An Assessment Method to Evaluate Index Insurance Quality and Effectiveness

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Table of Contents

Executive Summary

Index insurance was introduced as an innovative solution to help farmers manage climate risks, addressing persistent shortcomings of traditional crop insurance such as delayed payouts, adverse selection and moral hazard. However, despite its promise, concerns around affordability, accuracy, and timeliness continue to raise questions about its real-world effectiveness. Common challenges such as limited farmer understanding, weak communication, and misalignment between payouts and actual losses have affected both uptake and impact, often due to a lack of trust in the product.

One of the most overlooked challenges is limited systematic, pre-contract evaluation processes. Currently, sponsors of insurance products such as governments, donors, and agribusinesses often lack a clear method to assess whether an insurance product is appropriate, transparent, and effective before they commit funds. Without such a method, they risk supporting products that may fall short of protecting farmers or are not sustainable, further eroding trust and curtailing benefits to farmers.

To address this need, the team at Columbia University's School of International and Public Affairs (Columbia SIPA), under the guidance of the Columbia Climate School and in collaboration with the International Finance Corporation (IFC), developed a practical, adaptable assessment method to evaluate index insurance programs ahead of contracting. This method is not intended as a compliance or due diligence tool, but rather as a framework for guidance, dialogue, and continuous improvement designed to support delivering more effective and impactful insurance solutions.

The assessment method is organized around six core evaluation areas below:

1. **Background of the Insurance Product** – Outlines the purpose, coverage, and intended outcomes of the insurance product.
2. **Payout Value and Distribution** – Assesses whether payouts are timely, fair, and of sufficient value and frequency to be useful for farmers.
3. **Alignment of Payouts with Farmer Losses** – Evaluates how well the selected index (either weather-based or area yield) reflects actual farmer losses.
4. **Addressing Index Gaps** – Examines whether insurers can identify and quantify mismatches between the index and real losses, including the cost of closing that gap.
5. **Farmer Communication** – Uses a rubric to assess how well providers inform, engage, and respond to farmers regarding the product and their claims.

Once all sections have been completed, the key quantitative metrics generated throughout the assessment can be summarized on a customizable dashboard, providing an overview of the insurance product and giving stakeholders, including both insurance sponsors and farmers themselves, a measurement tool to understand strong points of the product and/or areas for further discussion and evaluation.

Overall, a structured assessment method for index insurance will enable insurance sponsors to make sound and evidence-based decisions on which contracts to pursue and identify actionable adjustments to product and contract design in the future. This assessment methodology can be easily adaptable to specific markets and project contexts. It provides in effect a starting framework of how stakeholders could be thinking in evaluating the value of index insurance contracts they are offering or purchasing.

I. Background and Project Objectives

A. Background

Index insurance offers an innovative way to protect smallholder farmers from climate-related shocks, addressing the limitations of traditional loss-based insurance. Unlike traditional loss-based insurance, which relies on data from individual loss assessments, index insurance provides payouts based on pre-defined triggers from weather patterns, satellite data, or area-yield measurements. This approach offers the potential for reduced administrative costs, faster payouts, and lower risks of moral hazard and adverse selection.

However, index insurance has faced significant challenges, particularly in developing regions where agricultural systems are most vulnerable to climate risks. Despite its advantages, index insurance programs often struggle to achieve their intended outcomes due to issues such as:

1. **Basis Risk[1]:** Farmers may have losses that the insurance doesn't cover since payments are based on an external index (e.g., weather measurements, satellite data, yield area for a large area). The mismatch between index triggers and farmer losses raises questions about index insurance programs' scalability and long-term viability.

2. **Limited Farmer Understanding and Weak Communication:** Effective communication between insurance providers and farmers remains a critical challenge. Limited farmers' understanding of insurance mechanisms hinders trust and reduces the uptake of insurance products. Poor communication strategies have worsened the problem, leading to dissatisfaction and a lack of farmer engagement.

3. **Lack of Systematic Pre-Contract Evaluation:** Sponsors and governments that often support index insurance programs would benefit from a structured yet customizable pre-contract evaluation method to ensure that products are suitable and effective before implementation. This gap highlights the need for a structured assessment framework to enhance accountability and transparency. Without robust assessment methods, it is challenging to determine whether these products are providing adequate protection to smallholder farmers.

B. Proposed Approach and Objectives

The capstone team developed an initial, working methodology that different users, such as government agencies, agribusinesses, agri-input suppliers, and donors, can adopt and customize to assess the overall quality of index insurance products they wish to purchase for their farmers.

The proposed methodology builds upon Carter's theoretical approach of assessing the quality of index insurance. Carter's method evaluates index insurance quality by calculating expected utility, comparing the value of an insurance contract to having no insurance or receiving an equivalent cash transfer. This involves statistical analysis using historical data on yields, index measures, and household consumption to determine whether a contract meets a Minimum Quality Standard (MQS).[2] In contrast, the following proposed approach is designed for practical use in real-time decision-making, especially where such data or technical capacity to calculate the MQS may be limited. It provides a set of questions that help insurance sponsors assess key quantitative indicators

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[1] Basis Risk is the risk that arises in index insurance when the index used to trigger payouts (such as weather data or satellite imagery), fails to accurately reflect an individual farmer's actual losses.
What is basis risk? (2014, June 23). Index Insurance Forum.
https://www.indexinsuranceforum.org/faq/what-basis-risk

[2] Carter, M., & Chiu, T. (2018). A Minimum Quality Standard (MQS) to Ensure Index Insurance Contracts Do No Harm. Policy Brief. UC Davis.

during early-stage discussions with providers. This makes the evaluation process more accessible and actionable for implementers and policymakers.

The project began with a comprehensive desk review to understand the existing landscape of index insurance programs and their limitations. Through guidance from Columbia Climate School and analysis of previous case studies, existing literature, and policy tools, the team identified key areas of development. The collaborative effort resulted in a practical, pre-contract assessment method designed to be adaptable, scalable, and applicable across diverse projects and geographies.

Note that it serves as a flexible foundation rather than a rigid, standardized method. It can be adapted and refined to meet the specific needs and contexts of its users.

The proposed approach includes:

1. A structured set of quantitative and qualitative questions to evaluate insurance products
2. Verification and visualization tools to support key assessment areas
3. A dashboard to summarize key metrics and areas for further discussion

This proposed assessment method enables sponsors and governments to make more informed insurance decisions and provide stronger protection for farmers. The expected outcomes include:

1. **Informed contract decisions**: Sponsors can assess insurance products before committing funds.
2. **Standardized evaluation criteria:** A method for applying sanity checks across insurance programs to ensure quality before implementation.
3. **Improved farmer protection:** Enhances alignment between insurance payouts and actual farmer losses, reducing risk and improving farmer satisfaction.
4. **Higher transparency & accountability**: Encourages better provider practices, more transparent communication, and helps ensure all parties understand what they're buying.
5. **Scalable & adaptable**: Can be used across different projects, geographies, and stakeholders.
6. **Identification of Key Focus Areas**: Flags components of insurance products that require redesign, closer oversight, or further evaluation.
7. **Stronger best practices in insurance design**: Helps refine and improve index insurance offerings over time.

II. Overview of the Assessment Method

The proposed assessment method is designed to evaluate the quality and effectiveness of index insurance programs across five key categories. These categories provide a structured framework to comprehensively evaluate insurance programs' structural, financial, communicative, and operational aspects.

1. **Background of the Insurance Product** – This section will qualitatively set the background of the desired insurance, what it aims to achieve, and what it's meant to cover.
2. **Payout Value and Distribution** – This section will quantitatively assess whether payouts are financially fair and delivered at the right value and frequency to be useful for farmers.
3. **Alignment of Payouts with Farmer Losses** – This section will quantitatively assess how accurately the chosen index (either weather-based or area-yield) reflects the farmer's experience of losses.
4. **Addressing Index Gaps** – This section will quantitatively check if insurers can detect mismatches between the index and losses, and estimate what a potential additional premium would be to close the gap.

5. **Farmer Communication** – The section will employ a qualitative rubric to assess providers' effectiveness in communicating with farmers regarding the insurance product, monitoring product reception, and handling grievances.

> The full assessment method can be found in this Excel sheet which houses the dashboard and verification tools with illustrative examples to guide users through the evaluation process.
> The full process and documentation of the steps is detailed in this webpage https://kimlouisev.github.io/SIPA_IFC_Capstone/ with links to the verification examples in the Excel.

A. Background of the Insurance Product

To properly evaluate any insurance product, it is imperative first to ask: What is the point of this product? Articulating the core objectives is a critical first step in the assessment process. This assessment section begins with a series of qualitative questions to frame a comprehensive understanding of the insurance product's structure and the business models behind the involved providers. These questions will set the stage for identifying the insurance requirements of the contracting entity. Before proceeding with the rest of the assessment tool, they should be answered by the contracting entity. This will ground the discussion and support the evaluation of subsequent, more quantitative elements in this assessment tool.

These foundational questions aim to clarify the insurance product's purpose: is it intended to safeguard input costs such as fertilizer, support access to credit by backing loans, shield against catastrophic weather events, or ensure livelihood security for farmers? In many real-world cases, the objectives are not clearly defined, and payouts may serve multiple or overlapping purposes, such as repaying loans, replacing lost crops, or enabling financial restructuring. This makes it essential to identify and agree on the product's intent from the outset. This section also explores the insurance product's funding model, the level of subsidies, the demographic and geographic profile of the beneficiaries, and the nature of the proposed index insurance type.

To guide a structured evaluation of the insurance product, the following key questions should be addressed:

> - ***What is the insurance product meant to cover?*** *(e.g., protect farmers from catastrophic events, provide guarantees for loans, cover the cost of inputs, etc.)*
> - ***How is the insurance product funded or structured?*** *(e.g., national insurance program with government subsidy, contract farming with a food manufacturer where payment for insurance is taken from farmer earnings post-harvest, agri-input supplier bundling inputs with insurance for a discounted/subsidized price, etc.)*
> - ***Will the insurance product be subsidized?*** *(If yes, what percentage of the premium will be covered? Who will provide the subsidy (government, donors, agribusinesses, financial institutions, etc.)?*
> - ***Who are the intended beneficiaries of the insurance?*** *(e.g., smallholder farmers, farmer cooperatives, individual commercial farmers)*
> - ***Which regions and crops will the insurance product cover?***
> - ***What is the proposed index-insurance type?*** *(weather-based, area-yield or hybrid)*

B. Payout Value and Distribution

This section addresses two essential questions that help assess the fairness and effectiveness of the index insurance contract:

- ***How much of the money farmers pay is expected to be paid out? (payout vs. premium)***
- ***What is the expected size and frequency of payouts?***

Index insurance only works when it is both fair and reliable. Farmers must believe that what they pay in premiums is worth it and is justified by the protection they receive. The insurance company must be able to cover payouts and remain financially sustainable. If the balance tips too far in either direction, the product may fail to fulfill its purpose in supporting farmers.

This section uses a simple calculator and visualizer to explore payout value and payout distribution.

a. Payout Value

How much of the money farmers pay is expected to be paid out? (payout vs. premium)

One of the most common factors contributing to the limited impact of index insurance programs is the perceived disconnect between what farmers pay and what they receive in return. When farmers do not receive payouts, even in years with notable losses, premiums begin to feel like a sunk cost, undermining confidence and discouraging future participation. On the insurance company's side, premiums must be adequate to support financial sustainability, both covering the payouts and all the loadings, while remaining affordable and providing meaningful coverage to target users, the farmers.

Understanding payout value is essential, as it offers a quantitative view of whether a proposed contract returns a meaningful portion of farmer contributions while remaining actuarially sound. The key metric used for this purpose is the Expected Loss Ratio (ELR), which will be explained further in the following section. The ELR reflects the portion of premiums expected to be returned to farmers in the form of payouts over time.

Development of the Calculator

In the capstone project, the team identified a gap in the methods available for non-specialist stakeholders. Existing actuarial pricing models are often too technical and inaccessible to the wider ecosystem.

Thus, a simplified calculator was developed. It enables early-stage evaluation of contract quality by generating some indicators using minimal available input. The method is not intended to replace full actuarial pricing models, but rather to flag potentially unbalanced contracts and support informed discussion.

Verification Process - Steps in Utilizing a Calculator

Step 1: Data Inputs

Two sources of data are needed for the verification process: first, the proposed insurance contract and relevant historical data.

- Proposed Contract (Annex A)- users enter data:
    - Premium rate (percentage or dollar value)

    - Maximum Liability (if premium is in dollar value)

- Relevant Historical Data must come from a similar insurance product/s (Annex B):
    - Total Maximum Liability
    - Gross Premium collected
    - Number of farmers or number of contracts
    - Total payouts made
    - Number of payouts

  Historical data must align with the same type, coverage, and contract length of insurance being proposed. For instance, if the contract is weather index-based, then the historical data should also be for weather index-based data.

Step 2: Generating key indicators

After the user enters the data, the table automatically assesses the performance of the historical dataset. This step is essential for understanding how a similar insurance product has performed in the past, which helps users form expectations for the proposed contract. The indicators in this section are pre-calculated using built-in formulas that reference the data entered in the previous step (Annex C).

The burning rate is one important indicator from the table above [14]. It is calculated by dividing the total value of payouts by the total value of liabilities. This tells us, out of all the liabilities that the insurance company is responsible for, how much was paid out over the historical period.

This indicator is then used alongside the proposed premium rate (entered as % [8] or derived from the dollar value of the new proposed premium [6] divided by the maximum liability [7]), to calculate the Expected Loss Ratio (ELR).

> Expected Loss Ratio (ELR) = Burning rate ÷ New Premium rate

The ELR estimates the proportion of a farmer's premium expected to be returned as payouts over time. It must be noted that this ELR served as a simplified yet informative measure to evaluate whether the proposed contract offers a reasonable return to farmers based on historical performance. The actual calculation may vary depending on assumptions, pricing methodologies, and projections of each insurance company.

Step 3: Verification Dashboard

After generating all indicators, the next step is to interpret these results using a visual verification dashboard. This step helps users assess whether the ELR aligns with what is considered reasonable and balanced, both from the farmer's and the insurance company's perspective.

Step 3a: Define preferred reasonable ELR

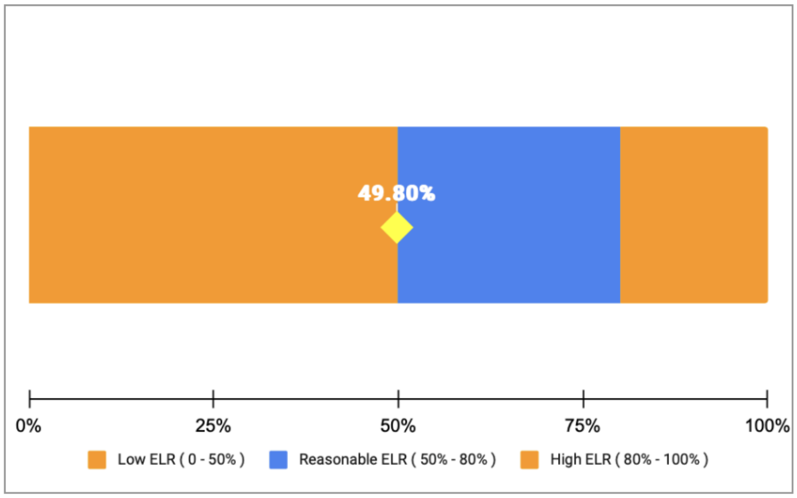
To begin the verification process, users are asked to define a reasonable range (min and max) for the ELR (Annex D). This range should reflect what is considered fair for farmers, and sustainable for the insurance company. This can vary based on context, prior program experience, or input from insurance experts.

This defined range acts as a reference point for evaluating whether the proposed premium and coverage offer an appropriate balance of risk-sharing. Users input this range into the calculator in the designated yellow cells [18] to ensure consistency across contract assessment and help interpret the result more easily.

Step 3b: Do a visual check of the chart

Once the reasonable range has been defined, the verification dashboard automatically generates a simple, color-coded visual as shown in the figure below.

Figure 1: Visual Chart from the Verification Dashboard: ELR Placement Against Defined Ranges



'ELR: Expected Loss Ratio

🔶 **Yellow Diamond:**	Represents the ELR calculated from the proposed contract and historical data (Step 2)
🟦 **Blue Zone:**	Represents the user-defined reasonable range for ELR (Step 3a)
🟧 **Orange Zones:**	Represent values that fall outside the reasonable range, potential flagging that needs further discussion between the users and the insurance company.

This visual allows users to review whether the calculated ELR falls within the defined range based on past experience or policy preferences. Rather than relying solely on numerical outputs, the chart offers a straightforward way to assess whether the proposed contract aligns with expectations or whether further questions should be raised.

Interpreting the Chart:

- If the yellow diamond falls within the blue band, it means that the contract appears to align with expected norms for fairness and sustainability
- If the yellow diamond is in the lower orange zone, or the ELR is too low compared to the reasonable range, it may indicate that farmers are overpaying, as the premium is too expensive for the level of protection offered. In such cases, users are encouraged to ask the insurance company:
  - What assumptions were used in pricing?
  - Are there any loading factors that can be revisited to improve value for farmers?
- On the other hand, if the yellow diamond falls in the higher orange zone, it may suggest a potential risk for the insurance company, as too much of the premium may be going toward payouts, leaving insufficient funds for operational costs. In these cases, key questions include:
  - How will the insurance company sustain operations and payout payments, especially during bad years when big payouts are needed?
  - Are there plans to adjust coverage, pricing, or reinsurance arrangements?

This step ensures that the assessment moves beyond simple calculations toward a more reflective process. By visually validating ELR against a defined benchmark, the method encourages users to explore not just whether a contract is numerically sound, but also whether it is practically aligned with real-world needs and constraints.

b. Payout Distribution

What is the expected size and frequency of payouts?

Even if the ELR appears reasonable, payout timing and distribution patterns must also be examined to ensure the insurance contract functions effectively in practice. Questions around how payouts should be distributed over time, how often they occur, and in what size are critical to consider. Are payouts happening when farmers face actual risks, and are they valuable enough to provide meaningful support?

A contract that pays out a fair percentage overall but concentrates those payouts in a few isolated years may not provide the kind of protection farmers need to manage seasonal or recurring risks. For the insurance contract to be perceived as meaningful and useful, it must align with the timing and scale of farmers' potential losses. When payouts are too infrequent, the product may not provide support when it is most needed, raising concerns that it is not delivering on its intended purpose. Conversely, if payouts occur too often, they may increase operational costs or challenge the financial viability of the product.

This part of the assessment helps explore and help initiate discussions about whether the proposed contract achieves an appropriate balance, avoiding payouts that are so rare they provide little value to farmers, or so frequent that they create strain for program operations and may fail to deliver meaningful protection for farmers. Even a contract with a fair ELR may not meet farmers' needs if payout distribution is not aligned with the rhythm of agricultural risks. An effective product balances these concerns, offering moderate-sized payouts delivered at meaningful intervals that support farmers cope with real challenges.

Visualizer

To support this analysis, a payout distribution visualizer was developed in Annex E. The method simulates historical payouts collected by Columbia Climate School for region Ethiopia and specifically Genete district. The visual output presents this data as a bar chart, where each bar represents the payout in a given year as a percentage of the contract's maximum liability. This format help users observe years with no payout, clusters of payouts, and frequency and size of payouts over time.

Alongside the bar chart, a summary statistics table provides additional insights into the payout performance (see table below). This includes metrics such as Average Payout, which indicates the average severity of claims as a percentage of the maximum liability. For example, an average payout of 0.10 means that, on average, payouts equaled 10% of the maximum liability in any given year.

Another key metric is Frequency, which shows how often payouts occurred over the observed period. A frequency of 0.21 implies that payouts happened in 21% of the years, or roughly 1 every 5 years.

Some years had no payouts at all, reflected in the minimum value of 0.00, while the maximum payout reached 77% of the liability, illustrating a wide range of outcomes. The 95th percentile represents the highest 5% of payouts, where the payout value reached up to 54$, indicating the potential severity of rare but extreme events.

Figure 2: Statistical Summary of Simulated Payout Distribution

Summary (1983-2020)	
Average Payout (Index)	0.10
Frequency	0.21
Min (Index)	0.00
Max (Index)	0.77
95th percentile	0.54

C. Alignment of Payouts with Farmer Losses

This section examines how well the chosen insurance index aligns with farmers' experiences of loss. Both weather-based index insurance and area-yield index insurance rely on proxies, such as rainfall data or average regional yields, to estimate loss, which introduces the risk of basis risk, where payouts may not correspond to actual damages experienced by farmers.

This section poses the following guiding question:

> ***How well do the payouts that would have been made by the insurance product align with farmer expectations of loss, based on your chosen index?***

Given the different data types used in weather-based and area-yield insurance, two tailored verification methods are applied. For weather-based insurance, index payouts triggered by rainfall or weather measurements are directly compared with the years farmers recall as the worst. For area-yield insurance, a combination of farmer recollections, average area yield data, and satellite imagery is used to verify payout accuracy.

Providers should reflect on:

- How often payouts aligned with years farmers considered "bad years" (i.e., years of significant crop loss or income reduction).
- Instances where farmers experienced losses but received no payout, and what factors (e.g., poor index calibration, low data resolution) may have contributed.
- Cases where payouts occurred despite farmers reporting little or no loss which can undermine trust in the product's fairness and accuracy.

This analysis serves as an essential step in identifying opportunities to evaluate the index insurance product to reduce basis risk.

a. Weather-based Index Insurance

To determine whether weather-based index insurance accurately reflects farmers' lived experiences of crop loss, we apply a three-step verification process. This participatory and data-driven method allows us to assess the degree of alignment between payouts triggered by the index and farmer-identified "bad years".

This methodology builds on work developed by Professor Daniel Osgood and his team at the Columbia Climate School, who have been at the forefront of designing innovative, data-informed tools for index insurance evaluation. A key contribution of this approach is its integration of participatory methods, which remains uncommon in mainstream insurance design and assessment. Most insurance providers rely primarily on remote data sources like satellite imagery or area-yield statistics, rarely engaging with farmers to understand how losses are experienced on the ground. However, research by Osgood et al.[3] has consistently shown that farmers' recollection of "bad years" is often more accurate than satellite or yield-based indices, particularly in capturing localized shocks and timing-specific vulnerabilities. By embedding farmer knowledge into the verification process, this methodology helps bridge the gap between technical design and lived reality — a critical step toward more equitable and effective climate risk protection.

For the illustrative verification example below, data from Ethiopia has been used:[4]

Source of data
Collected by Columbia Climate School Time period: 1983-2020 Focus on village Genete Data Elements: • Index would-be payout calculated based on weather data (as % of max liability) • Farmer expected payout based on farmer ranking of bad years across 38 years • Difference between farmer expected payout and index would-be payout (total and downside only)

Step 1: Identify Index Would-be Payout based on Satellite Data

Begin by calculating the would-be payout for each year based on historical weather data and the insurance product's design.

- Use the contract's trigger variable (e.g., rainfall amount, dry spell duration, or temperature extremes).
- Reference predefined payout thresholds: the trigger point (when payouts begin) and the exit point (when the full payout is due).
- Use the insurance payout formula to determine payouts per year based on how the actual weather compares to these thresholds.[5]

Outcome: This step provides the index-based perspective on which years were "bad" enough to justify a payout.

Step 2: Identify Farmer Ranking of Bad Years and Calculate Farmer Expected Payout

In this step, facilitators conduct focus group discussions with farmers in the target location.

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[3] Osgood, D., Powell, B., Diro, R., Farah, C., Enenkel, M., Brown, M. E., Husak, G., Blakeley, S. L., Hoffman, L., & McCarty, J. (2018). Farmer Perception, Recollection, and Remote Sensing in Weather Index Insurance for Agriculture in the Developing World: An Ethiopia Case Study. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3242142

[4] Data collected by Columbia Climate School

[5] Refer to Annex F for Payout formula and Annex H for the Index would be payout list

Farmers are asked to recall and rank historical years based on the severity of agricultural losses they experienced. These qualitative assessments of "bad years" provide a ground truth reference against which index payouts can be compared.[6]

- Farmers collaboratively mark years of drought or major crop failure.
- This historical timeline helps identify patterns of loss and farmers expectations of when insurance should have triggered a payout.
- Using the list of farmer-identified bad years, estimate what farmers would have expected to receive as payouts during those periods.[7]

Outcome: A list of years classified as "bad" by farmers, which serves as a reference for evaluating index performance.

Step 3: Compare Payouts from Satellite and Farmer Expectations

Then, we compare farmer expected payout against the actual or simulated payouts that would have been triggered based on the weather index used by the insurance provider.

- A simple table comparison is created showing:
    - Index-triggered payout level
    - Farmer expected payout level
    - Difference (both raw and directional)
    - Whether the payout was perceived as fair or mismatched
- Differences (e.g., average gap) are computed to quantify alignment.

Outcome: A clear visualization of gaps between index payouts and farmer expectations, highlighting under- or over-compensation. (Annex I)

Step 4: Analyze Accuracy and Visualize Results

This final step summarizes the overall accuracy and reliability of the index using key metrics:

- Average difference between index and farmer-expected payouts
- Downside difference (i.e., when index underperforms during actual bad years)
- Matching rate, or the percentage of times the index correctly aligned with farmer-identified loss years

These metrics can be visualized in scatter plots or bar graphs, enabling an at-a-glance understanding of the index's performance over time. A higher matching rate and lower downside difference indicate a more trustworthy and farmer-aligned insurance product.

Outcome: A quantified and visual assessment of how well the weather index mirrors farmer realities, informing decisions on index refinement, calibration, or adoption. (Annex J)

[6] International Research Institute for Climate and Society. *Initial visit interaction to determine the worst years*. Weather Index Insurance Educational Tools. Columbia University. https://wiiedu.iri.columbia.edu/materials/updated_educationalMat/html/games/initialvisitexercise_Ethiopia.html

[7] Refer to Annex G for the R script to convert farmer recollection to expected payout (SIPA IFC Capstone, 2022)

b. Area-yield Index Insurance

The accuracy of a chosen area-yield index can be verified through a slightly different method, outlined below. Because area-yield indices rely on aggregate data, they can be less precise. To assess the index's accuracy, it's worth comparing area-yield data with both farmer recall of bad years and satellite imagery, allowing for better triangulation.

Source of data[8]

The verification example uses data from Rwanda's Karongi village collected by One Acre Fund. The raw data includes:

- Average yield data for maize harvested in Season A from 2014-2021 in the district of Karongi (8 years)
- Farmer's recollection of bad years from 1983 - 2021 (38 years)
- satellite rainfall measurements from CHIRPS from 1992-2021 (30 years)

For the verification, the example focuses on 1992 - 2021 (30 years) across the three data sources.

Step 1: Identify Yield Bad Year Ranking based on Area-Yield Data

Start by calculating average yields, often available for only a few years. These yields are then ranked from lowest (worst year) to highest (least bad year). In the verification example, average maize yields in Karongi, Rwanda (2014–2021) were estimated from randomly sampled sites within the district.

Step 2: Identify Farmer Recollected Bad Year Ranking

Similar to the weather-based index verification process, identify farmer recollection of bad years by asking farmers in Focus Group Discussions (FGDs) what their bad years were from worst to least bad. In the verification example, the worst year based on farmer recollections was 1997.

Step 3: Identify Satellite Bad Year Ranking

Identify satellite bad year ranking through a process similar to determining the index would-be payout for the weather-based index verification. This means taking rainfall or weather measurements, setting a trigger and exit, then arriving at a number representing the payout farmers would have gotten for that year as a % of maximum liability. These figures are then ranked from highest (worst) to lowest (least bad). In the verification example, the worst year based on satellite rainfall measurements was 1993.

Step 4: Compare the ranking from Area-Yield, Farmer Recollection, and Satellite data

Convert the average yield and satellite payout values into rankings for comparison across all three data sources. In one table, highlight the worst year for each data source. In the verification example, cells in dark red represented the worst year for that data source.

In the verification example, the eight-year dataset is too short to identify the worst year confidently. However, comparing it to a 30-year record from farmer recollections and satellite data helps place it in a broader context. The three data sources cover different periods and use different methods, so, unsurprisingly, they don't all point to the same worst year. Still, the alignment between the short and

[8] The Columbia Climate School provided the data to the Capstone team with permission from One Acre Fund.

long time series supports the conclusion that 2019 was a particularly bad year and that the area-yield index got the worst year mostly right.

Step 5: Compare the severity/magnitude of the event across all three sources in the worst year for average yields

To interpret the rankings from Step 4 meaningfully, convert the figures into the severity/magnitude of the event for that year by dividing the rank by the number of years available. Then, check that the severity/magnitude of the event is similar across data sources for the worst year in terms of average yield. Note that his simplified method is less effective for identifying similarities in the 2nd, 3rd, and subsequent worst years.

In the verification example, the severity/magnitude of the event using average yield data is 1 in 8 or 0.125. Using farmer recollection data, the severity/magnitude of the event is 3 in 30, or 0.100. Finally, satellite data has a severity/magnitude of 4 in 30 or 0.133. Once the conversion is made, the relative severity of the event in the worst year, based on average yield (in this case, 2019), looks similar across all data sources. This points to a clear alignment in identifying the worst year. This method doesn't show strong agreement for the second, third, or fourth worst years. But it gives a valuable sense of how well the sources agree on the worst year, arguably the most critical year for farmers.

Annex K illustrates Steps 1 to 5 using the sample data from Rwanda by One Acre Fund.

Interpretation

To assess accuracy, generate two high-level metrics:

1. Difference in severity/magnitude of the event between yield data and farmer recall
2. Difference in severity/magnitude of the event between yield data and satellite data

The goal would be for the difference to be close to zero. While simplistic, this method indicates the accuracy of the area-yield index.

In the verification example, the average difference between yield data and farmer recall severity in 2019 (the worst year average yields) was 0.025. While the difference between yield data and satellite data severity in 2019 was 0.008. These differences are relatively small, hence one can say that there is a considerable alignment in the worst year for average yields.

Step 6: Conduct sanity checks based on the level of yields

As a sanity check, it's best to verify whether the average yield of the worst year matches farmer experience, since average yield data can have a large variance by being an aggregate statistic. This can be done by calculating how often the average yield in the worst year happens (X%) and talking to farmers to see if that squares with their experience. (e.g., Does the average yield such as that of the worst year indeed happen only X% of the time?)

D. Addressing Index Gaps

This section evaluates whether the insurance product has mechanisms to identify and address the potential mismatch between index-triggered payouts and farmers' actual losses. It poses the following guiding questions:

- ***Do you have a system in place to detect the mismatch?***

Follow up: If yes, how would you detect it? Potential answers: farmer hotline to request an audit, scheduled visits to farmers, etc.

- ***What grievance and remedy mechanisms do you have in place to ensure payouts align with actual farmer losses or compensate farmers for actual losses, if any?***

Potential answers: ex gratia payments, satellite-based plus audits, contingency fund, etc.

- ***If all uncovered losses were compensated, how much more would farmers need to pay as a premium?***

Follow up: Is this a gap you could include in the design of the product?

- ***What avenues can be explored to address these gaps?***

Potential answers: donor support, contingency funds, subsidies, etc.

The third question consists of a set of verification steps that quantify the gap between actual losses and payouts in monetary terms. This helps inform whether and how compensation might be provided through adjustments to the product, where farmers pay for the premium, or through external mechanisms. It is expressed:

1. As a top-up percentage that would need to be added to the insurance premium for full coverage
2. As the total fund size required to compensate the uncovered loss across all insured farmers

While not all insurance providers are expected to have this information readily available, this calculation acts as a valuable sanity check. It provides insight into the scale of basis risk and helps estimate the value of the gap, whether it could be addressed through an additional premium paid by the farmer or would require alternative financing mechanisms like humanitarian assistance, donor funds, etc.

Sources of Data

This method draws on the work of the 2023 SIPA Capstone Team, which used data from the World's Food Programme's R4 Rural Resilience Initiative[9]. The data was collected by the Columbia Climate School and covers 38 years from 1983 to 2020 across 166 villages in the Amhara region of Ethiopia. The dataset includes:

- Index would-be payout calculated based on weather data (as % of max liability)[10]
- Farmer expected payout based on the farmer's ranking of the top bad years across 38 years
- Difference between the farmer's expected payout and the index's would-be payout (total and downside only)

The assessment method consists of two primary stages, each with a set of sub-processes.

a. Total Premium Price Breakdown for the Farmer

[9] R4 Rural Resilience Initiative. World Food Programme. Available at: https://www.wfp.org/r4-rural-resilience-initiative

[10] In this data, there was an average payout frequency of 8 / 38 years. Hence, farmers were asked to rank the top 8 bad years.

This stage focuses on calculating the premium farmers would need to pay if they were compensated for past payout gaps, and assessing how including this difference would impact the total premium. It consists of three steps.

Step 1a: Calculate Index Insurance Premium

1. Find out the index would-be payout per year and village (i.e., what payout would have been if the chosen index were used)
2. Get the *Expected Payout*[11] – average index would-be payout across all years and villages
3. Identify the *Value at Risk*[12] – the 95% percentile event across all years and villages
4. Set the *Cost of Capital*, i.e., the price an insurance company pays to access money to cover potential payouts

Once the above values have been established, apply the following formula:

Index Insurance Premium = *Expected Payout + [Cost of Capital (Value at Risk – Expected Payout)]* [13]

Step 2a: Calculate Basis Risk Premium

1. Get the difference between the index's would-be payout and the farmer's expected payout per year and village
2. Calculate average difference between index would-be payout and farmer expected payout across all years and villages: E(Index would-be payout - Farmer expected payout)
3. Get average difference for instances where farmer's expected payout is larger than the index would-be payout (i.e., downside basis risk): E(Index would-be payout - Farmer expected payout) > 0
4. Identify the Value at Risk – the 95th percentile event across all years and villages
5. Set the Cost of Capital, i.e., the price an insurance company pays to access money to cover potential payouts

Once the above values have been Once these values are established, apply the following formula:

Basis Risk Premium = *E[Index would-be payout - Farmer expected payout] >0 + (Cost of Capital (Value at Risk – E[Index would-be payout - Farmer expected payout]*[14] *>0)* [15]

Step 3a: Calculate Total Premium and Derive Share Of Basis Risk Premium

Once the Index Insurance Premium (Step 1a) and the Basis Risk Premium (Step 2a) are calculated, they are added to estimate the total premium a farmer would need to pay if the insurance product were designed to cover both index-based and basis risk losses fully.

Total Premium = Index Insurance Premium + Basis Risk Premium[16]

---

[11] Probability to incur losses x maximum payout i.e., 1
[12] Calculated based on the 95th percentile of events
[13] All values are expressed as a percentage of the Maximum Liability.
[14] Mismatch between index and farmer experience (i.e., downside basis risk), counting only differences where farmer losses were greater than index payout
[15] All values are expressed as a percentage of the Maximum Liability
[16] All values are expressed as a percentage of the Maximum Liability

Annex L illustrates Steps 1 to 3 using the data from the 2023 Capstone (originally collected by Columbia Climate School)

Interpretation
The key metric in this verification is the Basis Risk Premium as a percentage of the Total Premium. This helps assess whether the additional amount required to fully compensate for uncovered losses (i.e., basis risk) is reasonable and potentially affordable for farmers. This metric does not imply a definitive "go or no-go" decision. Instead, it is a practical indicator that invites dialogue on needs, financing feasibility, or the potential need for humanitarian backup mechanisms.

b. Estimate Total Fund Size Required to Cover Basis Risk

This stage focuses on estimating the total cost in monetary terms if this adjustment were applied to all farmers in all the villages.

Step 1b: Calculate the total potential highest/worst-case payout ($)

This entails calculating the maximum possible payout across all villages and all years, based on the index's maximum liability by using the formula below:

Total Potential Highest / Worst-case Payout = Value at Risk * No. of villages * Ave. Maximum Liability

Step 2b: Calculate the total mismatch of payout and actual losses ($)

This captures the aggregate downside difference between what the index would have paid and what farmers expected across all villages.

Total Mismatch of Index Would-be Payout and Farmer Expected Payout *= Expected Payout * No. of villages * Ave. Maximum Liability*

Step 3b: Arrive at the total Initial Fund size

The final step estimates the size of a complementary fund that would be required to fill the gap between what farmers expected and what the index would otherwise deliver

Initial Fund Size *= Total Potential Highest / Worst-case Payout - Total Mismatch of Index Would-be Payout and Farmer's Expected Payout*

Annex L illustrates Steps 1 to 3 using the data from the 2023 Capstone (originally collected by Columbia Climate School)

Interpretation

This calculation results in an initial fund size large enough to cover any potential compensation to villages in the first few years that falls above the average downside difference between the index's would-be and farmer's expected payout and below the worst-case year.

It also helps to determine whether the gap size is feasible to address through other financing avenues, such as donor funds, contingency pools, or targeted subsidies.

E. Farmer Communication

As introduced, farmer communications play a critical role in shaping perceptions and recollections about payout size and frequency. Many technical shortcomings in payout delivery stem from current gaps in the efforts outreach and farmer education about the nature of coverage. Open and effective communication helps align insurance products with farmers' expectations and lived experiences, especially during years of significant losses.

The following section will evaluate how well the provider communicates and educates farmers about the product, monitors the effectiveness of these efforts, and manages complaints or grievances. The section will pose the following questions:

Communications Strategy:

- ***In the past, have you established ways to communicate and train farmers about their insurance?***
- ***For the proposed product, what is your planned communication and training strategy?***

Monitoring Strategy

- ***In the past, did you check that farmers understood that they had insurance and what they could expect from the product?***
- ***For the proposed product, how do you plan to check that farmers understand the insurance and set their expectations about the product?***

Grievance and remedy mechanisms

- ***In the past, did you have grievance and remedy mechanisms for farmers who experienced losses but did not receive payouts?***
- ***For the proposed contract, what grievance and remedy mechanisms will you establish for farmers who experience losses but do not receive payouts?***

A scoring rubric will assess farmer communications and the quality and reliability of the implementing partner's approach to engaging with farmers about agricultural index insurance. The rubric is intended to guide fair and consistent evaluation while identifying gaps or areas for improvement. The evaluation will focus on the three key sub-areas: Communications Strategy, Monitoring Strategy, and Remedy and Grievance Mechanisms. Each strategy will be scored on a scale from 0 to 3, based on past performance and proposed plans, with scores finally averaged across each criterion. While the assessment remains more qualitative, it will be supported by rigorous verification through submission of documents such as training, plans, questionnaires etc.

- Communications Strategy**:** This criterion will assess the clarity and effectiveness of proposed communication efforts with farmers. Strong scores include documented successful outreach, training materials, communication activities, and forward-looking plans demonstrating thoughtful design, accessibility, and relevance to the target audience.

- Monitoring Strategy: This area evaluates how farmer understanding and satisfaction with insurance products have been tracked in the past and how they are proposed to be monitored going forward. High scores demonstrate strong submissions of past data collection, clear lessons learned, and detailed future plans with defined tools, responsibilities, and timelines,, designated responsible parties, and structured timelines for follow-up and analysis.

- Remedy & Grievance Mechanism: This criterion examines how complaints and disputes, particularly those related to payout issues in difficult years, have been addressed historically and how they are intended to be managed in future operations. A high score is awarded on the basis of documented past examples of effective resolution, supported by logs, procedures, and testimonials, as well as proposed mechanisms that include transparent processes, clear roles and responsibilities, and accessible channels for farmers to raise concerns.

Annex O shows the complete rubric and next steps for this section.

III. Dashboard of Insurance Product Metrics

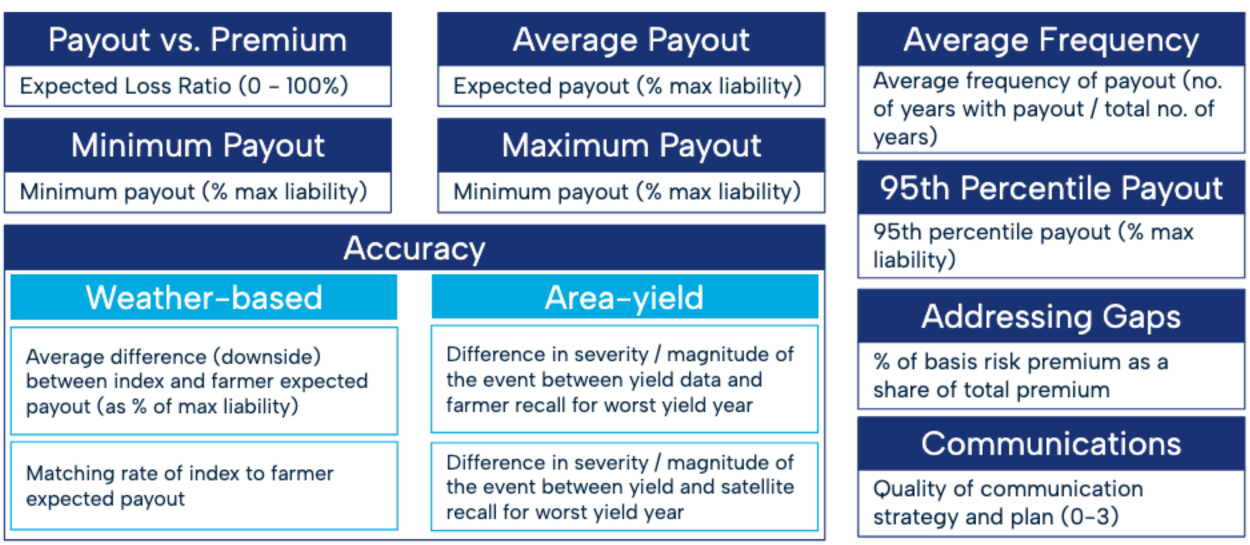
Once all sections have been completed, the key quantitative metrics generated throughout the assessment can be summarized on a customizable dashboard, providing an overview of the insurance product and giving stakeholders and decision makers a measurement tool to understand strong points of the product and/or areas for further discussion and evaluation.

A. Dashboard Metrics

The following metrics will be summarized after all sections of the assessment method are completed. The choice of metrics to report and summarize can vary based on user preferences and needs. The ones listed here are simply suggestions, drawn from the verification tools used in this assessment approach.

The following metrics can be summarized upon completion of all sections of the assessment method:

Figure 3: A summary of the key metrics of the Assessment Method



B. Preferred Parameters

The metrics can be evaluated and interpreted by setting preferred parameters and ideal values. Figure 4 is an example set of default or preferred parameters that a contracting entity would find reasonable. ***Note: These may be updated depending on farmer expectations or needs.***

Figure 4: Sample parameters that a contracting entity would set as ideal

Preferred Parameters	Ideal Range	
Expected Loss Ratio (ELR)	50%	80%
Average typical payout	0.15	or higher
Average frequency	0.5	or higher
Minimum payout	0	
Maximum payout	0.75	or higher
95th percentile payout	0.6	or higher
Weather-based: Gap between index and farmer payout	0.5	or below
Weather-based: Matching rate (index and farmer)	0.5	or higher
Area-yield: Difference in severity bet. yield data & farmer recall	0.05	or lower
Area-yield: Difference in severity bet. yield & satellite data	0.05	or lower
Basis risk premium	50.00%	or below
Communication quality	2	or higher

C. Sample Dashboards

Annex N shows an example dashboard that compiles the metrics with formatting for the desired values to help users, such as governments, agribusinesses, input suppliers, donors, or other entities contracting an insurance provider.

The blue boxes indicate values within the predefined reasonable range, while the orange boxes indicate values that fall outside the ideal values and, therefore, require further discussion. It should be noted that these values are not meant to automatically decide whether to pursue or discard a certain insurance product offer or whether to stop or go with a certain provider. Instead, they are meant to guide further discussion about the assumptions built into the insurance product and elicit transparency for the contracting entity.

Annex O shows an example of a simplified version of the dashboard tailored for farmers. Many farmers aren't fully aware of the insurance product they're buying or receiving, so a one-page summary with key figures could help inform them. Useful information might include the ELR to show the value they get for what they pay, the average payout frequency (total payouts divided by total years), and the average and maximum payout size, assuming a set maximum liability (e.g., $250). A basic accuracy check could also show whether a payout would have occurred in the worst year. Summarizing these figures can make the product easier to understand.

IV. Conclusion & Next Steps

The assessment method has been shared with IFC, the Columbia Climate School, and Ethiopia's Agricultural Transformation Institute (ATI), where it generated interest and constructive feedback. These initial engagements demonstrated the tool's potential to support real-world decision-making around index insurance quality and design. The method is designed to evolve and be further tested or adapted. Sponsors can be trained to apply the method, interpret results, and collaborate with providers to co-design improved insurance products that are more transparent, responsive, and aligned with farmer needs.

The method also enables post-assessment refinement. For example, for better product design, tools like the Decision Engine for Socioeconomic Disaster Risk (DESDR) developed by Columbia Climate School can be used to run simulations on rainfall timing and see which trigger windows better align with farmer-reported "bad years". These interactive tool allows users can adjust timing windows (e.g., early vs. late rainfall seasons) and payout frequency (e.g., every 4 or 5 years). Annex P shows how the tool displays how different index options match farmer-reported bad years, historical rainfall patterns and trade-offs between early vs. late season risk.

The assessment is not the end of the process but a starting point for targeted refinement. It is not intended as a one-time checklist, but as a decision and design support system—one that encourages ongoing dialogue between sponsors and providers, and continuous improvement based on evidence.

V. References

Carter, M., & Chiu, T. (2018). A Minimum Quality Standard (MQS) to Ensure Index Insurance Contracts Do No Harm. Policy Brief. UC Davis. https://basis.ucdavis.edu/publication/policy-brief-minimum-quality-standard-mqs-ensure-index-insurance-contracts-do-no-harm.

Carter, M. (2018). Quality Standards for Agricultural Index Insurance. Rationale, Measures and An Agenda for Action. University of California, Davis, University of Cape Town, NBER & BASIS Assets & Market Access Innovation Lab. World Bank Brown Bag.

Flatnes, J. E., & Carter, M. R. (2017). *Fail-safe index insurance without the cost: A satellite based conditional audit approach*. Working Paper. UC Davis. https://basis.ucdavis.edu/publication/paper-fail-safe-index-insurance-without-cost-satellite-based-conditional-audit-approach

Hazell, P., Jaeger, Dr. A., & Hausberger, R. (2021). Innovations and emerging trends in agricultural insurance for smallholder farmers –an update. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. https://www.giz.de/expertise/downloads/2021%20GIZ_Innovations%20and%20emerging%20Trends%20in%20Agricultural%20Insurance-An%20update.pdf

Osgood, D., Powell, B., Diro, R., Farah, C., Enenkel, M., Brown, M. E., Husak, G., Blakeley, S. L., Hoffman, L., & McCarty, J. (2018). Farmer Perception, Recollection, and Remote Sensing in Weather Index Insurance for Agriculture in the Developing World: An Ethiopia Case Study. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3242142

International Research Institute for Climate and Society. Initial visit interaction to determine the worst years. Weather Index Insurance Educational Tools. Columbia University. https://wiiedu.iri.columbia.edu/materials/updated_educationalMat/html/games/initialvisitexercise_Ethiopia.html

Osgood, D., & Shirley, K. E. (2012). The Value of Information in Index Insurance for Farmers in Africa. In R. Laxminarayan & M. K. Macauley (Eds.), The Value of Information (pp. 1–18). Springer Netherlands. https://doi.org/10.1007/978-94-007-4839-2_1

SIPA Capstone. (2023). Establishing a Complementary Risk Fund for Index Insurance. Accessible: https://www.sipa.columbia.edu/sipa-education/capstone-workshops/establishing-complementary-risk-fund-index-insurance

SIPA Capstone. (2022). When does Index Insurance Provide Good Coverage? Access can be provided upon request.

Stigler, M., & Lobell, D. (2023). Optimal index insurance and basis risk decomposition: An application to Kenya. *American Journal of Agricultural Economics*, ajae.12375. https://doi.org/10.1111/ajae.12375

VI. Technical Appendix

Annex A. Contract Information Input

Proposed Contract			
No	**Contract Information**	**Value**	**Unit**
6	Maximum liability	100	currency ($)
7	Gross premium per contract	8	currency ($)
	OR		
8	Gross premium rate (%)		% of max liability

Annex B. Relevant Historical Data Input

Relevant Historical Data			
No	**Historical Information**	**Value**	**Unit**
1	Total value of maximum liability	2,510.00	million currency ($)
2	Total value of gross premiums	122.00	million currency ($)
3	# Insurance contracts / farmers	50.00	no. of contracts in million
4	Total value of payouts	100.00	million currency ($)
5	# Payouts	10.00	no. of payouts in million

Annex C. Calculator Outputs

Assessment of Relevant Historical Data				
No	**Historical Information**	**Value**	**Units**	**Formula**
	Client Profile			
9	Average premium	**2.44**	currency ($)	[2] / [3]
10	Average maximum liability	**50.20**	currency ($)	[1] / [3]
	Loss Profile			
11	Average payout per event	**10.00**	currency ($)	[4] / [5]
12	Payout frequency	**20.0%**	percentage	[5] / [3]
	Ratios			
13	Historical Loss Ratio (total $ payouts / $ gross	**81.97%**	percentage	[4] / [2]

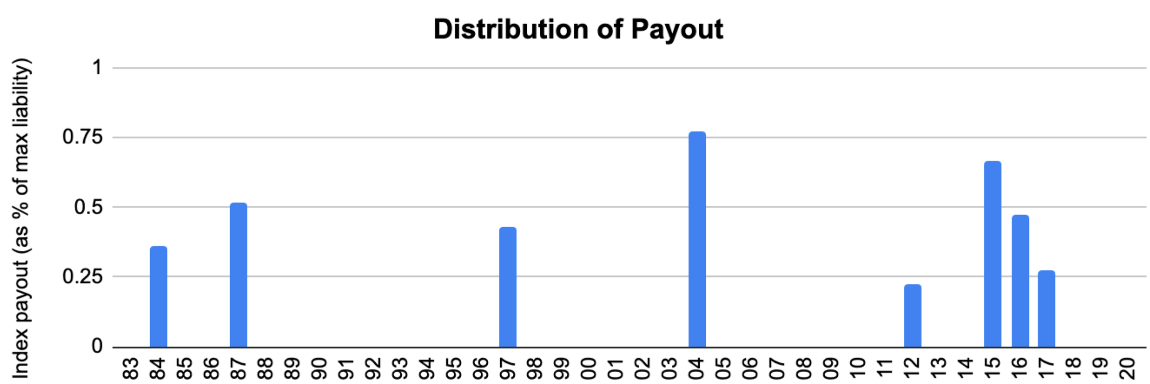
	premiums)			
14	Average payout as % of max liability ("Burning rate")	**3.98%**	percentage	[4] / [1]
15	Historical gross premium as % of max liability	**4.86%**	percentage	[2] / [1]

Assessment of Proposed Contract				
No	**Contract Information**	**Value**	**Units**	**Formula**
16	Gross premium as % of max liability	**8.00%**	percentage	[7] / [6] *OR* [8]
17	Expected Loss Ratio using historical burning rate (ELR)*	**49.80%**	percentage	[14] / [16]

Annex D. Benchmarks Setting for Visual Checks

No	Expected Loss Ratio	Minimum	Maximum
18	Reasonable Range	50.0%	80.0%

Annex E. Sample Distribution of Payout



Annex F. Formula for Determining Index Would-be Payout

$$\text{Payout} = \begin{cases} 0 & \text{if } I > T \\ \frac{T-I}{T-E} \times M & \text{if } E < I \leq T \\ M & \text{if } I \leq E \end{cases}$$

- T = Trigger threshold
- E = Exit threshold
- M = Maximum Payout

Annex G. R Script to Assign Index Would-be Payout based on Farmer Bad Year Ranking

```
library(dplyr)

payouts_shouldbe <- payouts %>% group_by(district) %>%
  mutate(payout_rank = rank(-payout,ties.method = 'first')) %>%
  mutate(payout_rank = ifelse(payout_rank >
(n()*frequency),NA,payout_rank)) %>%
  ungroup() %>%
  dplyr::select(district,payout,payout_rank) %>%
  dplyr::rename('payout_shouldbe' = 'payout') %>%
  filter(!is.na(payout_rank))
```

where "payouts" is the time series data of retrospective estimated payouts in each location (one column for year, a second column for district, and a third column for payout amount), and "frequency" is a global variable for how often the product is meant to pay out (here, 20% of the time, or 0.2).

Annex H. Sample Calculation of Index Would-be Payout

Payout as % of max liability

Year	Index would-be payout
07	0.00
08	0.00
09	0.00
10	0.00
11	0.00
12	0.23
13	0.00
14	0.00
15	0.67
16	0.47
17	0.27
18	0.00
19	0.00
20	0.00
Ave	**0.10**
Max	**0.77**

	Input numbers

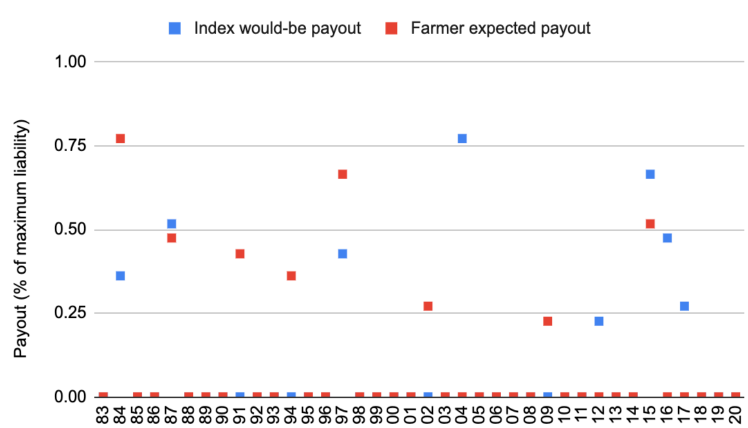
Annex I. Sample Index Would-be and Farmer Expected Payout

	Ethiopia: Genete Village					
Year	**Index would-be payout**	**Farmer Ranking**	**Farmer expected payout**	**Diff (Farmer - Index)**	**Diff Farmer - Index >0**	**Payout trigger matched?**
05	0.00		0.00	0.00	0.00	
06	0.00		0.00	0.00	0.00	
07	0.00		0.00	0.00	0.00	
08	0.00		0.00	0.00	0.00	
09	0.00	8	0.23	0.23	0.23	0
10	0.00		0.00	0.00	0.00	
11	0.00		0.00	0.00	0.00	
12	0.23		0.00	-0.23	0.00	0
13	0.00		0.00	0.00	0.00	
14	0.00		0.00	0.00	0.00	
15	0.67	3	0.52	-0.15	0.00	1
16	0.47		0.00	-0.47	0.00	0
17	0.27		0.00	-0.27	0.00	0
18	0.00		0.00	0.00	0.00	
19	0.00		0.00	0.00	0.00	
20	0.00		0.00	0.00	0.00	
Ave	**0.10**	**-**	**0.10**	**0.00**	**0.05**	**50.00%**
Max	**0.77**	**-**	**0.77**	**0.43**	**0.43**	**-**

	Input numbers
	Formula Output

Annex J. Summary Statistics and Graph for Weather-based Index Verification

Genete Summary (1983-2020)	
Ave. difference (downside)*	0.32
Matching rate	0.50
Average Payout (Index)	0.10
Min (Index)	0.00
Max (Index)	0.77
95th percentile	0.54



Annex K. Area-Yield Index Sample

Step 1, 2 and 3

Input Values

Year	Average Yield *(kg/acre)*	Farmer Rank Bad Year	Satellite Bad Year Payout
2021	1,730.43	5	0.28
2020	2,119.89	4	0.02
2019	1,421.13	3	0.38
2018	1,501.00		0.00
2017	1,859.64	7	0.00
2016	1,800.93		0.11
2015	1,641.93		0.00
2014	1,528.43		0.00
2013			0.27
2012			0.09
2011			0.38
2010			0.00
2009			0.00
2008			0.48
2007		6	0.01
2006			0.00
2005			0.07
2004			0.00
2003			0.00
2002			0.18
2001			0.00
2000		8	0.18
1999			0.25
1998			0.00
1997		1	0.00
1996			0.08
1995			0.00
1994			0.00
1993		2	0.50
1992			0.00

Step 4

Bad Year Ranking

Year	Yield Bad Year Rank	Farmer Recollected Bad Year Rank	Satellite Bad Year Rank
2021	5	5	5
2020	8	4	14
2019	1	3	4
2018	2		
2017	7	7	
2016	6		10
2015	4		
2014	3		
2013			6
2012			11
2011			3
2010			
2009			
2008			2
2007		6	15
2006			
2005			13
2004			
2003			
2002			9
2001			
2000		8	8
1999			7
1998			
1997		1	
1996			12
1995			
1994			
1993		2	1
1992			

Step 5

Severity / Magnitude of Bad Year

Year	Yield Bad Year Severity	Farmer Recollected Bad Year Severity	Satellite Bad Year Severity
2021	0.625	0.167	0.167
2020	1.000	0.133	0.000
2019	0.125	0.100	0.133
2018	0.250	0.000	0.000
2017	0.875	0.233	0.000
2016	0.750	0.000	0.000
2015	0.500	0.000	0.000
2014	0.375	0.000	0.000
2013	0.000	0.000	0.200
2012	0.000	0.000	0.000
2011	0.000	0.000	0.100
2010	0.000	0.000	0.000
2009	0.000	0.000	0.000
2008	0.000	0.000	0.067
2007	0.000	0.200	0.000
2006	0.000	0.000	0.000
2005	0.000	0.000	0.000
2004	0.000	0.000	0.000
2003	0.000	0.000	0.000
2002	0.000	0.000	0.000
2001	0.000	0.000	0.000
2000	0.000	0.267	0.267
1999	0.000	0.000	0.233
1998	0.000	0.000	0.000
1997	0.000	0.033	0.000
1996	0.000	0.000	0.000
1995	0.000	0.000	0.000
1994	0.000	0.000	0.000
1993	0.000	0.067	0.033
1992	0.000	0.000	0.000

Annex L. Verification to Calculate Gap Between Index vs. Farmer Expected Payouts

Tool to calculate gap between index vs. farmer expected payouts

(yellow)	Input numbers
(grey)	Formula output

When farmers face losses but don't receive enough insurance payouts (Basis Risk) *Data from Spring 2023 Capstone*

Average Maximum Liability	250.00
No of Villages	166

Total Premium Price Breakdown for Farmer

Pricing of Index insurance

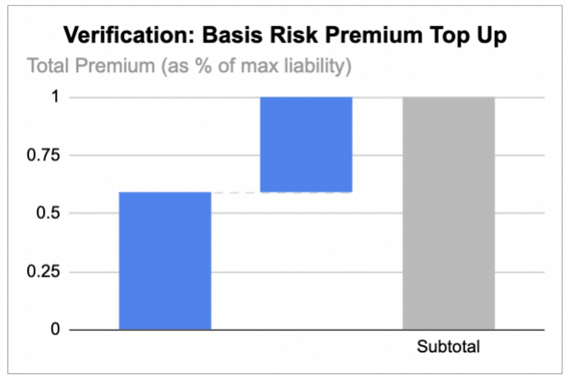
Item	% of max liability
Expected Payout (a)	0.11
Cost of Capital	0.08
VaR (95%) (a)	0.38
Index Insurance Premium	**0.13**

Pricing of Basis Risk

Item	% of max liability
Expected Payout (b)	0.07
Cost of Capital	0.08
VaR (95%) (b)	0.27
Basis Risk Premium	**0.09**

Total Premium	**0.22**

Index Insurance Premium	Basis Risk Premium
59.44%	***40.56%***



Total Fund Size

Item	%	$
Total Potential Highest / Worst-case Payout	44.38	*11,095.10*
Total Mismatch of Payout and Actual Losses	12.01	*3,003.32*
Initial Fund	**32.37**	***8,091.78***

Annex M. Qualitative Rubric to Score Farmer Communication Quality

Criteria	0 – 1 – Poor/ No structure	2 – Fair	3 – Good	Next Steps
Communications Strategy: Understand past and praised strategies in communication and training with farmers on insurance products	No past communication or training efforts, or only ad-hoc activities without documentation. No assigned roles or structured plan.	Limited documentation of past activities. Proposed strategy includes some planned roles and outreach but lacks formal structure, timelines, or supporting materials.	Strong evidence of both past and proposed strategies (e.g., communication plans, training modules, outreach reports, farmer testimonials). Clear responsibilities, structured delivery, and tailored messaging to farmer contexts.	**Document Past Activities:** Compile and organise all previous communication efforts, including training sessions, outreach materials, and feedback from farmers. Define Clear Roles **Develop a Structured Plan:** Build a formal communication strategy with objectives, target audiences, key messages, delivery channels, and timelines. **Create Supporting Materials:** Prepare standardised, farmer-friendly content (e.g., brochures, audio clips, visual aids) in local languages and accessible formats
Monitoring Strategy: Assess past and proposed efforts to track farmer understanding and satisfaction with insurance products	No structured monitoring. Limited evidence of past assessments; informal methods only. No clear plan for future monitoring.	Some past data collected (e.g., reports, basic surveys, anecdotal feedback). Proposed monitoring plan exists but lacks detail, tools, or implementation structure.	Comprehensive evidence, tools, roles, and structure with credible evidence (e.g., reports, surveys, training scores) to assess farmer understanding and satisfaction, backed by a well-defined plan for future assessment.	**Review Existing Data:** Collect and assess any reports, surveys, or informal feedback related to past training or communication activities. **Define Monitoring Tools:** Develop or refine tools like surveys, training assessments, or short interviews to track farmer understanding and satisfaction. **Establish a Monitoring Plan:** Outline clear timelines, roles, and methods for data collection and analysis.
Remedy & Grievance Mechanisms: Ascertain past and proposed mechanisms to address farmer complaints, especially when losses occurred without payouts	No formal mechanism or relevant documentation. No track record of handling farmer concerns or providing follow-up.	Some information on past responses, but inconsistent or poorly documented (e.g., informal feedback, limited contracts, or client references). Proposed mechanisms are unclear.	Documented grievance mechanisms with clear steps, roles, and timelines. Proven use in past cases with strong endorsements and data on impact, resolutions, and renewals. Proposed systems build on existing frameworks with defined protocols and escalation paths.	**Map Existing Mechanisms:** Identify any current channels used by farmers to raise issues (formal or informal), and evaluate how they function. **Document Past Cases:** Gather examples of past grievances, resolutions, and how they were handled. Highlight data on response times and farmer satisfaction. **Develop Clear Protocols:** Create a step-by-step grievance process with defined roles, timelines, escalation paths, and response guidelines. **Track and Report Outcomes:** Monitor grievances and resolution outcomes over time to improve product design or delivery.

Score	Rationale
0 –1	Limited or weak evidence; documentation is missing or incomplete; no clear proposed strategy.
2	Some evidence, but lacks depth, clarity, and credibility; proposed strategies are partial or vague.
3	Sound basic evidence of experience and effectiveness; proposed strategies address key gaps.

Annex N. Sample Dashboard for Contracting Entity

Payout vs. Premium	Average Payout	Average Frequency
How much money will farmers get (payout) for how much they pay (premium)?	On average, how big is the typical payout?	On average, how often is the typical payout?
Expected Loss Ratio (0-100%)	*Payout as % of maximum liability*	*No. of years with payout / Total no. of years*
49.80%	0.10	4/19

Minimum Payout	Maximum Payout	95th Percentile Payout
What is the minimum payout size?	What is the maximum payout?	What is 95th percentil payout?
Payout as % of maximum liability	*Payout as % of maximum liability*	*Payout as % of maximum liability*
0.00	0.77	0.54

Alignment of Index with Farmer Experience		Addressing Gaps
Weather-based Index Insurance only	*Area-yield Index Insurance only*	
On average, how big is the gap between index payout and what farmers expect?	Difference in severity / magnitude of the event between yield data and farmer recall for worst yield year	What share of the price would the top up be if all losses not covered by the index could be compensated?
Average difference (downside) (payout as % of maximum liability 0-1)	*Average difference in severity / magnitude of event (in terms of probabilities across years)*	*Basis Risk Premium (0-100%)*
0.32		40.56%
		Communication
On average, how big is the gap when index payout is lower than what farmers expect?	Difference in severity / magnitude of the event between yield and satellite recall for worst yield year	How effective is communication with the farmers?
Matching rate (0-100%)	*Average difference in severity / magnitude of event (in terms of probabilities across years)*	*Qualitative Score (0-3)*
50.00%		3

Annex O. Sample Dashboard for Farmers

Payout vs. Premium	Maximum Liability
How much money will farmers get (payout) for how much they pay (premium)?	$250.00
Expected Loss Ratio (0-100%)	
49.80%	

Average Frequency	Average Payout	
On average, how often is the typical payout?	On average, how big is the typical payout?	
No. of years with payout / Total no. of years	*Payout as % of maximum liability*	*In currency value*
4/19	0.10	$24.44

Alignment	Maximum Payout	
Would the index have made a payout on the worst year for farmers?	What is the maximum payout?	
	Payout as % of maximum liability	*In currency value*
Yes	0.77	$192.93

Annex P. Index Calibration with the [DESDR Tool]