of the occurrence of an event, so policyholders can implement preventive measures. This mechanism only works with an index-based insurance scheme.

The **ENSO**⁰⁵ Business Interruption Index Insurance (EBIII) is a risk transfer product established by La Positiva, a Peruvian insurance company, with the assistance from GlobalAgRisk, Inc, a global insurer specialised in natural disaster risk transfer in rural areas. EBIII provides companies and financial institutions insuring, among others, smallholder farmers, with an insurance against climate-related disasters associated with the El Niño Southern Oscillation.

Since 2010, smallholders in Northern Peru can purchase insurance that pays out just as flooding starts and stakeholders begin incurring extra costs and consequential losses (J. Skees & Collier, 2010). An insurance policy that will pay out in early January must be purchased until April of the previous year. After April, ocean water temperature variations provide early forecasting information about the probability of the occurrence of an El Niño event. Payout is determined based on ENSO severity and data from November and December and the threshold level indicated in the contract (J. Skees & Murphy, 2009). The insurance product provides indemnities to smallholders before a severe El Niño event emerges. An index of sea surface temperature in the Pacific Ocean triggers the payout (J. R. Skees, Hartell, & Murphy, 2007).

Given the high basic risk associated with selling index insurance to households, this insurance is designed for firms and institutions that serve households that are highly exposed to ENSO (such as risk aggregators in the agricultural value chain). The aggregators can then transfer payments to the smallholder policyholders. Paying before the emergence of the catastrophe allows smallholders to mitigate the losses and disruptions that are likely to occur by taking risk reduction measures (J. Skees & Murphy, 2009).

05. The El Niño – Southern Oscillation (ENSO) is a band of anomalously warm ocean water temperatures that occasionally develops off the western coast of South America and can cause climatic changes across the Pacific Ocean. It can cause droughts and floods. The phenomenon is called after Christ child, because it is usually noticed around Christmas.

Conclusion

12

The examples show that it is possible to use agricultural microinsurance schemes to directly induce smallholders to undertake DRR measures. The study reveals that many dimensions of the DRR mechanisms – currently in place – are poorly understood. The effects of DRR measures induced by microinsurance schemes on actual behaviour change of smallholders, on resilience and their cost efficiency are still to be analysed. A thorough assessment of the effects of these mechanisms on DRR should not only evaluate economic outcomes but also the impacts on long-term resilience and vulnerability of communities. The assessment should also acknowledge challenges smallholders face in responding to the mechanisms and further advance these direct links. Furthermore, DRR incentives also need to be evaluated to better understand which ones are the most effective and efficient in decreasing vulnerability to climate-related disasters of smallholder communities.

More research – and experimentation – are needed to better understand how to bundle the different mechanisms and what role farmer federations can play in strengthening DRR. The example of People Mutuals in India shows that working very closely with farmer federations can be an effective way to reach rural populations. Using existing social structures and networks to provide information and capacity building, reward DRR activities, and assess losses locally is an approach that deserves more careful attention and further assessment.

As microinsurance can explicitly induce DRR, it could become an extremely cost-effective mechanism to support smallholders in adapting to climate change. Our study shows that as yet this potential has not been fully leveraged.

Further Readings

- Churchill, C. (2006). *Protecting the Poor: A Microinsurance Compendium*. Geneva, Switzerland.
- IPCC (2012). *Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)*. Retrieved from <http://ipcc-wg2.gov/SREX/report/>
- Mahul, O., Boudreau, L., Lane, M., Beckwith, R., & White, E. (2011). *Innovation in Disaster Risk Financing for Developing Countries : Public and Private Contributions* (pp. 1–77). Washington, D.C.
- Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences of the United States of America*, 104(50), 19680–5. doi:10.1073/pnas.0701855104
- Schellnhuber, H. J., Hare, B., Serdeczny, O., Schaeffer, M., Adams, S., Baarsch, F., ... Rocha, M. (2013). *Turn down the heat : climate extremes, regional impacts, and the case for resilience* (pp. 1–255). Washington, D.C. Retrieved from <http://documents.worldbank.org/curated/en/2013/06/17862361/turn-down-heat-climate-extremes-regional-impacts-case-resilience-full-report>
- Thornton, P. K., & Gerber, P. J. (2010). Climate change and the growth of the livestock sector in developing countries. *Mitigation and Adaptation Strategies to Global Change*, 15, 169–184

Conclusion

References

- Churchill, C. (2006). *Protecting the Poor: A Microinsurance Compendium*. Geneva, Switzerland.
- De Fraiture, C., & Wichelns, D. (2010). Satisfying future water demands for agriculture. *Agricultural Water Management*, 97(4), 502–511. doi:10.1016/j.agwat.2009.08.008
- DHAN Foundation. (2010). *People Mutuals*. Retrieved June 17, 2013, from <http://www.dhan.org/peopleinstitutions/peoplemutual.php>
- DHAN Foundation. (2011). *People Mutuals - Annual Report 2011* (pp. 1–17). Madurai, India.
- Eriksen, S., & Silva, J. A. (2009). The vulnerability context of a savanna area in Mozambique: household drought coping strategies and responses to economic change. *Environmental Science & Policy*, 12(1), 33–52. doi:http://dx.doi.org/10.1016/j.envsci.2008.10.007
- Gregory, P. J., Johnson, S. N., Newton, A. C., & Ingram, J. S. I. (2009). Integrating pests and pathogens into the climate change/food security debate. *Journal of Experimental Botany*, 60(10), 2827–2838. doi:10.1093/jxb/erp080
- IPCC. (2012). *Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)*. Retrieved from <http://ipcc-wg2.gov/SREX/report/>
- Mahul, O., Boudreau, L., Lane, M., Beckwith, R., & White, E. (2011). *Innovation in Disaster Risk Financing for Developing Countries: Public and Private Contributions* (pp. 1–77). Washington, D.C.
- MCII. (2013). *Climate Risk Adaptation and Insurance in the Caribbean*. Retrieved June 17, 2013, from http://www.climate-insurance.org/front_content.php?idcat=873
- Morton, J. (2012). Livestock and climate change – impacts and adaptation. *Agriculture for Development*, 17, 17–20.
- Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences of the United States of America*, 104(50), 19680–5. doi:10.1073/pnas.0701855104
- Munich Climate Insurance Initiative. (2012). *For Individuals: The Livelihood Protection Policy* (pp. 1–2). Bonn, Germany.
- NatCatService. (2005). *Natural Disasters according to Country Income Groups, 1980-2004*. Munich, Germany.
- Parry, M. L., Canziani, O. J., Palutikof, J. P., van der Linden, P. J., & Hanson, C. E. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1–976).
- Prochaska, J. J., Spring, B., & Nigg, C. R. (2008). Multiple health behavior change research: An introduction and overview. *Preventive Medicine*, 46(3), 181–188. doi:http://dx.doi.org/10.1016/j.ypmed.2008.02.001
- Roth, J., & Mccord, M. (2008). *Agricultural Microinsurance: Global Practices and Prospects* (pp. 1–50). Appleton, WI.

Conclusion

- Schellnhuber, H. J., Hare, B., Serdeczny, O., Schaeffer, M., Adams, S., Baarsch, F., ... Rocha, M. (2013). Turn down the heat : climate extremes, regional impacts, and the case for resilience (pp. 1–255). Washington, D.C. Retrieved from <http://documents.worldbank.org/curated/en/2013/06/17862361/turn-down-heat-climate-extremes-regional-impacts-case-resilience-full-report>
- Skees, J., & Collier, B. (2010). New Approaches for Index Insurance: ENSO insurance in Peru (pp. 1–2). Washington, D.C.
- Skees, J., & Murphy, A. (2009). ENSO Business Interruption Index Insurance for Catastrophic Flooding in Piura , Peru (pp. 1–32). Lexington, KY.
- Skees, J. R., Hartell, J., & Murphy, A. G. (2007). Using Index-Based Risk Transfer Products to Facilitate Micro Lending in Peru and Vietnam. *American Journal of Agricultural Economics*, 89(5), 1255–1261. doi:10.1111/j.1467-8276.2007.01093.x
- Steinmann, R. (2012). Climate change : a microinsurance perspective. Luxembourg.
- Tao, F., & Zhang, Z. (2013). Climate change, wheat productivity and water use in the North China Plain: A new super-ensemble-based probabilistic projection. *Agricultural and Forest Meteorology*, 170(0), 146–165. doi:<http://dx.doi.org/10.1016/j.agrformet.2011.10.003>
- Thornton, P. K., & Gerber, P. J. (2010). Climate change and the growth of the livestock sector in developing countries. *Mitigation and Adaptation Strategies to Global Change*, 15, 169–184.
- Thornton, P. K., van de Steeg, J., Notenbaert, A., & Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agricultural Systems*, 101, 113–127.
- UAP. (2011). Kilimo Salama - Presentation (pp. 1–26). Nairobi, Kenya.
- United States Agency for International Development (USAID). (2013). Mekong Adaptation and Resilience to Climate change (Mekong ARCC) Synthesis Report (pp. 1–233).
- Vargas Hill, R., & Viceisza, A. (2010). An Experiment on the Impact of Weather Shocks and Insurance on Risky Investment. Washington, D.C. Retrieved from <http://www.ifpri.org/sites/default/files/publications/ifpridp00974.pdf>
- Warner, K., Bouwer, L., & Ammann, W. (2007). Financial services and disaster risk finance: Examples from the community level. *Environmental Hazards*, 7(1), 32–39. doi:10.1016/j.envhaz.2007.04.006
- Wassmann, R., Hien, N. X., Hoanh, C. H. U. T., & Tuong, T. O. P. (2004). Sea level rise affecting the Vietnamese Mekong Delta: Water elevation in the flood season and implications for rice production. *Climatic Change*, 66, 89–107.
- WFP, & Oxfam America. (2012). R4 Rural Resilience Initiative: Quarterly Report January 2012-March2012 (pp. 1–19). Rome, Italy.
- Wong, C. (2013). Partnering for Food Security in Emerging Countries. Zurich, Switzerland.



Endeva stands for “enterprise solutions for development”. It also stands for our endeavour to make poverty a thing of the past and preserve ecosystems for the future, by inspiring and enabling truly sustainable and inclusive businesses.

As an independent institute, we work closely with partners from all sectors, including large and small companies, development agencies, foundations, and universities.

With them, we build, share and apply knowledge about how to develop, implement and grow inclusive business models. We rely on a global network of experts to carry out our projects.

You can find more information about our work on our website at www.endeva.org

© 2013 by Endeva

The material in this publication is copyrighted. Quoting, copying, and/or reproducing portions or all of this work is permitted provided the following citation is used:

Florent Baarsch, Johanna Huppert, Christina Tewes-Gradl (2013).
“Changing Climate, Changing Behavior – How agricultural microinsurance can help smallholders reduce their risk of climate-related disaster.”
Our next Endeavour 2. Berlin: Endeva.
