

Robust Decision Making for Sustainable and Scalable Drought Index-Based Microinsurance in Ethiopia: Reducing Weather Related Disaster Risk With Rural Agro-Insurance

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ABSTRACT: Climatic and socio-economic vulnerability pose significant challenges to development, often requiring large-scale solutions to overcome. Index-based microinsurance for weather risk transfer is one potential element of sustainable and scalable management solutions. Agent-partner microinsurance models are particularly attractive since they can be distributed as low-cost products on an individual basis in remote areas. Loan-bundled index products can also support access to microcredit as a form of collateral that mitigates weather-related default. An agent-partner, index-based microinsurance product design was explored as a risk management tool for drought in Ethiopia. This research used scenario-based computer modeling and qualitative interviews to test the supply and demand-side sustainability of index products. Robust decision methods were used to consider uncertainty in the estimates of product design and financial sustainability. Model structure and inputs were informed by commercial product designs in India, and the earliest stages of pilot study work in the Tigray region of Ethiopia, undertaken by the HARITA (Horn of Africa Risk Transfer for Adaptation) project involving over a dozen partner organizations coordinated by Oxfam America.¹ The modeling compared the financial sustainability of both standalone and loan-bundled microinsurance products. Interview work with farmers and potential suppliers assessed opportunities and tradeoffs of products. Overall results indicate that practical recommendations for implementing an agent-partner model in Ethiopia include the need to: (i) improve index quality for more robust risk assessments (ii) consider initially offering standalone microinsurance products with established

¹Ethiopian farmers, the Relief Society of Tigray, Nyala Insurance Co., Dedebit Credit and Savings Institution, Mekele University, Ethiopia's National Meteorological Agency, Tigray Regional Food Security Coordination Office, Tigray Cooperative Promotions Office, the Institute for Sustainable Development, Swiss Re, International Research Institute for Climate and Society, the Rockefeller Foundation, the Index Insurance Innovation Initiative at UC-Davis, Goulston & Storrs LLP, and Weil, Gotshal & Manges LLP.

demand and supply-side impact criteria (iii) address demand and supply-side capacity constraints and (iv) gauge domestic interest relative to other index insurance model designs. To achieve sustainable scaling of drought index-based microinsurance in Ethiopia and elsewhere, these and other issues should be considered. Innovative product distribution based on an existing public-private program addressing food insecurity, use of satellite data and emerging financial resources for climate change adaptation offer possible solutions for increased product performance and affordability in Ethiopia.

KEYWORDS: Microinsurance, weather risk management, robust decision making, Ethiopia

1 DROUGHT INDEX MICROINSURANCE FOR WEATHER RISK MANAGEMENT

1.1 Vulnerability context

Extensive climatic and socio-economic vulnerability challenges the wellbeing and livelihoods of low-income agriculturalists that make up the majority of rural populations in developing nations. In African regions, recurrent droughts, exacerbated by socio-economic and political instability, resulted in the largest number of people affected and lives lost from natural disasters between 1980 and 2008. One of the best-known examples is Ethiopia's 1984 drought, which claimed the lives of between 300,000 and 1 million people and affected over seven million (IFRC, 2003: 1, EM-DAT, 2008). While only subtle changes in rainfall were observed during this period, extreme poverty and lack of full recovery from previous droughts, institutional weakness and civil conflict catalyzed humanitarian crisis (Fraser, 2007: 503). Anthropogenic climate change may magnify such sensitivity to environmental change by increasing risk of weather related disasters (IPCC Assessment Report 4, 2007, 433-467).

1.2 Microinsurance risk management tools

Insurance products offer one strategy to manage these threats by transferring weather risks to financial service providers. In the last decade, a new form of insurance has been developed based on a payout index correlating losses (e.g. crops or livestock) to a weather parameter/s. Derived from available historical weather and loss data, these index-based risk transfer products (IBRTPs) have shown promise as weather risk management tools with theoretically lower transaction costs as direct investigation of losses is avoided (Barrett et al., 2008, 1766).

Initially explored in North America and Europe, index-based insurance is being tested in developing country contexts as low-cost, low-payout "microinsurance" products (Ulardic, 2008). Experimental pilots with standalone index

microinsurance products provided learning experiences from which viable, countrywide industries emerged for early adopters like India (Gunaranjan, 2008). Further pilot innovations introduced index microinsurance products tied to small loans to serve as a form of collateral for poor borrowers. Loan-bundled microinsurance has the potential to increase client pools of lenders who are reluctant to extend services given default risks associated with rain-fed farmers (Linnerooth-Bayer et al., 2007: 54). Early pilot experiences with bundled products in Malawi have been qualified successes and reached around 2,500 farmers in the third season (Mapfumo, 2009).

Given the weather risk reduction and livelihood enhancing potential of standalone and loan-bundled index microinsurance, providers are engaging in strategic work to scale conventional project-level efforts (Bryla, 2008). Scaling concepts involve the expansion of client pools or “outscaling” to diversify the covered weather risks geographically, and “upscaling” to transfer aggregated risk pools to insurance or reinsurance companies. Success stories amongst pilot and program-level experiences to date have resulted in important lessons of what makes index microinsurance products sustainable at various scales. Sustainability criteria fundamentally require that products involve affordable costs and low risk levels to both suppliers and vulnerable clients (Ibarra and Skees, 2007: 67). However, developing scalable index product designs that satisfy supply and demand-side sustainability criteria have proven a continued challenge in remote, low-income areas of the world. In countries like Ethiopia, this challenge is exacerbated by endemic natural climate variability and resource constraints, among others. The following section explores such practicalities in the context of theoretical advantages and disadvantages of weather index products.

2 WHY INDEX MICROINSURANCE FOR AGRICULTURALISTS?

2.1 *Agro-insurance context*

While use of insurance products for transferring weather risks holds much promise, practical realization of sustainable and scalable products in developing country contexts is an ongoing effort. For this study, the theoretical context of IBRTPs provides insight into why weather index microinsurance in particular is being explored for agriculturalists, and the principle challenges facing design decisions to date.

Among agricultural microinsurance products, two design categories predominate: i) indemnity or loss-based and ii) area yield-based. Under traditional indemnity insurance, products might cover single or multi-peril (e.g. precipitation, pests, and temperature) crop losses measured directly during on-farm visits. In contrast, area yield-based insurance products cover populations in a defined geography within which area-wide losses are vulnerable to simultaneous or “covariant risks” such as drought. Area-based payouts occur when estimated

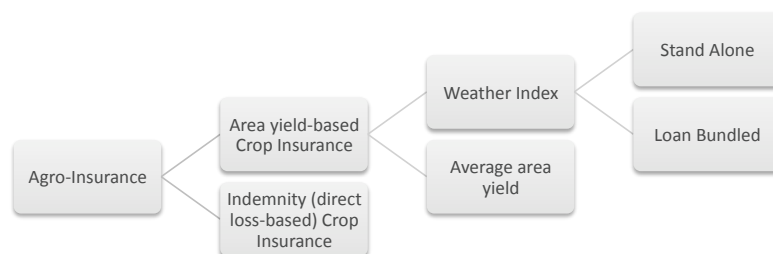


Figure 1: Conceptual landscape for agro-insurance products

yields produced in the area fall below a critical threshold. Depending on the product type, loss thresholds might be measured directly based on average area-wide yields or indirectly, based on a predetermined weather index indicating environmental stress for a select crop/s (Carter et al., 2007: 3) (See Figure 1).

For farmers and insurance providers sensitive to environmental change, the type and design of an insurance product has significant implications. Decisions ultimately depend on these actors' risk aversion and preferences in relation to product cost, coverage and delivery features. Given variance among these preferences, overall product sustainability requires that products are tailored to local contexts.

2.2 Potential advantages and disadvantages of index microinsurance

Lower costs and risk levels account for the arguable sustainability and scalability of weather index microinsurance. With payouts triggered by a predetermined index rather than after individual claims investigations, affordability of index products is predicated on low transaction costs to suppliers and correspondingly low premiums for poor clients. Moral hazard, or the risk of farmers deliberately increasing their risk exposure in anticipation of insurance payouts, is also reduced by the objective and tamper-proof index. Adverse selection of clients due to asymmetric information about farmers' real risk exposure is similarly avoided when reliable historical weather data are available (Skees et al., 1999: 3). From demand and supply-side perspectives, index microinsurance therefore, has theoretical advantages in terms of lower premiums and supplier costs, and increased transparency. The versatility of index products is complimented by their potential to lower risks associated with small loans through loan-bundled products, and also to be outscaled to low-income clients and upscaled to spread aggregated risk pools among insurers and reinsurers (See Figure 2).

Index microinsurance products are not without implementation challenges, however, as pilots are outscaled to more clients and coverage areas. From the perspective of farmers, the primary challenge is heightened exposure to conditions of "basis risk" characterized by a poor correlation between

Potential advantages	Potential challenges
• Affordability • Transparency • Versatility • Scalability	• Basis risk • Large-scale payouts • Capacity constraints • Institutional environment

Figure 2: Potential advantages and challenges of index microinsurance

individual and area-wide losses estimated by the payout index. By measuring loss indirectly based on a proxy, index products have greater potential for inaccuracy and high levels of basis risk. In the case of drought index-based microinsurance, high basis risk exists when precipitation deficits registered by a local meteorological station are not representative of actual deficits experienced on the ground. Therefore, a drought could result in crop losses but no payout and vice versa (Carter et al., 2007: 3-10).²

For providers, index contracts increase exposure to covariant risks that may lead to large-scale payouts that can undermine the solvency of a supplier's risk portfolio (Skees et al., 1999: 6). For example, under one Indian company's scheme, covered areas can reach an over 40 km radius from a single station, exposing the insurer to a large-scale payout if drought occurs simultaneously across a large geographic area (Gunaranjan, 2008). Additionally, given limited data, adverse selection can arise when suppliers are unable to characterize risks for a particular area accurately. Reinsurance can mitigate these inherent risks.

Hence, while index-based products may increase affordability by lowering transaction costs, these advantages are offset by increased basis risk exposure for clients and covariant risk and/or poorly characterized risk portfolios for providers without reinsurance. While such risk exposure is often associated with issues of insufficient historical weather and yield data, and low-density networks of meteorological stations, financial and technical capacity constraints of clients and providers pose additional challenges.

Stemming from capacity issues is the related obstacle of identifying appropriate delivery channels for insurance provision. For index products (explored in later sections), risk aggregators and clients must be closely linked in order for aggregators to market and administer products effectively, ensure timely payouts, and support product improvement based on customer feedback. Pilot experiences in index-based microinsurance indicate that suppliers must be

²Covariant or idiosyncratic individual loss not directly related to weather, such as pest or plant pathogen infestations, are also a significant source of basis risk which drought index insurance does not protect against.

Table 1: Drought index-based agro-insurance models (existing and proposed) in Ethiopia

Model Developer	Scale	Client	Distribution Channel	Product Function	Technical Approach	Pilot Stage
WFP/ World Bank	Macro	Government	Government (PSNP program)	Livelihoods protection (safety net), famine prevention	Station data index (LEAP software)	Phase II, beyond proof of concept
HARITA project partners	Meso/ micro	Farmers	Govt (PSNP)/ Private providers	Livelihoods building (cargo net)	Station data index & satellite data	Phase II, beyond proof of concept

context appropriate. This may involve distribution by a domestic insurer, a microfinance institution (MFI), government agency, civil society organization, or other entity providing microinsurance directly or indirectly (as an intermediary agent) (Manuamorn, 2007: 2). The ease of suppliers to access and regularly communicate with often remote and difficult to reach customers adds additional delivery challenges.

Compounded by underdeveloped regulatory environments for insurance and banking industries in many developing countries, implementation of index-based microinsurance requires a host of theoretical and practical tradeoffs from both supply and demand side perspectives (See Figure 2).

3 DESIGNING SCALABLE DROUGHT INDEX INSURANCE PRODUCTS FOR ETHIOPIA

3.1 Distribution models in Ethiopia to date

Accounting for approximately 50% of GDP and 80% of employment, Ethiopia's drought-prone agricultural sector has been a subject of particular focus for experimental drought index agro-insurance products at various scales (Demeke et al., 2003: v). For the purposes of this study, two Ethiopian pilot programs were focused on: a country-scale 2006 pilot designed by the World Food Programme (WFP) and the World Bank (WB) and the HARITA (Horn of Africa Risk Transfer for Adaptation) project coordinated by Oxfam America (OA), which has just completed implementation in the Tigray regional province (Victor, 2010). These pilot programs might be considered cousins in that they share similar conceptual underpinnings, distribution channels, and technical approaches. However, they are markedly different in their client focus and corresponding product scale and function (See Table 1).

Fundamental differences between the two models are perhaps best characterized by classifications of IBRTP approaches relating to poverty traps developed by

Barnett et al., 2007. The WFP/WB work is a “safety net” model to prevent farmers falling back into poverty traps, based on a macro (national)-level focus on livelihoods protection and famine prevention using existing government relief channels. In contrast, HARITA’s farmer-oriented, livelihoods building design has elements of both the safety net and “cargo net” model. The HARITA model aims not only to help prevent vulnerable farmers from falling further into poverty traps during times of drought, but also provides tools so that farmers can lift themselves out of poverty (Osgood, 2009). A poverty trap occurs when farmers pursue low-risk, low-return activities and forego critical consumption (e.g. sending their children to school) to avoid liquidating productive assets (e.g. draught animals) during times of environmental stress or shocks when family or communal safety nets are weakened (Barnett et al., 2007: 9). Frequent shocks lead to both chronic and transient food insecurity (Hess et al., 2006: 4).

The WFP/WB safety net addresses worsened poverty traps by distributing contingency funds supplied by reinsurers and/or donors if widespread drought is registered by 26 meteorological stations across the country. When the indices are triggered, payouts are distributed through government relief channels established by Ethiopia’s national Production Safety Net Programme (PSNP). PSNP is a national program where food or cash transfers are delivered in exchange for a specified number of labor days on projects benefiting a local community. The program started in 2005 and reaches close to 8 million Ethiopians, providing predictable relief transfers for predictable needs of chronically vulnerable individuals. The WFP/WB index insurance safety net provides support to this otherwise predictable system when unpredictable drought shocks result in additional needs for transiently food insecure participants. During the WFP/WB’s first pilot phase in 2006 with Axa RE, no payouts were triggered and the experience was considered a successful proof of concept for drought index-based humanitarian insurance in Ethiopia (Hess et al., 2006: 4-8).

Although the WFP/WB model provides an important drought risk transfer option for the Ethiopian government, because it is not specific to local areas or individual households, farmers cannot base management decisions on anticipated coverage. In contrast, the HARITA model develops locally specific indices and engages farmers at the micro level and insurers, and potentially banks and microfinance institutions (MFIs), at the meso level. For farmers, the model provides PSNP participants the option of working extra days in exchange for a microinsurance contract that distributes payouts through the PSNP. Non-PSNP participants have the option to purchase insurance in cash. The HARITA approach reaches both PSNP and non-PSNP farmers, providing a hybrid safety and cargo net for chronic and transient food insecurity. Farmer-level contracts help provide farmers with an additional risk management tool for individual decision making.

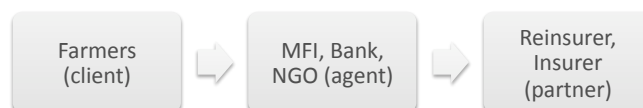


Figure 3: Conceptualized agent-partner model adapted from (Manuamorn, 2007: 24)

Administration of in-kind premium payments involves domestic insurers as risk aggregators. In the future, the HARITA model will potentially incorporate small loans offered by banks or MFIs that insured farmers might not be offered otherwise (Victor, 2009). Livelihoods protection through weather risk transfer, and responsible risk taking and livelihoods building through insurance bundled loans are therefore possible with the HARITA approach. Moreover, the WFP/World Bank model's primary function is to reduce the impacts of bad weather years while the HARITA model proposes to do this at local scales and also help make the good years even better (Osgood, 2009).

3.2 Future model development and lessons from India

Over the last five years an analogous trajectory to that of HARITA in Ethiopia has evolved in India's weather index microinsurance industry as micro-level commercial products, outscaled across the country, aim to better meet individual farmers' needs. The design featured in India's private sector is known as an "agent-partner" model whereby an agent with strong community links markets and delivers insurance to client farmers, and a partner designs products and provides capital input (Diaz Nieto et al., 2006: 12) (See Figure 3).

In the case of India, the company ICICI Lombard is a notable leader in the private index microinsurance business, upscaling over 50% of covered risks to international reinsurers and selling nearly 1 million contracts as of March 2008 (Argarwal, 2008, Skees and Collier, 2008: 38). In partnership with the MFI BASIX, as well as other community-level agents, ICICI offers a range of weather index microinsurance products. These include multi-peril and multi-phase (crop growing phases) products based on temperature, rainfall and relative humidity indices for select crops (Argarwal, 2008). In order to outscale coverage to rural areas where long-term weather data is limited, ICICI has piloted indices that use satellite-based imagery to measure vegetation 'greenness' using a Normalized Difference Vegetation Index (NDVI) and moisture data. These data are combined with soil and meteorological (rainfall and temperature) station data to assess crop health. Through this hybrid satellite-station-derived index, loss estimates are more robust and triggered payouts made within 30 days, compared to the yearlong claims process under the current government crop insurance program (Argarwal, 2008, ICICI interview with Rediff News, 2008).

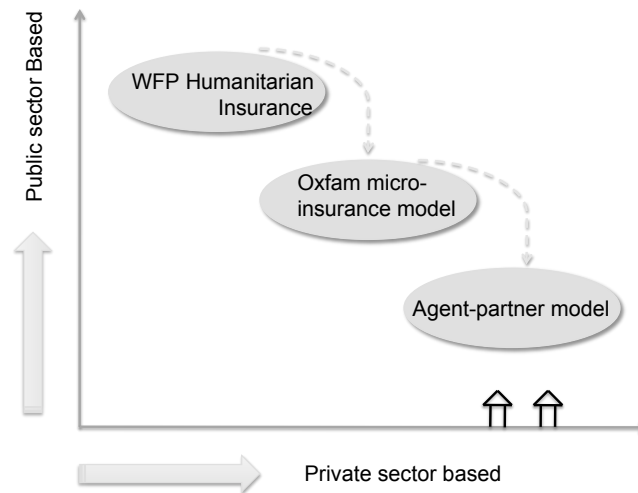


Figure 4: Conceptual landscape of “safety net” (WFP/WB) and progression towards more privatized “cargo net” weather index microinsurance models in developing countries.

Closely resembling HARITA’s proposed model for an Ethiopian program, ICICI’s innovative approaches are illustrative of ways in which financial risk transfer services can be offered that transcend traditional aid-based humanitarian relief systems in developing countries. The relevance of such solutions is underscored by growing evidence that “crisis-management” disaster risk response paradigms, exemplified by large-scale, ex-post food-aid transfers, may cause more long-term harm than short-term good. Concerns are supported by disincentives for local production and public and private investment from artificially low price signals observed after large aid influxes (Del Ninno et al., 2007: 427). Moreover, public-private models for index agro-insurance, ranging from the WFP/WB macro-level “safety net” approach to the partial and full privatization of HARITA’s and ICICI’s meso/micro-level “cargo net” designs, represent constructive alternatives to traditional interventions (See Figure 4).

4 A STYLIZED AGENT-PARTNER MODEL FOR ETHIOPIA

4.1 *Criteria for a sustainable agent-partner design*

Short and long-term objectives and potential impacts are critical to sustainability considerations for elevating index-based microinsurance pilot initiatives to larger scale programs. No matter the country context, one overarching consideration relates to long-term affordability of products for both clients and suppliers (Ibarra and Skees, 2007: 65). Given the strong livelihood building or

“cargo net” potential of agent-partner models, the following conceptual case study assesses the financial sustainability of scaling a stylized agent-partner index microinsurance model in northern Ethiopia. To this end, financial sustainability is interpreted as actors either breaking even or increasing their incomes over simulated scenario futures dictated by a range of deeply uncertain exogenous variables. Both standalone and loan-bundled index microinsurance products are considered. It should be noted that while certain elements of the ongoing HARITA pilot were drawn from ‘for model’ design, the stylized model explored in the case below is not representative of the HARITA pilot design that is actually being implemented. For detailed information on the actual HARITA pilot, please visit www.oxfamamerica.org.

4.2 Case study region

Information for a conceptual agent-partner model was based on the Adi Ha *tabia* (sub-district) within Kola Temben woreda (district) in the Tigray regional state of Ethiopia (See Figure 5). Adi Ha and Tigray were identified based on their vulnerability to drought (the focus of ongoing work by HARITA project partners in the area), and the extensive reach of Dedit Savings and Credit Institution (DECSI), a microfinance supplier throughout the region (Teshome et al., 2008: 8, Victor, 2008). Regional vulnerability was manifest during prolonged droughts of the early 1970s, 1980s and in 2008 when minor *Belg* rains failed and the major *Kiremt* rains were late, disrupting crop cycles and worsening existing food insecurity (REST, 2008: 2). Exceptionally high commodity prices coupled with high domestic inflation rates exacerbated this insecurity, making food and inputs even more unaffordable for farmers (Hailu, 2008). Similar to the HARITA pilot work, the endemic grain *teff* was selected as an ideal index crop given its central importance to the food security and livelihoods of Adi Ha and Ethiopian farmers in general (Teshome et al., 2008: 8).

5 ADDRESSING DEEP UNCERTAINTY

5.1 Scenario-based assessment of index product design decisions

The methodologically diverse field of strategic decision-making theory provides useful analytical frameworks to assess the performance of design decisions for agent-partner index microinsurance in Tigray, Ethiopia. Within this field, concepts, methods and tools designed to confront a large degree of uncertainty based on a systematic decision framework for robust decisions (Rosenhead, 1989, among others) has emerged from literatures on scenario planning (Van der Heijen and Kees, 1996), robust design (Ulman, 2006), imprecise probabilities (Walley, 1991), and Info-Gap methods (Ben-Haim, 2006).

Applied within appropriate contexts, these methods can serve as powerful

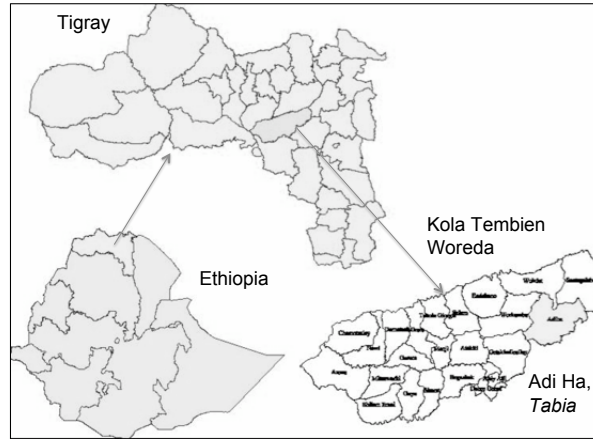


Figure 5: Adi Ha *Tabia* within Tigray Regional State, Ethiopia. Adapted from Teshome et al., 2008: 18.

support tools for decision makers. Contexts are identified based upon how well defined the probability distributions characterizing influential uncertain factors are (e.g. rainfall), as well as the values held by decision makers (Postma and Liebl, 2005: 161-165, Lempert et al., 2006: 515). Under conditions characterized by uncertain parameters with well-defined probability distributions, traditional optimization approaches that maximize expected utility are appropriate. Conversely, under conditions of poorly defined or unknown probabilities for parameters with deeply uncertain values, strategies robust across many uncertain scenario futures can be appropriate (Groves and Lempert, 2007: 73).

While the usefulness of scenario-based methodologies might be criticized given no likelihoods are associated with scenario outcomes, they can nevertheless provide a valuable conceptual framework to guide decision-makers in conditions of deep uncertainty. Significant sources of uncertainty surrounding weather index microinsurance, including long-term levels of demand and poorly understood rainfall regimes, lend theoretical appeal to non-probabilistic methods for sustainability assessments. This study used a quantitative scenario-based approach called Robust Decision Making (RDM - detailed below) to assess the financial demand and supply-side sustainability of a conceptual agent-partner pilot program scaled throughout Tigray.

5.2 Robust Decision Making (RDM)

Robust Decision Making (RDM) is an analytic, scenario-based approach for strategic decision-making. In contrast to standard decision theory, RDM seeks to identify strategies that are robust, rather than optimal, over many

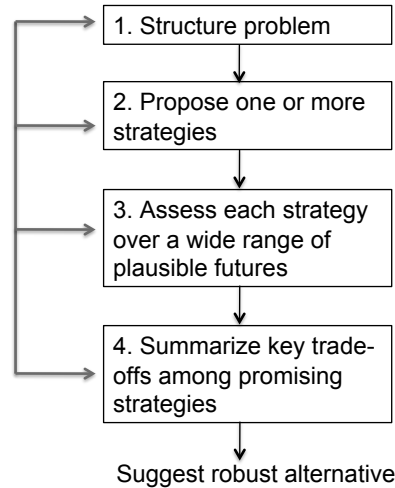


Figure 6: RDM process (from Groves, D. G., Lempert, R., Knopman, D., and Berry, S. (2008). “Preparing for an Uncertain Future Climate in the Inland Empire: Identifying Robust Water-Management Strategies.” DB-550-NSF, RAND Corporation, Santa Monica, CA.)

future states of the world (Lempert, Popper, and Bankes, 2003; Groves and Lempert, 2007: 77). RDM uses quantitative models, or scenario generators, to evaluate how different strategies perform under large ensembles of scenarios reflecting different plausible future conditions (often hundreds to thousands of cases). RDM seek robust strategies through a vulnerability-and-response-option analysis.

An RDM analysis begins, similarly to a standard probabilistic analysis, by structuring the problem. But instead of then characterizing the uncertainties as a prelude to ranking the decision making strategies, an RDM analysis first proposes alternative strategies and then characterizes the uncertainties according to their effect on the choice among these options (Figure 6). To accomplish this, analysis begins with a set of alternative strategies and then assesses each over a wide range of plausible futures. Each future is defined by a particular combination of values for the uncertain input parameters to the model. Statistical procedures then determine those combinations of uncertainty parameters most important to the choice among the strategies. Once the RDM analysis has isolated the combinations of uncertainties most important to comparing the policy options, it identifies the key trade-offs among the most promising strategies. At this stage, RDM may employ probabilistic information to illuminate such trade-offs. For instance, the analysis might suggest that decision-makers choose one strategy over another as long as future precipitation is sufficiently likely to remain above some threshold, helping the decision-makers decide whether this is a risk they are willing to take.

Ideally, an RDM analysis helps identify a robust strategy, one that performs reasonably well compared with the alternatives over a very wide range of uncertainties. If none of the strategies initially considered emerges as robust, the information about key uncertainties and trade-offs can be used to suggest new and potentially more robust strategies. In many cases, this type of analysis can be very helpful, allowing decision-makers to identify and agree on a robust strategy, even if the uncertainties are very large. The success of an RDM analysis often depends on the ability to find strategies that have this robustness property. If no such strategies exist,³ the results of an RDM analysis may not prove particularly useful or satisfying to decision-makers. However, when no robust strategy exists, the method may provide some guidance to decision-makers on where they need to invest in research to reduce key uncertainties or find ways to expand their options.

6 ASSESSING AGENT-PARTNER MODEL SUSTAINABILITY

6.1 *Stakeholder engagement*

As a first step in the RDM method, viewpoints and values held by stakeholders relevant to a decision making challenge were elicited to capture the range of future scenarios for quantitative model development and crafting robust pilot designs. This information can be conveniently summarized using an “XLRM” framework, representing the exogenous factors (X), policy levers (L), performance metrics (M), and relationships (R) that comprise a modeling system (Lempert et al., 2003: 64-67).

Stakeholders relevant to potential agent-partner index microinsurance design decisions were engaged using a variety of qualitative methods. Four stakeholder groups were identified and included farmers, MFIs, insurers and reinsurers. Group representatives were either directly involved in ongoing HARITA project work in the area or represented relevant interests to fields of microinsurance and microfinance (See Table 2).

Primary qualitative methods included semi-structured telephone or personal interviews with individuals as well as focus group discussions (FGDs) with farmers during fieldwork conducted in the Tigray region from July 6-17, 2008. For the three FGDs conducted, between 5 and 10 farmers were chosen using stratified purposeful sampling based on income, age, and gender to ensure a diversity of viewpoints were represented (Baxter and Eyles, 1996: 505). Sessions were assisted by Tigrinya translators made available by the Relief Society of Tigray (REST) and involved two groups in Lemlem, and one group in Adi Ha.

³Lempert and Collins (2007) described some conditions under which robust strategies do not exist.

Table 2: Interview details of four stakeholder groups

Stakeholder group	Organization	Date	Method
Farmers	OA pilot	6-11 July, 2008	Focus group discussion
Microfinance institutions (MFIs)	Dedebit Credit and Savings Institution (DECSI)	12 July, 2008	Personal interview
	Poverty Eradication & Community Empowerment (PEACE) MFI	15 July, 2008	Personal interview
	Addis Credit and Saving Institution	16 July, 2008	Personal interview
	Wisdom MFI	17 July, 2008	Personal interview
Insurers	Nyala Insurance	10 July, 2008	Personal interview
	ICICI Lombard	3 July, 2008	Phone interview
Reinsurers	PartnerRE	30 June, 2008	Phone interview
	Munich RE Foundation	3 July, 2008	Phone interview
	Swiss RE	30 July, 2008	Phone interview

6.2 Conceptual model development

Based on qualitative and quantitative research, a Microsoft Excel-based scenario generator was developed to represent the elements of the analysis as summarized by the XLRM framework. Respective categories of uncertainty parameters (Xs) and decision levers (Ls) were comprised of multiple input variables assigned specific ranges based on gathered information.

6.3 Model scenario generation and strategy selection

Scenario “landscape creation” and analysis was conducted using the model. Landscapes represent ensembles of X values simulating uncertain future scenarios over which ensembles of decision levers (Ls) or strategies are tested. 1000 different scenarios were generated by a method known as a Latin Hypercube Sampling which, for each simulation, uses algorithms to combine a single value for each X and L sampled from assigned ranges to generate equally probable future scenarios (Lempert et al., 2003: 118).

Once generated, software conducts sensitivity analyses to help modelers identify strategies that appear successful across different future landscapes. Strategy success is defined by specified criteria of “good”, “mediocre” and “bad” outcomes based on M performance measures. Therefore, a computer helps direct modeler attention to combinations of X and L values that produce agreeable M outcomes. Once identified, additional stress testing methods are carried out on candidate robust strategies by considering alternative values of

key Xs and Ls, while keeping others at specified nominal values. Based on results of stakeholder engagement, tailored strategies (specific combinations of L values) of interest were also tested across 1000 simulations created from the X input ranges. Computer-guided and user-tailored strategies were then compared based on how positive or negative their impacts were on measurements of strategy success. Ultimately, strategies that generated the best M outcomes across the different future landscapes were judged to be robust (Lempert et al., 2003: 76-85).

7 CONCEPTUAL MODEL DEVELOPMENT

7.1 *Model structure*

Structurally based on the XLRM framework, and concepts of demand and supply-side sustainability, a scenario-based model was created using interview results and relevant literature. Informed by stakeholder feedback and interest, scenarios capture outcomes of both standalone and loan-bundled drought index-based microinsurance schemes.

From the perspective of supply-side sustainability, the MFI DECSI was identified as the most appropriate delivery channel for the model given its extensive presence in the Tigray region and its interest in microinsurance products. Model scenarios were structured around 15 consecutive contract years, since most microfinance products are bought and/or renewed on an annual basis.

7.2 *Exogenous uncertainty parameters (X)*

Drawn from interviews conducted with farmers, MFIs, insurers and reinsurers, 14 X parameters were incorporated as model variables. These variables fall within three primary categories: demand, environment, and market-related exogenous uncertainties. Each of the 14 Xs were identified and assigned ranges by stakeholders given their importance for calculating index insurance payouts and premiums, and influence on farmers' risk preferences, which drive demand. Parameters capturing the latter dynamic include base year demand for standalone and loan-bundled schemes, as well as an annual demand change ratio that operates over the 15-year model horizon.

In terms of environment-related uncertainty, the first key X factor represents cumulative rainfall for the 20-day-long crop phase (2 dekads) covered by each annual contract. This parameter marks a key grain filling stage for *teff* plants during which sufficient rainfall is critical for successful production outcomes. This period was identified by HARITA technical advisors at the International Research Institute (IRI) at Columbia University and its importance confirmed with Adi Ha farmers during fieldwork. The second key environment-related X

factor is the number of droughts that might occur within the 15-year period. Historical burn analyses conducted by IRI in 2008 using the 7 years of available Adi Ha rain gauge data, and some surrounding stations, estimate 1 drought is probable every 7 years (Osgood, 2008). Given the uncertainty inherent in deriving reliable probabilities from limited data, particularly in light of future climate change, it was important to model the full range of drought scenarios possible over 15 years. Equally important was capturing non-drought-related risks facing farmers using a “basis risk” X parameter representing negative production impacts caused by risks such as pests, pathogens, hail, poor soil quality, etc.

Lastly, market-related X factors include respective base year (year 1) prices and inflation rates for fertilizer, *teff* seeds and *teff* harvest prices. According to farmers, inflation rates of *teff* seeds and harvest prices track each other and were therefore assigned identical ranges.

7.3 Policy lever parameters (L)

To model a range of policy or decision lever (L) parameters across future scenarios, application of the XLRM framework resulted in the selection of 16 Ls following fieldwork. These Ls can be grouped under four major categories: pilot scheme design and corresponding contract, supplier costs, and farmer impact considerations. In terms of sustainability impacts, the choice of either a standalone or loan-bundled product has substantial implications for providers and customers, as previous pilot experiences show (Churchill et al., 2003: 1-222).

To capture contract design and pricing parameters, the model incorporated L factors foundational to both scheme design types including ranges for hypothetical insurance premium rates and maximum payout amounts set by suppliers, similar to Osgood et al., 2007. Additional Ls for loan-bundled schemes include the interest rate on the loan, ratio of contracts per microfinance institution (MFI), number of MFIs, and number of farmers per contract.⁴ These Ls are based on the capacity of DECSI branch facilities and, when maximized, represent natural supply-side limits on scheme outscaling in the Tigray region in which DECSI reports nearly full market penetration.

Depending on the extent of outscaling, i.e. the size of the risk pool, an “upscaling” parameter captures the supplier option to pass on risk to reinsurers at the cost of a reinsurance premium ratio. Other non-optional costs incorporated in the model include marketing, staff, office overhead, index consultation, and variable costs taken as different ratios of supplier premium revenues based on estimates reported from experienced providers at ICICI Lombard. For both staff and consultation costs, higher ratios were assigned

⁴Note: Model loan interest rates were fixed at 9% in light of recent DECSI negotiations with the Ethiopian government (Asefa, 2008).

in the first 5 years of the model since in-house expertise for index contract creation and staff education investments would be necessary expenses based on interview results.

A number of stakeholders interviewed felt Ethiopia was likely to join the WTO in the next 5 to 10 years. Based on this anticipation, domestic providers of financial services expect global competitors to enter the Ethiopian market offering products at lower prices. A “global competition” L factor reflects this by reducing supplier profit margins after the model’s first 5 years.

7.4 *Relationships between uncertainties and policy levers (R)*

In order to produce a model that is dynamic over a multi-year period, quantitative portions of the RDM process require mathematical functions that capture key relationships between uncertainty factors and policy levers. Three key functions were used for this purpose. The first relationship involves calculation of payments by farmers for financial services including microinsurance premiums and, in loan-bundled schemes, loan payments. Hypothetical premiums were calculated as a percentage of the maximum liabilities covered for a policy while loans were calculated according to the cost of inputs (fertilizer, seeds) per hectare, similar to methods used by Nyala Insurance in their area-based insurance pilot.

With regard to insurance payment calculations, although actuarial methods are typically based on the quantified amount of risk covered, the probability of payouts, and clients’ willingness to pay, these values were either unknowable or deeply uncertain at the time of research. Therefore, a range between zero and 100% was given to the premium percentage and 1,000 to 7,000 Ethiopian Birr for the maximum payout amount based on the size range of DECSI microcredit loans.

The second key relationship of indemnity payouts was calculated using a payment index based on rainfall deficit in equations 1 and 2 below.

$$[1] Payout = (1 - RainfallSum - Exit) / (Trigger - Exit) * MaxPayout$$

$$[2] Payout = (1 - RainfallSum - 0/85mm) * MaxPayout$$

Designed by Columbia’s IRI, this equation creates a linear payment index (See Figure 7) which triggers payouts if the cumulative rainfall in the last 2 decades of August (11th–31st) and first decade of September (1st–10) does not surpass the trigger value of 85 mm (McLaurin, 2008). In the event of no rainfall, the contract exit of zero is achieved and full payment of the maximum liability covered is paid.⁵

Lastly, the third key relationship explored in the model was the calculation

⁵These details do not reflect the actual contract that was transacted in the HARITA pilot. For technical details on the contract that was implemented, please visit: <http://portal.iri.columbia.edu>

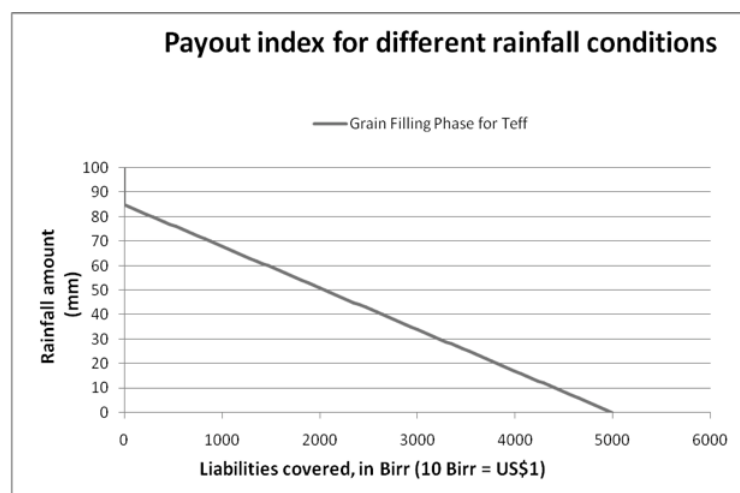


Figure 7: Insurance payout index for draft contract using 5000 Birr as an example of a maximum payout when zero rainfall (mm) occurs, adapted from McLaurin, 2008.

of farmers' gross revenues that were used to estimate welfare impacts of standalone and loan-bundled schemes. Under both scheme designs, average yields per season for farmers without inputs were calculated using production estimates from fieldwork discussions with farmer groups. For the loan-bundled scheme, a "fertilizer effect" was modeled based on quantitative production-enhancing benefits reported by farmers. Regardless of scheme type, all gross revenues were proportionally reduced when rainfall deficits below critical crop water requirements were simulated.

7.5 Measures for assessing strategy performance (*M*)

Arguably the most valuable contribution of the RDM process to hypothetical agent-partner model decision-makers is a diversity of performance standards or measures that, when satisfied, can indicate robustness of strategy outcomes across scenario futures. Five such measures were identified for the model and categorized according to supply and demand side sustainability measures over mid-term (>5 years) and long-term (15 years) periods (See Table 3). With regard to supply-side measures, the primary method of evaluation relies on the concept of loss ratios whereby a ratio of administrative costs and indemnity payouts over premium revenues is assessed. When this ratio is less than 1, schemes are considered financially solvent for suppliers (Skees et al., 1999: 2). Over the model period, if the number of years this ratio was satisfied is greater than the mid-term of five years (M1) or the ratio for the sum of total costs and revenues over the long-term period of 15 years is less than one (M4), then scheme design is considered sustainable.

Table 3: Measurement criteria of good strategy outcomes

Measure	Sustainability perspective	Relationship	Good outcome
M1	Mid-term supply	$(A + I)/P < 1$	> 5 years satisfied
M2	Mid-term demand	Partial profit = 0	> 5 years satisfied
M3	Mid-term demand	Partial profit = minimum yields target *harvest price	> 5 years satisfied
M4	Long-term supply	Total costs/profits over 15 yrs.	Ratio < 1 after 15 yrs
M5	Long-term demand	Avg. income/farmer over 15 yrs.	Avg. > 0 after 15 yrs

For demand-side measures, farmers' partial profits, calculated as gross revenues minus costs of scheme participation (premiums and/or loan payments), were used to measure strategy viability with increasingly ambitious standards of positive welfare impacts. Representing the basic measure of viability, when partial profits are greater than or equal to zero for more than 5 years (M2), schemes are considered "good" in the mid-term. M3 raises this standard based on a range of target yield outcomes (quintals) which providers could set as a minimum production requirement for scheme designs to be considered sustainable. Lastly, M5 represents the average income per farmer over the 15 year period and is considered "good" if it is greater than 0, i.e., scheme participation did not have negative income impacts overall.

According to these model criteria, ultimate scheme sustainability and strategy robustness is achieved when all M measures of success are satisfied over the model period.

8 RESULTS OF THE ANALYSIS

As part of an ongoing iterative process of model calibration and incorporating newly available stakeholder input, preliminary results were obtained from the analysis. Using Latin hypercube sampling techniques, stakeholder-specified ranges for uncertainties (Xs) and decision levers (Ls) were combined to generate scenario landscapes. Notably, more model development is necessary; particularly further iterations and calibration for scaling considerations.

Analysis of preliminary scenario outcomes examined foundational concerns of basis risk and index reliability highlighted by stakeholders as major sources of uncertainty impacting the sustainability of strategy outcomes at scale. Across scenarios, it was found that when the "basis risk" X factor is greater than 50%, target yield measures (M2, M3, M5) are undermined for standalone and loan-bundled index schemes as index inaccuracy and/or high non-drought-related risks obviate strategic welfare standards. Additionally, when seasonal rainfall

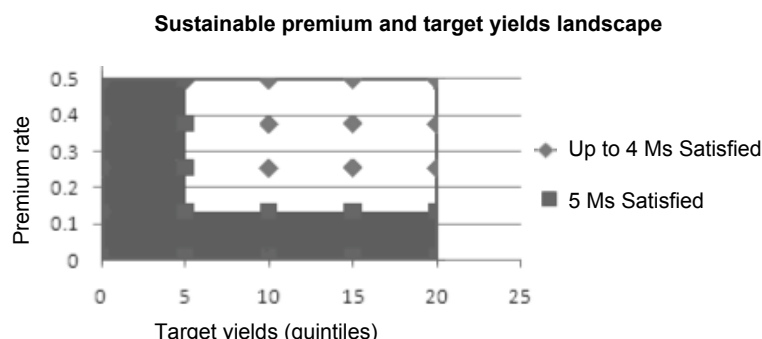


Figure 8: Premium rate and target yields (quintals) sustainability landscape

sums fall between 0 and 85 mm, triggering index payouts, both standalone and loan-bundled schemes satisfied supply-side solvency criteria (M1 and M4) for the majority of contract years (>10 years), even under multi-year drought scenarios (>1 year). In contrast, farmer welfare criteria were met for more years (>5 years) under standalone than loan-bundled schemes (M2, M3, M5) across simulated conditions.

With regard to computer-guided analyses of the 1000 initial ensemble landscapes, results revealed 5 key decision levers whose values were both highly sensitive to model uncertainties and very influential to the outcomes by which strategy success was measured (Ms). These levers include insurance premium costs, scheme type (standalone or loan-bundled), marketing or transaction costs, and target yields for farmers.

Outcomes across model scenarios revealed that potentially robust designs correspond with both premium rates above roughly 13% of liabilities covered and low target yields of 5 quintals (See Figure 8). This indicates that either of these values may be used as robust strategy criteria. This decision highlights an important sustainability tradeoff as farmers have the opportunity for greater income gains (5-20 quintals) when the 13% premium rate rather than 5 quintals is the chosen robustness criterion. Give the development benefits of higher incomes for subsistence farmers, selecting this premium rate criterion appears to be the most robust measure for ensuring sustainable product outcomes. Additionally, income benefits greater than 8 quintals, the average ideal yields without improved inputs reported by farmers, are only possible under loan-bundled strategies. This is because greater yields (8 and 20 quintals) can only be afforded by credit opportunities facilitating purchase of improved inputs (namely fertilizers) being incorporated into the model.

Building upon the above results, four modeler-guided experiments using the three most sensitive decision levers were tested within ranges of acceptable values identified by stakeholders as part of the iterative RDM process (See Table 4).

Table 4: Four experimental strategies tested. SA = standalone scheme, BUN = loan-bundled scheme.

Scheme type	Yield target (qunitals)	Premiums	Marketing cost ratio
SA/ BUN 1	Low (1)	Nominal (15%)	High (5%)
SA/ BUN 2	Nominal (8)	Low (1%)	High (5%)
SA/ BUN 3	Low (1)	Low (1%)	Low (1%)
SA/ BUN 4	Nominal (8)	Low (1%)	Low (1%)

Experimental results suggest that while basic criteria of successful strategy outcomes are possible, since both M1 and M2 are satisfied in standalone and loan-bundled schemes, higher performance criteria of M3, M4, and M5 prove more difficult to achieve. Using good (smiley face), mediocre (open circle) and bad (barred circle) symbols, three of the four experiments are shown to perform well by M1 and M2 measures (See Figure 9 and 10). Results indicate that, not surprisingly, low premium revenues combined with high marketing costs are not financially sustainable for suppliers. Likewise, good strategy outcomes across M2 confirm that farmer incomes will at least not decrease for roughly 7 years in loan-bundled schemes and hardly ever decrease over 15 years in standalone schemes.

However, as indicated by Figures 11 and 13, higher standards for income outcomes (M3, M5) are more difficult to meet. M5, measuring average income per farmer over the 15 year period, further reveals that standalone schemes versus loan-bundled appear to have more sustainable farmer income impacts overall (See Figure 13). Significantly, the opposite holds true for suppliers as M4 outcomes clearly indicate they benefit more from loan-bundled versus standalone schemes over the long-term (See Figure 12).

Overall experimental design results suggest that two of the three key decision lever (L) variables tested, including premiums and marketing costs, performed well between values of 1 and 15% and 1 and 5%, respectively. This finding compliments initial analysis, suggesting that premium rates of around 13% are arguably robust sustainability criteria, corresponding to target yields of greater than 5 quintals. However, further analysis iterations and calibration are necessary to confirm and refine these preliminary results.

9 DISCUSSION OF QUANTITATIVE AND QUALITATIVE RESULTS

9.1 Sustainable product design criteria

In theory, sustainable drought index-based microinsurance ideally provides an affordable and low risk management tool to both suppliers and clients, regardless of delivery scale. Through stakeholder engagement and the

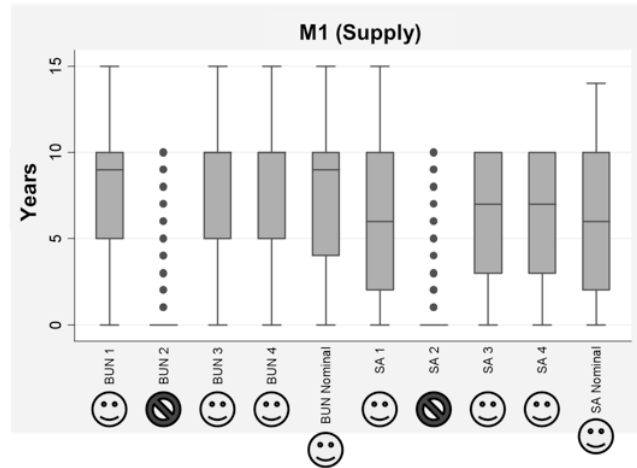


Figure 9: M1 performance of four strategy experiments for standalone (SA) and loan-bundled (LB) schemes. Nominal strategies are shown for reference purposes.

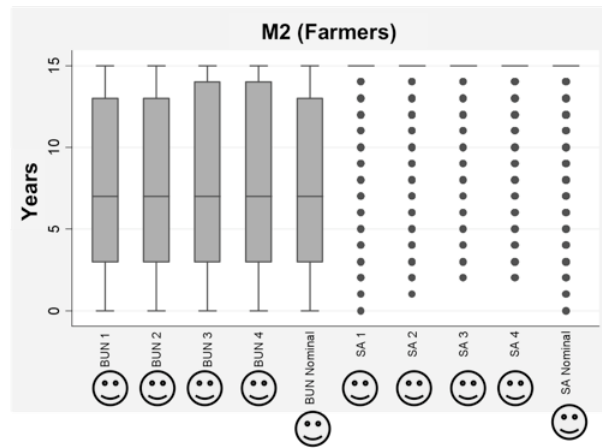


Figure 10: M2 performance of four strategy experiments for standalone (SA) and loan-bundled (LB) schemes. Nominal strategies are shown for reference purposes.

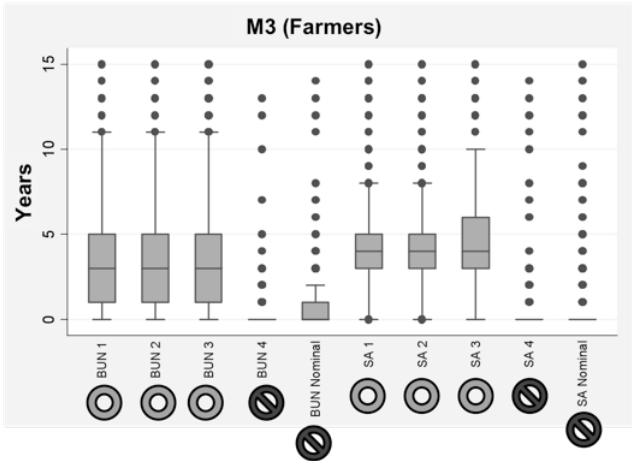


Figure 11: M3 performance of four strategy experiments for standalone (SA) and loan-bundled (LB) schemes. Nominal strategies are shown for reference purposes.

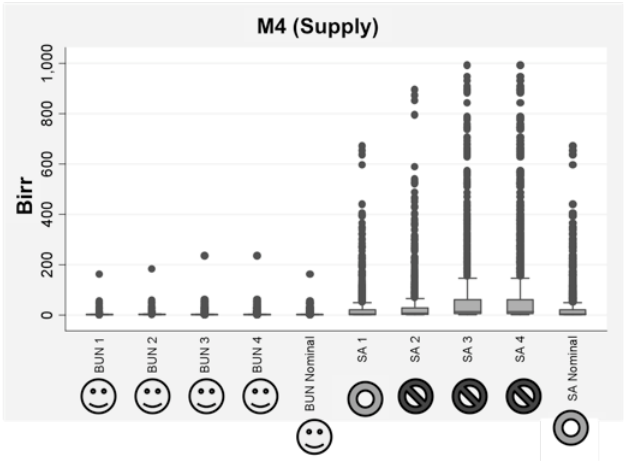


Figure 12: M4 performance of four strategy experiments for standalone (SA) and loan-bundled (LB) schemes. Nominal strategies are shown for reference purposes.

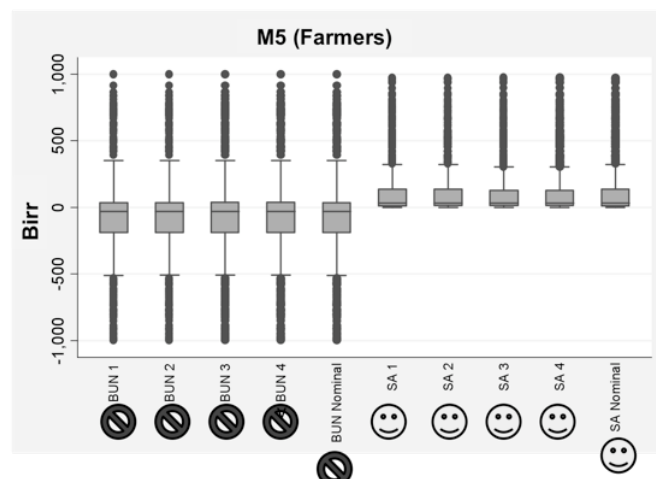


Figure 13: M5 performance of four strategy experiments for standalone (SA) and loan-bundled (LB) schemes. Nominal strategies are shown for reference purposes.

RDM analysis, these considerations were used to quantitatively explore basic criteria for sustainable microinsurance products. Results identify index reliability and correspondingly low basis risk levels as critical for sustaining high quality products that meet farmers' drought risk management needs without overwhelming supply or demand-side capacity. Significantly, however, qualitative results reveal that while potential suppliers agree on the theoretical basis of product sustainability, in practice these criteria are not equally satisfied. Informed by model findings for potentially robust strategies, these results have important implications for sustainable and scalable agent-partner microinsurance.

From a supply-side perspective, although the model's results reflected the importance of index schemes' financial solvency, criteria for assessing long-term financial sustainability differed among potential providers. In the case of international reinsurance companies and Ethiopian insurers such as Nyala, sophisticated actuarial methods are used to assess risks taken on with insurance products to ensure portfolio solvency. In contrast, domestic MFIs lack this underwriting capacity, evidenced by the fact that many MFIs sell credit-life microinsurance products without accounting for solvency measures in product pricing. Rather, low premium rates of 1 to 2% are used, regardless of risk considerations or loan size. Based on these qualitative findings, it is clear that reinsurance and domestic insurance companies, rather than MFIs, presently have the capacity to help develop actuarially sound insurance products.

Regarding demand-side sustainability criteria, while stakeholders expressed an interest in avoiding negative impacts of products on farmer livelihoods, among reinsurers and insurers no formal assessments were conducted, or planned,

to explore actual impacts on livelihoods. Despite the extreme seasonality of income insecurity manifest in the reluctance of farmers to take out loans for fear of default, only informal impact assessments are conducted. Even experienced providers (e.g. ICICI and Nyala) do not investigate policy non-renewal rates. In contrast, the Ethiopian MFIs interviewed in this study actively researched demand-side impacts of loan products through client feedback sessions and exit surveys.

In light of the potential for poorly designed index products to undermine livelihoods, the RDM analysis included these considerations by establishing farmer impact criteria using production outcomes as proxy measures for farmer income. The model demonstrated that high basis risk and unaffordable pricing, with the latter particularly evident in loan-bundled schemes, created hypothetical negative impacts on farmer welfare. Ultimately, qualitative results reveal that, in practice, potential suppliers of drought index-based microinsurance do not place equal emphasis on sustainable supply *and* demand-side impacts of insurance products. Results also suggest that reinsurers and Ethiopian insurers are best suited as risk takers and domestic MFI's as risk aggregators given their respective competencies in ensuring sustainable supply and demand-side impacts.

9.2 Key limitations for informing agent-partner model design

While the model provides a conceptual guide to underlying financial considerations of scheme sustainability, it must be recognized as an incomplete iterative process that requires more information based on stakeholder input and calibration. The model is limited in a number of important respects relating to provider and farmer impacts, among other sustainability and scaling considerations. One unrepresented supplier impact is the concept of portfolio pricing used by providers based on the risk exposure of different geographical regions. In the model, although schemes are fully outscaled, i.e. supply capacity is maximized across the Tigray region, covered farmer populations are assumed to have identical or 100% covariant risk exposure. In reality, drought risk exposure varies considerably across areas. This variability can in turn reduce risk exposures of insurers and reinsurers as microinsurance payouts are more sporadic and staggered, depending on seasonality and local conditions (Osgood et al., 2007: 14).⁶

From the perspective of farmers, limitations relate to both qualitative and quantitative variables as the model does not capture the extent of farmer understanding of schemes or farmer risk aversion to financial activities. The former challenge is compounded by considerations of illiteracy and innumeracy

⁶For work on assessing benefits of spatial pooling of microinsurance schemes to providers using Monte Carlo analysis, see Meze-Hausken, E., et al. (2008): Reducing climate risk for micro-insurance in Africa: a case study of Ethiopia, Journal of Environmental Change, (In Press).

that pose significant barriers to launching, let alone outscaling, insurance products (Teshome et al., 2008: 20). In terms of farmer risk aversion, it was not possible to model the impact of these variables. Additionally, it was also too early to be certain about the amounts of risk an insurer such as Nyala or a reinsurer would be willing to take on, or loan amount or interest rates DECSI MFI will ultimately charge if loan-bundled products are offered.

Although the RDM model was designed to account for these uncertainties, ultimately model sustainability criteria and pricing outcomes can only be proven truly robust when more information from stakeholders is available. Nevertheless, the promise of this model for livelihoods protection in Ethiopia and building justifies further design development.

9.3 Practical implications of results within the Ethiopian context

Despite spreadsheet model limitations, results highlight practical implications concerning the overall interest of stakeholders in drought index microinsurance, and how appropriate scaling these products is within the Ethiopian context.

The first implication derives from many stakeholders' tenuous interest in exploring index microinsurance as a financial risk management tool over other forms of microinsurance products. For interviewed MFIs and farmers, although weather-related risks were named as the greatest source of production risk and uncertainty, death of draught animals or farmer death is what *both* supply and demand-side stakeholders expressed interest in actively mitigating with insurance. In the case of DECSI clients, this is corroborated by results of a microfinance workshop where livestock and farmer life insurance were among the top three insurable risks DECSI and client farmers would like to explore with microinsurance products (MicroSave, 2007). This is also supported by widespread MFI experimentation with credit-life microinsurance products in response to family and group requests to address farmer death as a major cause of loan defaults.

For MFIs like DECSI, choosing to offer such products not only satisfies client demands, but is a more financially prudent investment than index products, given the resource constraints that are reportedly preventing expansion of current MFI loan services. Liquidity problems, exacerbated by the exogenous uncertainty of record economic inflation rates, make meeting current customer needs difficult, and allow for limited investment in new products or outscaling client pools. Furthermore, outside financial assistance is likely to be required to cover high marketing and transaction costs, as well as consultation and data processing investments required to build expertise in launching standalone and/or loan-bundled schemes. It is precisely these practical capacity constraints, in addition to concerns over trustworthiness of business partners serving as risk aggregators, which inspire caution among reinsurers to whom risk pools may be scaled up (Ibarra, 2008).

From a demand perspective, Ethiopian farmers' near or long-term interest in either standalone or loan-bundled products is highly uncertain outside of the Tigray region where the HARITA partners have completed feasibility and demand surveys. This in turn makes the sustainability of index products uncertain if scaled beyond the region. Two reasons undergird demand-side uncertainty, which HARITA is working to address in the study region. Firstly, the extent of farmer understanding of products is hindered by illiteracy and innumeracy, especially among women.⁷ Second, index reliability is extremely uncertain given that only seven years of historical rainfall data for Adi Ha were available for risk assessment. However, similar to ICICI Lombard pilot efforts, promising developments in the use of satellite data in combination with ground-level data were successfully explored to address this issue. Time and client experience will tell if products are effectively marketed, fairly and affordably priced, and not undermined by unreasonable levels of basis risk to maintain farmers' interest. The willingness of farmers to pay is also a significant source of future uncertainty, although HARITA's "insurance-for-work" (IFW) program has met initial success, suggesting that IFW is a potentially important breakthrough in making risk transfer products much more affordable.

In the context of fieldwork observations, it was clear that index microinsurance products needed to be complimented by other risk management activities. Moreover, many challenges to Ethiopian agriculture are rooted in non-weather-related production issues. In the case of Adi Ha, most farmers work on sandy soils and struggle with erosion, exacerbated by a lack of fallowing practices and intensified flooding which farmers attribute to extensive deforestation in the last 30 years, and possibly climate change. More immediate and perhaps effective interventions than index microinsurance may include addressing land preparation, conservation, use of irrigation, improved seed varieties or other production activities. Therefore, initial or complimentary risk reduction interventions need to be weighed along with risk transfer tools like index insurance. These efforts are key pillars in the HARITA project's actual pilot efforts.

10 OVERCOMING SUSTAINABLE SCALING CHALLENGES TO INDEX AGRO-INSURANCE

10.1 *Basic elements of success*

Based on experiences to date and study findings, significant opportunities and challenges arise with index agro-insurance at scale. To overcome challenges in the Ethiopian context, particularly for agent-partner models, basic elements of success appear to include: product affordability, flexibility and predictability

⁷Though it should be noted that in the HARITA project partners' actual experience with popular education methods, understanding in Adi Ha was not a major concern as evidenced by high uptake rates among female-headed households.

for farmers, quantifiable and reliable cost and risk estimates for suppliers, and political and financial support at international, national and sub-national levels.

10.2 Product affordability, flexibility, and predictability for farmers

Anecdotal evidence from field research, namely reluctance to take out even small loans due to default concerns, suggests that Ethiopian farmers are highly risk averse. One study in the Ethiopian highlands found that more than 50% of surveyed households were “severely” or “extremely” risk averse (Yesuf and Bluffstone, 2007: 21). Fueling this risk aversion is the country’s endemic poverty. In 1999/2000, an estimated 44% of the population was living below the poverty line, with the majority dominated by rural farmers (Demeke et al., 2003: 1). Given such severe economic stress, affordability of financial products is key to sustaining demand for products targeting farmer clients. RDM model results analyzing both standalone and loan-bundled index microinsurance revealed that affordable premium rates proved a significant challenge over the long-term. This is in large part due to extremely low production returns from micro-plot farms ranging between 0.5 to 2 hectares in Tigray and the majority of Ethiopian regions.

In light of affordability challenges, innovative distribution models with easy to understand and flexible payment options constitute a basic element of product sustainability and scalability. HARITA’s proposed alternative of using productive labor to buy a microinsurance policy through Ethiopia’s Production Safety Net Programme is one such example. Beyond affordability issues, successful models also rely on the predictability that policies will perform well when unpredictable drought events occur. These concerns underscore the importance of contracts based upon an accurate payout index. In order to benefit from index schemes, there must be significant correlation between droughts signaled by collected data and those experienced on clients’ farms. If this correlation is poor, farmers will not benefit from index insurance as a predictable weather risk transfer tool for improved management decisions, and they will not reinvest in policies.

10.3 Quantifiable and reliable cost and risk estimates for suppliers

As a business opportunity, and given motivations to engage with financially underserved and vulnerable rural populations over large scales, governments, insurers, reinsurers, and other groups are interested in weather index microinsurance. Providing attractive alternatives to costly indemnity insurance, index products offer promising models for minimizing risks of moral hazard, adverse selection, and high transaction costs with respect to poor rural clients. Further challenges posed by these products relate to data availability and associated tradeoffs between index quality and basis risk. Since the majority of developing

countries have sparse and often incomplete long-term historical rainfall or yield records, developers are experimenting with hybrid solutions combining satellite and station data for more robust indices. Such solutions may not only improve index quality at limited cost, but also help standardize scaling methods for data integration (Osgood, 2009). Scalable technical advances may also help lower capacity-related market entry barriers to potential commercial providers such as MFIs that have close community links but limited financial and human resources. Significantly, under agent-partner models, improved transparency and reliability of indices may impart more confidence in local-level agents; further incentivizing insurers and reinsurers to take on upscaled risks.

10.4 Political and financial support for scaling

The importance of government and financial support of sustainable index products at scale cannot be underestimated. Predictable political and financial operating environments are necessary for commercial providers of index products in particular. In Ethiopia, government roles in the microfinance, insurance and banking industries are important for scaling considerations.

At the sub-national level, municipal and regional government involvement in the microfinance industry impacts potential channels for microinsurance delivery based on agent-partner models. In the case of Tigray, the regional government as well as civil society owners require that the leading MFI, DECSI, fulfill the region's own credit needs before outscaling beyond Tigray. As a result, despite DECSI's being one of the largest non-banking institutions in the world, its owners restrict service expansion beyond Tigray (Assefa, 2008). Hypothetical scaling of weather index-based microinsurance throughout Ethiopia with DECSI as an agent is therefore infeasible in the near future; it is unclear that other MFIs could play this role although the PSNP might be a possible alternative.

At the national level, supporting efforts of the Federal Democratic Republic of Ethiopia (GFDRE) have involved domestic and joint international initiatives addressing poverty, food insecurity and climatic vulnerability. Notable poverty and food insecurity alleviation efforts include 1996 proclamations legalizing microcredit, and the ongoing PSNP program, among others (Gobezie, 2005: 4, EC Press Release, 2009). Climate initiatives include a Master Plan to double the density of Ethiopia's meteorological station network and implementation of its national adaptation program of action (NAPA) under the United Nations Framework Convention on Climate Change (UNFCCC) (Tadege, 2008). Through the NAPA initiative, Ethiopia selected drought index and/or crop insurance as its lead adaptation project. However, no delivery model had been identified for executing the insurance proposal (Tadege, 2008).

In the context of sub-national government involvement in finance and insurance industries, and national WFP/WB pilot experiences, the preferred short-term

approach of the GFDRE to index products appear to be based on large-scale public relief channels. The extent of private/public-private development of alternative agent-partner models is uncertain but promising in light of emerging climate change adaptation funds through the UNFCCC and private sector financing. This is supported by positive experiences in the HARITA project to broaden the reach of index products through cash/work-based premium payments; providing affordable services to potentially large client pools in Ethiopia.

11 CONCLUSIONS AND RECOMMENDATIONS

Extensive climatic and socio-economic vulnerability challenging Ethiopia's development requires large-scale solutions that are sustainable and robust against uncertain futures. In this regard, drought index-based microinsurance represents a risk management tool with much potential in Ethiopia. Agent-partner delivery models represent a promising approach to weather risk transfer and poverty reduction, particularly when complimented with risk reduction activities, namely sustainable natural resource management. Based on a conceptual agent-partner model scaled in the Tigray region of Ethiopia, a scenario-based robust decision making method explored, but does not confirm, the sustainability of this approach. Findings revealed important tradeoffs and design considerations that product developers should consider for sustainable pilot or program-level designs. However, more operational experience and design testing is needed.

Key results from quantitative robust decision-making analysis indicate that standalone versus loan-bundled index schemes are more affordable for clients given the limited financial capacity of subsistence farmers. This highlights a decision tradeoff regarding the affordability of different index insurance products with cash-based premium payments. Qualitative results indicate that while MFI and insurance stakeholders are interested in the potential benefits of drought index-based microinsurance, financial capacity is lacking among potential local suppliers to develop these products without some level of outside support. There are also opportunity costs associated with investment in index products given substantial interest among farmers and MFIs in credit-life microinsurance and other production-related risk reduction tools.

Based on quantitative and qualitative results, recommendations can be made regarding the strategic timing and delivery method of weather index insurance provision in Ethiopia. In the near-term, public channels (e.g. PSNP) will likely continue to be the focus of national government actors and their partners. Given existing political will, donor support and established delivery models, public channels facilitate immediate and large-scale solutions to development challenges posed by weather risks. In the mid- to long-term, interested domestic microfinance and insurance industries should continue to develop

service quality, client pools and sound business practices to build capacity for offering sustainable microinsurance products using agent-partner models. The HARITA project's weather index pilot work in Tigray is one such example as local public/private partners develop farmer-focused and innovative services, including work-based premium payments for PSNP and non-PSNP participants, along with risk reduction activities.

Based on model results, providers might consider offering standalone index microinsurance coupled with supply and demand-side assessment criteria to ensure index quality and basis risk do not jeopardize sustainability. Providers might also consider loan-bundled products and upscaling financial risk as reinsurance companies build confidence in on-the-ground delivery agents if sustainability criteria are met. Moreover, national investment in weather infrastructure and innovative satellite-based methods for index development may lower upfront capital requirements, strengthening suppliers' financial capacity to accelerate product outscaling and lower basis risk.

Although the future of weather index insurance is unpredictable, experience to date and study results demonstrate the value of applying basic principles of financial demand and supply-side sustainability to future scaling efforts. These represent first steps towards more holistic index insurance designs that promote constructive development at large scales through weather risk transfer and reduction.

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