Published by:

micro insurance network

BRIEFING PAPER

Climate change and index insurance

How can the insurance industry respond to the challenge?

In cooperation with:

IFAD
Investing in rural people

WFP

Introduction

This briefing note summarises the emerging issues related to climate change and index insurance, discussing how climate trends are being considered in index product design and pricing, and how this could be improved. It is intended to inform further discussion and collaboration across the insurance sector with a focus on index solutions.

The note presents the common challenges observed by index designers and risk takers in response to climate change, highlights some new approaches being undertaken by these stakeholders in relation to technical product design, processes, and actuarial approaches, and provides some recommendations on how the wider index insurance industry can continue responding to the challenges.

The briefing note is produced by the Microinsurance Network's (MiN) Best Practice Group (BPG) for Climate Change and Food Security[1] which in 2022 became the "Building the resilience of smallholder farmers" BPG and is the result of a series of industry workshops with actuaries and risk takers from the insurance and reinsurance industry, as well as development practitioners and researchers. The note is not intended to be a research paper and the BPG acknowledges the absence of academic reference points.

The workshops, conducted virtually in April and May 2021, were aimed at gathering practical expertise and real-world feedback in response to the following question *"What is the impact of climate change and climate trends in the design and pricing of index insurance products?"*. The workshops were focused primarily on drought index insurance products in specific countries in Africa (namely, Senegal, Zambia, Kenya, Mali, Burkina Faso), although some discussions included experiences related to flood indices as well as learnings from South America (Colombia).

1 The BPG was co-chaired in 2021 by the two United Nations agencies, the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP) and included participation for 22 organisations, including Access to Insurance Initiative (A2ii), Agence Française de Développement (AFD), Appui au Développement Autonome (ADA), AXA S.A., Centre for Financial Regulation and Inclusion (Cenfri), ClimateRe GmbH, Denis Garand & Associates, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Feed the Future MRR Innovation Lab - University of California, Grameen Crédit Agricole Foundation (GCAF), Hollard, IBISA, ILO's Impact Insurance Facility, InsuResilience, Katie School of Insurance & Financial Services at Illinois State University, Lorica Conseil, Microinsurance Network, Milliman, RADIANT YACU LTD, Sanasa Insurance Company Limited (SICL), Swiss Agency for Development and Cooperation (SDC), and Women's World Banking (WWB).

Background and problem statement

Climate change increases the frequency and severity of climate-related risks and higher climate variability is affecting the production cycles and yields of some staple crops - with future climate predictions threatening to exacerbate the trend. Changes in rainfall patterns, temperatures, and escalation of climate-related risks, such as droughts and floods could affect crop quality and quantity, as well as yields.

While the negative consequences of climate change on food security for the most vulnerable communities increases the need for risk management solutions like agricultural and climate risk insurance, it also means the insurance industry will need to incorporate climate change considerations implicitly in their product design and underwriting processes. This applies to traditional indemnity-based insurance, but also to index insurance, which, while it has advantages in terms of protecting low-income and food insecure populations, relies on historical data to develop the statistical index on which payouts are based rather than in-person loss assessments.

In the series of workshops, index designers and risk takers expressed a mutual concern about the rapidly evolving nature of climate risks. The projected climate trends have prompted many industry stakeholders to revise policies and rethink index design methodologies for index insurance. Past loss experiences are no longer sufficiently predictive of the future, and it has become increasingly difficult to differentiate between natural climate variability and variation caused by climate change. New underwriting solutions are being explored to take complex nonlinear climate effects into consideration, but the degree of climate variability between regions is high, making it harder to replicate these solutions.

There is consensus on using climate projections to optimise insurance products. However, it is harder to agree on how to incorporate them into the design of indices and pricing. This is leading to instability in pricing for insurance products in some vulnerable regions, negatively impacting the affordability and thus accessibility of risk transfer options. For example, if there is an observed trend of less rainfall for a drought product, it will be factored either into the premium on a yearly basis, gradually increasing the premium or by progressively adjusting the triggers and exits. In instances where short-term claims experiences are used to determine premiums instead of longer-term trends, it is difficult for underwriters to defend maintaining a lower premium after a large payout. Some risk takers are also hesitant to sign multi-year reinsurance slips to stabilise the premium pricing because of risk volatility in the climate space, although other risk carriers might prefer to sign multi-year deals to prevent adverse selection (i.e., decision making based on weather forecasts) and to limit costs which can be used to deliver better value products.

Climate change and challenges faced by index insurance designers and risk takers and emerging solutions

Developing countries are particularly vulnerable to climate change impacts owing to weak institutional support systems and a high dependency on rain-fed agriculture among smallholder farmers in these countries. Growing evidence suggests that many African countries will be severely impacted by climate change in the coming years while resources to finance disaster risk management and adaptation to climate risk are limited and segmented. Climate risk management tools such as index-based insurance products can contribute to improving financial management of climate variability. However, climate change implications for index design must be discussed among industry stakeholders to ensure the ongoing viability of these products.

Index Designers[2]

Sharing the varied approaches to factoring in climate change impacts in index design can help augment the applicability of index-based insurance on a larger scale across regions. The challenges and approaches taken by index designers are presented using the index product design framework, namely:

1. Identifying and quantifying the risks faced by smallholder farmers
2. Designing the index
3. Measuring the indexed parameters
4. Pricing methodology

1. Identifying and quantifying risks faced by smallholder farmers has become increasingly challenging because of changes in climate and agricultural/ farming practices. In some countries the evidence that the climate has changed is strong but in other cases, it is harder to discern between natural climate cycles and variability resulting from climate change. For example, in the Sahel, the underlying trend is that the 1980s and 1990s were much drier compared with the last 20 years. This had an impact on farming practices, which evolved over time to adapt. Further, the trend shift suggests a decrease in the homogeneity of the risk profiles that would consider data over the last 40 years. Best practices usually recommend using at least 30 years of data to structure and price the index. But, in this case a shorter data series of about 20 years would provide a more homogenous data set and thus a more efficient index regarding the experience of clients.

Setting the right data set is not an easy decision and should be discussed between the risk taker and the index designer. Including disproportionately dry years in the design led to higher attachment points (or triggers), and thus a lower performance of the products. The data was no longer representing the risk profile of the countries accurately. Upon further examination of the climate data, it was found that there was not only more rainfall on average in the past decade but also the variance was much higher. Since the volatility of extreme weather events is increasing and there are also changes in the nature of the perils, payouts values have been higher during the same time period because of longer dry spells and excessive rainfall patterns in a short frame of time.

In most of the case studies presented by the participating index designers, the task of identifying the relevant risk and choosing the appropriate index has been addressed in part through a participatory stakeholder process. Index designers model potential indices with stakeholders in the field, allowing for feedback on critical issues and perceptions of how shocks affect investment decisions. For instance, this has resulted in tuning the indices to better reflect local conditions, including developing windows that target the most vulnerable timings, in line with farmers' reported historical risk years and actual cropping practices.

2. Designing the index involves determining parameters essential to making the product conducive to the needs of the client. This includes targeting the main shocks for the different perils (drought, excess rain, floods, high temperature), understanding the most vulnerable times of the season, considering phenological phases, and identifying the impact of the rainfall regime during the growing phases of the crop/plant area analysis. A significant challenge faced in designing the

2 By index designers, this briefing note refers to several stakeholders, ranging from academic institutions, insurers, and intermediaries, involved in the design of insurance solutions.

index is separating variations due to climate change trends from natural climate cycles in order to apply statistical methods to remove the effect of a trend on historical data. Furthermore, a lot of satellite data sets (e.g., CHIRPS, ARC2, RFE2, NDVI) used to design the indices, do not go back as far to capture historical climate trends.

Beyond the availability of data series, a major challenge for designing and pricing is whether those data series are still representative of the future. For example, territories which never had excess rain earlier, may have to account for this risk in the future. Therefore, longer time series in themselves may not solve the issue of incorporating climate change-related considerations. In addition, there is sometimes a lack of accuracy on the exact planting dates and the crop types that farmers are using in a given season, making it harder to understand the risk profile of the crops. Index windows and types of windows to adopt (fixed, shifting, overlapping) are also difficult to determine. This is mainly because climate change has induced a shift in the start and end of the season, and erratic weather patterns have emerged. Windows are also extremely sensitive to data challenges.

3. Measuring the indexed parameters is a considerable problem because there is a shortage of historical and real-time high-resolution climate data in the very regions of the world that are most vulnerable to climate change and in need of risk management solutions. Data is an essential building block of index insurance and is needed to build a loss history, to link this to an index, and to determine loss probabilities as a basis for pricing. Solutions to the data problem may seem straightforward and involve expanding the data collection infrastructure but this is not always simple.

Approaches include corroborating data with farmers and considering various data sources. For example, in Zambia, a combination of historical data and participatory processes were used by government ministries to verify the data with satellite imagery and corroborate with farmer testimonials on historical bad years. Moreover, climate data must be checked for trends. While there is a problem of data availability beyond a certain number of years, other sources (i.e normalised difference vegetation index (NDVI), evapotranspiration, yield data) must be utilised to inform the occurrences of these trends. For instance, seasonality can also be taken into consideration as there is a good forecast for El Niño and La Niña events six months before the actual season occurs.

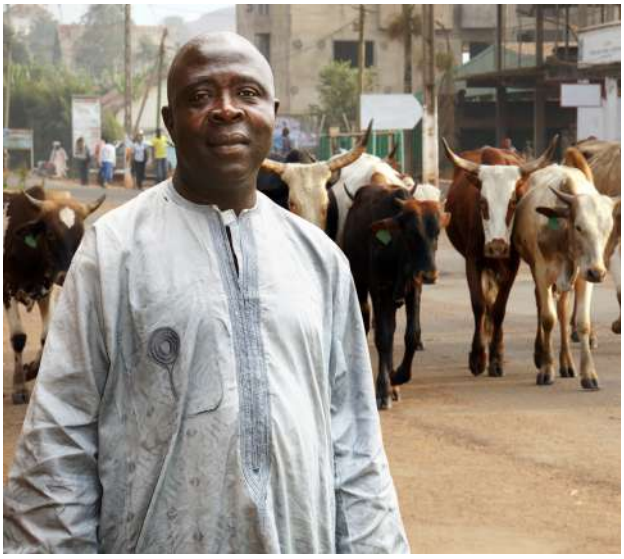
4. On the matter of pricing, one of the biggest challenges observed is that index designers do not have access to the pricing process early on in the design process to better guide them on how the index features may impact pricing. Between index designers and reinsurers, there is contestation on whether the qualitative information/data should be incorporated into the design of the index. Participants in the workshops noted that index designers tend to focus on burning cost[3] while reinsurers would rather focus on the expected loss cost (ELC)[4] as the starting point in the pricing process. ELC factors in the trends and probabilities to have a payout of a specific magnitude. For reinsurers, not every extreme event is automatically considered as indicative of a trend. In addition, lack of time series makes the analysis and estimation of some potential events and their respective return periods challenging.

3 Average payout rate over the entire historical dataset.
4 Expected loss cost (ELC) method is a technique used to determine the projected amount of claims, relative to earned premiums. It takes trends and extreme loss years into consideration, which are not included in a representative recurrence period in the data given the limit, which has to be insured.

Risk Takers

The challenges faced by risk takers, including insurers and reinsurers, and possible approaches are presented below and are mainly focused on pricing:

1. Weather patterns have become more volatile with climate change pushing underwriters to explore other methodologies to price and consider time series. This increased volatility investigated for this paper either manifests as too much or too little rainfall, or shifts when the rains come, and that uncertainty is difficult to judge. It is also difficult to predict whether the cycle will reverse, stabilise or exponentially worsen. From a pricing perspective, this uncertainty and particularly the increased volatility will require additional buffers to absorb shocks in the short and long term. As a result, most risk takers during the discussions mentioned their reluctance to move forward with multiple season (multi-year) policies as an option for stabilising pricing. Although this approach is relatively common with other risk financing models such as catastrophe bonds, risk takers are hesitant to go beyond one year with index insurance products. In some instances where multi-year policies are negotiated, they are usually for a short period (e.g. 3 years), and include exit clauses or options to review premium in the contract terms and conditions if an unforeseen catastrophic event occurs. Year-by-year pricing requires factoring in the climate evolution and an incremental approach to pricing as new data is integrated into the pricing models.



The impact of an unforeseen catastrophic year on the following year's pricing often comes down to the credibility and transparency of the index, i.e. if the reinsurer can independently determine that the event was indeed an outlier and not a failure of the index design to capture extreme events, then it should not significantly impact pricing, beyond the annual incremental adjustment.

2. Finding a fine balance between actuarial/ scientific considerations is important for streamlining product pricing. An increase in product complexity will result in increased difficulty and complicacy to assess data and price products appropriately.

Risk takers have also attempted to reposition insurance on less frequent shocks and over fewer medium shocks to optimise pricing. They have found it conducive to limit the focus on climate projections for structure and pricing. On the other hand, factoring in seasonal/ short-term forecasts for pricing has proven to be beneficial in view of an upcoming negative season, in particular when an El Nino or La Nina event is forecast. For example, some of the participating reinsurers have considered including an extra buffer in the pricing in case of a bad season and a higher-than-expected loss ratio if an extreme loss exhausting the limit was not observed in the history. On the other hand, if such a loss has been observed, it could be distributed over a longer period of time if a higher recurrence period is assigned to this loss than the observed history represents.

Additionally, dealing with anomalies within trends has proven to be challenging. Consider a scenario where there are one or two losses recorded in the last five years, but if the highest three losses are within the last five years, it is no longer considered a random occurrence. The years that have recorded near pay-out situations are also causing reinsurers to increase the price. Reinsurers observing a trend on the basis of statistical tests are incorporating it into the pricing by making a distinction between extreme events and those for which the parameter is very close to the trigger point. Similarly, if there is a trend showing reduced risk, then the pricing should go down. However, a decreasing trend would not lead to a decrease in price if climate is expected to deteriorate in the future.

Conclusion and recommendations

Index designers need to look at climate change and climate trends to best structure and adapt their products to the needs of the beneficiaries. The workshops showed that the rising cost of climate change has already prompted many insurers and reinsurers to reconsider and begin to remodel their index pricing approach to factor in climate change effects. The approaches are different, but the ultimate goal is to provide efficient and sustainable products to end users.

The topic is increasingly gaining traction as it is becoming harder to provide protection against climate risks, with more frequent catastrophic shocks possibly leading to more payouts and thus increasing premium levels. However, it highlights the need for more research, knowledge sharing, transparency, and partnership among industry stakeholders on the topic to ensure viability of these products in the near future, and their value for smallholders. Additionally, sharing the varied approaches to factoring in these impacts in index design can help augment the applicability of the solution on a larger scale across regions.

Based on the challenges observed and experiences shared by industry stakeholders in the workshops, recommendations can be made on technical product design; processes; actuarial approaches; business; and digital solutions. These recommendations are intended for all industry stakeholders to enable further discussions and collaboration, as well as the development of innovative solutions.

Technical product design

- **Factoring in climate change challenges while designing the index is becoming increasingly relevant, but simplicity is important.** Despite the noted climate variability, keeping the index simple is key because insurers prefer an elegant and simple index that captures the main shocks and a product that is easy to communicate to the customer, and reinsurers need a pricing methodology that is not too complex in order to keep costs down. Introduce an element of complexity only if it is fundamental to the functioning of the index or of significant benefit to its performance. If complexity is required, the focus should be on transparently conveying those elements to the insurer, reinsurer and client on why the index has been designed in that manner. Furthermore, complexity in the index model should be used as a transition phase to a simpler index.

- **Promote transparency in the design process by engaging in a collaborative manner and fostering an environment of trust with index design and pricing stakeholders.** Finding an acceptable balance between internal confidentiality and open data sharing to accurately represent the risk a specific consumer brings, or the extent of climate vulnerability and how that is factored into the model. In addition, digital solutions can create openness and transparency surrounding data collection setups, index design process and allow for direct interactivity with the client if needed.

- **Conduct research to separate climate change trends from natural climate variability to better apply detrending on historical data.** Undertaking research and analysis with the aim of reconciling between "bad year" data and the time of the year where the coverage is targeted can help design a more informed index.

- **Invest in freely accessible data and technology as well as monitoring infrastructure within countries and globally, which are essential to the design and implementation of indices.** While a lot of data may be freely available, its accessibility and accuracy can be a challenge, especially in the developing world. These investments will enable data pooling and other information sharing benefits, such as validating accuracy of data across partners and industry stakeholders. It also facilitates increasing the capacity of public infrastructure and other relevant actors (for example, the

national meteorological services, department of agriculture, among others). Promoting the use of next generation technology to gather data and monitor weather throughout the season will also be essential for effective and efficient design and monitoring of indices.

- **Leverage the expertise of academia and other relevant organisations to conduct research, broaden information sources and local know-how.** Research institutions can help provide additional support in data collection and assist in weather information monitoring and evaluation. Participating in a complementary research process with a locally-based knowledge hub of experts can further inform design of the index while expanding the repository of research for a particular area or region.

Processes and stakeholders

- **Improve collection and use of farmers' data and knowledge in developing the index.** While insurers and index designers often have good information, the advantage of gathering data from farmers is that it may limit information asymmetries that arise when applying purely structural data collection methods. Some non-structural methods like interviews and crowdsourced data via surveys can inform the index designer and insurer on various other aspects. Granularity of data is also of high importance to significantly reduce basis risk.[5] This could be a role for research and development institutions to support.

- **Foster meaningful and accountable involvement of potential beneficiaries/clients and other relevant in-country stakeholders in the design, implementation and review of products.** This can help in creating trust and providing a basis for local ownership, maybe even enabling political buy-in for risk resilience mechanisms. Participatory feedback mechanisms during the product development process and iterative prototyping during the life cycle of the product can help ensure the product actually meets the real needs of the people at risk, thus creating client value and relevance.

5 The potential mismatch between a farmer's loss experience and the index payouts.

- **Facilitate capacity building of in-country primary insurers to help them identify the needs, estimate demand and ensure effective delivery of the risk management service.** Assisting them with risk modelling and pricing risk-adequate premiums can further strengthen their technical capabilities and systematically enable them to communicate index insurance to clients. Donors and multilateral organisations could play a significant role in supporting this effort.

- **Exploring new methodologies and predictive models for pricing (for example, machine learning) should be undertaken as a collective exercise among industry stakeholders.** Currently, much of this research is not public and carried out in silos. Undertaking this collective research exercise is mutually beneficial and, with the rising costs of climate change, developing a replicable model is integral to comprehensive risk management in vulnerable areas.

- **Actively participate in framing policy infrastructure and set guidelines for the operations of stakeholders involved in developing and supporting the effective functioning of the product.** It is also necessary to structure the engagement criteria and effectively manage timescales of the various partners (i.e., index designers, insurers and reinsurers) involved. This is advantageous to building a strong long-term partnership with multiple stakeholders playing complementary roles. A multiple stakeholder engagement strategy can also facilitate knowledge sharing and in the long-term, ensure sustainability of the product.

- **Explore options to partner with businesses that can accommodate the price increase in premiums on account of climate change.** This can be done by partnering with businesses and brands by leveraging their sustainability strategies.[6] Certain brands that are proactively securing their supply chain to ensure continuity of their core business operations provide a unique opportunity to align social and business goals. It is however important that both parties find a balance between commercial and social objectives to best cater to the needs of the target group and that the approach is inclusive and deployable on a larger scale through public-private partnerships.

Actuarial approaches

- **Undertake a research path for incorporating medium to long-term changes in the underwriting methodology which consider climate change and climate variability, as well as agricultural production changes.** This is advised by the reinsurer community as there has been limited progress in changing the methodology based on climate change effects. It is advisable that future underwriting methodologies factor in both variability and changes in climate alongside changes in agricultural methods.

- **Adopt a portfolio approach to underwriting, as all countries insured are following the same underwriting rules, for the sake of coherence and homogeneity.** This approach is recommended as it allows for the enforcement of timelines of the model based on customisation. Customisation of the model can be done retrospectively based on validating the risk profile of the past data. While the risk profile serves to estimate future events, it must be separated from the underwriting process.

6 An example of this is the collaboration between Nespresso and Blue Marble Microinsurance which led to the launch of Café Seguro, a crop insurance program for coffee smallholders in Colombia. Find here more information about the insurance scheme.

- **Consider a systematic benchmarking methodology linked to detrending solutions.** Different benchmarks will give more or less volatility in the data. Benchmarking in some countries shows that there are clear outliers to regressions with high volatility to the chosen benchmark. Eliminating short benchmarks (i.e., one year), removing or standardising benchmarking (few choices for countries to choose from) is recommended. Choosing regional areas and looking at different signals for each area or applying a different weighting for each region is also an option. Undertaking research on underlying scientific aspects (attribution, trends, shifts in planting season, etc.) is highly recommended.

- **Model vendors should also adapt the underlying data and methodology of their models to account for climate change and climate variability.** For example, instead of using only past data as the basis for their models, they could also incorporate climate projections for the near or medium-term. Some models with such characteristics have appeared from time to time, but they are rather the exception.

- **The basis for data truncation should be scientifically justified.** In the case that the time series is limited or short, the need for eliminating data points within that time frame must be justified.

- **Consider assimilating various sources of information and harmonising data to apprehend any sudden changes in the data, accelerate digital integration across the crop insurance value chain and aim to have data driven insights for the index design process drawn from a multitude of data sources.** Significant changes in satellite platforms over the years requires factoring in newer platforms or contacting remote sensing data management agencies (i.e., the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), World Data Centre, etc.) to have more accurate data for pricing to confirm the integrity of the data sets. Partnering with meteorological research centres could also support this. In addition, open satellite data, low-cost sensors, big data and machine learning have been key enablers of digital climate resilience and leveraging these technological assets can foster innovation, facilitating localisation and scale up of services.

The BPG would like to thank the International Research Institute for Climate and Society (IRI) at Columbia University, Blue Marble, the Africa Risk Capacity (ARC) Agency and ARC Ltd, AXA, Hannover Re, SCOR, ASSA Insurance company, Guy Carpenter Africa, TransRe, Aspen Re, Zurich Re for their contributions to the workshops and guidance note. Please note that workshop outputs have been anonymised in the interests of protecting proprietary methodologies and underwriting policies.

Published by: Microinsurance Network

Lead authors: Tara James (International Fund for Agricultural Development (IFAD)), Mathieu Dubreuil (World Food Programme)

Contributors: Emily Coleman (IFAD), Susanna De Sousa (WFP)

Images used under license from Shutterstock.com

Visit us at:
www.microinsurancenetwork.org

Read our publications:
www.microinsurancenetwork.org/publications

Contact us:
info@microinsurancenetwork.org

Twitter:
@NetworkFlash

LinkedIn:
@Microinsurance Network

Facebook:
@MicroinsuranceNetwork

YouTube:
@Microinsurance Network