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Weather Index Insurance in Sub-Saharan Africa

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Food insecurity is a leading cause of poverty in sub-Saharan Africa. Overcoming food insecurity would improve the health and education of rural populations, increase labour productivity and promote rural economic development. Governments and numerous aid agencies dispense food aid during famines. The recent emergence of weather index insurance offers a promising new risk management tool that enhances economic opportunities and welfare in rural sub-Saharan Africa.

In 2004 MicroEnsure launched Africa's first weather index-based insurance product.[1] In 2008 the International Fund for Agricultural Development (IFAD) and the World Food Programme (WFP) established the Weather Risk Management Facility (WRMF), which supported pilot projects for weather index insurance. In 2009 Kenya Seed, the Syngenta Foundation, UAP Group, Swiss Re and the World Bank's Global Index Insurance Facility (GIIF) joined forces to establish Kilimo Salama, which offered index-based microinsurance to Kenyan maize and wheat farmers, with more crops and livestock being added later. In 2011 WFP and Oxfam America founded the R4 Rural Resilience Initiative, building on the Horn of Africa Risk Transfer for Adaptation (HARITA). In 2013 the AXA Group launched index-based agricultural insurance; in 2014 AXA and the South African Sanlam participated in MicroEnsure; and in 2015 AXA entered into partnership with the World Bank's GIIF. In 2014 Kilimo Salama was succeeded by the Agriculture and Climate Risk Enterprise (ACRE), which assists local insurers in Kenya, Tanzania and Rwanda. After a decade of keen experimentation, the focus has now shifted from pilot projects to scaling up index-based insurance as a risk management tool for smallholder farmers.

Uninsurable Agricultural Risks

Hail insurance emerged in Europe more than two centuries ago but drought insurance has remained elusive to this day. This crucial market failure has persisted even in countries with

sophisticated financial markets such as the United States, Australia and South Africa. Today, farmers can insure crops against a multitude of perils – hail, fire, straying livestock, chemical overspray and more – but drought, which is the most critical peril in dryland farming, remains mostly uninsurable in private insurance markets. Drought insurance is always heavily subsidized by the government where it is widely available, as for example in the United States. The lack of drought insurance for smallholders puts farming communities at risk of famines and inhibits rural investment and economic development in sub-Saharan Africa.

The disparity between hail and drought insurance has prevailed because drought and hail carry different risk attributes. A hail storm is a local event, whereas drought can affect an entire country or group of countries as in southern Africa in 2015/16. Therefore, hail insurance that covers a wide area benefits from the law of large numbers, whereas drought insurance is subject to undiversifiable spikes of losses that even large insurance companies find difficult to absorb. The South African Santam found that capital reserves must exceed premium income at least sixfold for drought insurance, whereas for hail insurance the capital requirement is "a fraction of this."[2]

Besides, insurers face more severe information problems in drought insurance than hail insurance. Farmers cannot materially influence hail losses because hail is a natural hazard outside their control. Although cloud seeding is practiced in many countries, evidence on its effectiveness in mitigating hail damage to crops has remained anecdotal. Cloud seeding may reduce the size of hail stones, which reduces damage to cars, greenhouses and similar structures,[3,4] but even small hail stones can destroy a crop. While hail loss is independent of farm behaviour, drought loss depends on farm management practices that are costly to observe for insurers.

A farmer can mitigate drought risk by choosing drought resistant crops and adhering to the optimal flowering window. Sowing too early exposes winter wheat to frost risk, while sowing too late extends the growing period into the dry and hot summer. To mitigate these risks, flowering can be staggered across a farm's paddocks using different wheat varieties and sowing dates. As frost risk is high in lower lying parts of undulating land, it may be expedient to sow late in those locations and accept a greater heat risk later in the season. Another trade-off exists between plant density and drought risk. High plant density raises potential yield but produces more evaporation through leaves. During a drought, a densely planted field may suffer but there may be enough residual soil moisture carried over from the previous growing season to sustain a field with low plant density. Depending on soil type, the roots of wheat can reach this moisture as far down as two meters. The typical root length for maize and soybean is 1.5 to 1.8 meters. A prudent farmer also considers seasonal weather forecasts, which are based on the EL Niño Southern Oscillation around the Pacific and Indian Oceans. Clearly, at the time when an insurance contract is being written, an insurance company does not know whether a farmer is able and willing to follow these best drought risk management practices.

Weather Index Insurance

Weather index insurance takes advantage of recent advances in weather monitoring technology. Weather stations collect data that are used to construct an index that measures local climatic conditions. The novelty is that insurance payouts are based on a weather index and not on actual crop loss as in traditional loss-indemnifying insurance. Thus, all insured farms within the range of the weather station will receive the same payout per acre of crop if meteorological conditions are unfavourable, irrespective of actual farm loss. The challenge is to devise an index that translates the many dimensions of weather – temperature, rain, atmospheric moisture, wind speed and sunlight – into a single number that correlates closely

with crop yield or income from livestock. Data-intensive techniques are required because weather conditions affect plant growth differently during successive phases of the crop cycle. For example, maize is most vulnerable during the reproductive phase, whereas the sensitivity of wheat is about the same during the vegetative and reproductive phases.[5] For the Kilimo Salama project weather stations recorded climatic conditions every 15 minutes, in order to detect adverse intraday weather events.

Weather index insurance eliminates most administrative costs associated with traditional crop insurance that indemnifies farmers for actual losses. Using a weather index to estimate crop damage renders insurance payouts independent of farm-specific risks and farm behaviour. Therefore, there is no need to distinguish between high risk and low risk farms when an insurance contract is being written and for monitoring farm management during the crop cycle. Traditional agricultural insurance is unavailable in sub-Saharan Africa because it is impractical to assess and monitor millions of smallholders, who often live in remote locations that are hard to reach. Index insurance does away with costly farm visits by insurance agents who sell policies and loss assessors who verify claims. These savings of administrative costs enable insurers to offer microinsurance to smallholders with plots of land that are as small as one acre.[6]

Index insurance and mobile money are complementary financial innovations that are transforming rural life in sub-Saharan Africa. Money transfers through mobile phones increasingly provide a substitute for cash payments for disadvantaged groups that do not have access to banking services.[7] Collaborating with the M-Pesa money transfer service in Kenya, ACRE/Kilimo Salama pioneered the sale of index-based insurance using mobile technologies.[8] Mobile phones provide a cost-effective distribution channel for weather index insurance because insurers need no farm-specific information that requires verification. A farmer simply applies for insurance through the mobile phone and weather index-based

insurance payouts are transferred into the policy holder's wallet at the money transfer service. The closest weather station can be determined by triangulation of the mobile phone or GPS. ACRE also gives farmers who are unfamiliar with mobile phone services and mobile money the option to purchase insurance through local agro-dealers.

Weather index insurance, however, does not give a firm amount of income protection. It differs from traditional crop insurance as it involves so-called basis risk, which is the risk that a farmer may be underpaid or overpaid after a loss event. Basis risk arises if the weather index and farm output are poorly correlated. There are many reasons for basis risk: it is high when a weather station covers a large area with different microclimatic conditions and soil types, and it also depends on farm behaviour. The African Risk Capacity (ARC), which was established by the African Union in 2012, serves as a risk pooling facility for member countries. During the drought in southern Africa in 2015/16, the insurance protection that the Malawi government had bought on behalf of farmers from ARC proved to be inadequate to cover crop losses. The index failed because farmers had switched to a maize variety with shorter growing cycle, making it more vulnerable to drought than assumed by the architects of the index.[9,10]

A risk-averse farmer would always buy weather index insurance if there were no basis risk and the insurance premium were actuarially fair. Under these assumptions, weather index insurance second-order stochastically dominates no insurance because it would reduce the dispersion of farm income without reducing its expected value. In practice, basis risk impairs the effectiveness of index insurance as a risk management tool and insurance premiums are not actuarially fair because insurers must recover administrative costs and earn a capital return. Recent field studies indicate that basis risk reduces the demand for weather index insurance, possibly explaining the low participation rate of farmers in some pilot projects.[11, 12, 13, 14, 15] To make weather index insurance more attractive in the presence of basis risk and

premium loadings, insurance is being linked to the provision of credit for seeds.[16] 97 percent of farmers insured by Kilimo Salama received loans linked to insurance.[17]

An intense research effort is underway to develop weather indices for different crops and locations that minimize basis risk. The calibration of a weather index as proxy for regional farm yield requires about 10 to 20 years of weather data and area yields. As these data are often not available in sub-Saharan Africa, insurers increasingly rely on satellite observations to determine local growing conditions. ACRE, for example, has constructed indices that combine data from weather stations with area yield statistics and high-resolution satellite data, while the International Research Institute for Climate and Society (IRI) uses satellite observations on evaporation, rainfall, soil moisture, vegetation and landscape at the village level.

Challenges

ACRE supports the largest index-based insurance programme in sub-Saharan Africa. In 2015 it headed a consortium of UAP Insurance, APA Insurance and SORAS Group that insured 394,426 farmers in Kenya, Tanzania and Rwanda, with Swiss Re and Africa Re providing reinsurance. Cumulatively, by 2017, over one million farmers had bought insurance products that had been designed by ACRE.[18] Despite this impressive number of participants, agricultural insurance penetration has remained low. Only a small fraction of farmers was reached in those three countries whose total population is about 110 million people, with more than half of the workforce being employed in agriculture. In Kenya the potential market for index insurance attached to maize seeds exceeds seven million farms or about 35 million people.[19]

The transition from pilot projects to large-scale provision of microinsurance to smallholders remains challenging. The pilot projects benefited from technical and financial support of

governments, insurance companies and aid organizations. All pilots relied on donor money during the set up phase and they have generally not become self-supporting at the operational stage. Even with the large cost savings, weather index insurance is not cheap. Kilimo Salama's loss ratio, which is calculated as insurance payouts divided by premium income, averaged 61 percent from 2010 to 2014.[20] This implies a loading of 64 percent above the actuarially fair insurance premium that had to be borne by insurance buyers or donors. Average cost of insurance amounted to 5 to 25 percent of the value of insured inputs or harvest.[21] ACRE relied on donors to start operations in 2014 and some donor money has been directed to premium subsidies since then.[22] A notable exception is the R4 Rural Resilience Initiative, which now reaches 40,000 farmers in Ethiopia, Senegal, Malawi and Zambia. R4 operates without premium subsidy but donors are invited to support the expansion of its insurance programme.

Weather index insurance holds immense promise for rural economic development in sub-Saharan Africa. If successful, it would allow smallholders to stay on the land when crops fail and livestock perish. It would protect the livelihood of smallholders from climate risk and furnish them with the financial means to replant crops after a drought. Agricultural microinsurance promotes rural economic development by enhancing the creditworthiness of smallholders and stimulating farm output and investment.[23] The greatest challenges, however, remain the construction of weather indices with low basis risk and the education of insurance professionals who can advance the insurance industry in sub-Saharan Africa. There is a demand for mathematicians who can analyse the vast amount of data supplied by weather stations and satellites and for local insurance professionals who set up distribution channels for index-based agricultural microinsurance through mobile phone services and networks of local agents and agro-dealers. This creates an exciting opportunity for teachers and researchers who are enthusiastic about economic and social progress in sub-Saharan Africa.

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