CHAPTER 6

Insurance Opportunities against Weather Risks for Smallholder Farmers in Africa

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In Africa, agriculture is the dominant source of livelihood for the poor, particularly in rural areas, where the majority resides. This sector employed about 60 percent of Africa's labor force in 2010, and more than 80 percent in some countries (FAO 2017). African agriculture is typically rainfed and occurs predominantly on smallholder farms of less than 2 hectares. In Africa south of the Sahara (SSA), rainfed agriculture accounts for more than 95 percent of farmed land (Wani, Rockström, and Oweis 2009), and smallholder farms represent 80 percent of all farms and up to 90 percent of production in some countries (Wiggins 2009). Smallholder farmers largely grow for subsistence purposes, usually using few to no modern inputs (such as fertilizer, high-yielding seeds, or irrigation), with some growing cash crops for income or engaging in livestock rearing, a combination of crop and livestock farming, or off-farm activities.

Extreme weather events can devastate crop yields and food production, adversely impact food security and nutrition, and erode the livelihoods and assets of the poor. The rainfed nature of African agriculture is often characterized by low productivity and thus subject to a wide range of weather risks such as extreme temperatures or rainfall, as well as weather-related hazards such as pests, diseases, and reduced accessibility to cultivated fields and roads. Weather-related hazards can also be transmitted to other segments of the agricultural supply chain, such as processors, wholesalers, and transporters, and also to other sectors that support agriculture, such as banking, for instance through loan defaults (Ceballos and Robles 2014).

In this context, the poor are disproportionately affected by extreme weather. Total crop and livestock loss can threaten the food security and nutritional status of entire communities. Moreover, the poor are at higher risk from vector- and waterborne diseases. Through their effects on health condition and nutritional intake, temporary weather shocks can thus induce permanent negative shocks to human capital.[25] Finally, a decrease in nonfarm employment availability may follow extreme weather events, further damaging the poor's livelihoods and their ability to recover.

For instance, the 2011/2012 drought in the Horn of Africa severely impacted food production as well as livestock and pastoral systems. The drought induced alarming rates of malnutrition among young children and an estimated 13 million people in need of humanitarian assistance (Slim 2012). The 2015/2016 El Niño cycle was related to both droughts in southern and eastern Africa and flooding in parts of eastern Africa, devastating agricultural production and threatening the food security and well-being of millions of people. Extreme weather events can also cause long-lasting damage to poor communities through the destruction of infrastructure (roads, schools, and hospitals), with staggering costs of recovery and rebuilding. For example, the 2013 flooding in Mozambique damaged health clinics and resulted in humanitarian and recovery costs estimated at US$30.6 million (UNRCO Mozambique 2013). In Kenya, the 2008–2011 drought caused a total of US$10.7 billion in damages and losses, of which nearly US$9.0 billion was in the livestock subsector alone, US$91.0 million in the food processing industry, US$1.5 billion in crops, US$53.0 million in fisheries, and US$85.0 million in nutrition (FAO 2015).

Climate change is projected to result in more frequent and intense droughts and heat extremes in central and southern Africa as well as

25 McIntosh (2015) highlighted considerable drops in consumption and food security resulting from the effects of severe weather shocks on the agricultural sector in Uganda.

increased precipitation and flooding in the Horn of Africa and other parts of eastern Africa (World Bank 2013). Moreover, climate change will likely exacerbate cyclical weather events such as La Niña and El Niño, resulting in even more frequent and severe droughts and floods. In addition, climate change is projected to increase risks from vector- and waterborne diseases in Africa (World Bank 2013).

In this context, it is crucial for smallholder farmers to rely on efficient protection mechanisms against these impending risks. But traditional indemnity agricultural insurance has not been able to reach rural communities in Africa at a large scale, mainly due to high distribution and loss verification costs and information asymmetry problems between farmers and insurers.

In the absence of well-functioning weather insurance markets, African smallholder farmers have typically resorted to informal and semi-formal risk-coping strategies to deal with weather-related shocks. However, traditional informal strategies such as savings, credit, borrowing from friends and relatives, and diversifying income sources have shortcomings. Savings can easily be diverted to more pressing household demands before weather shocks occur, credit can be expensive and out of reach for poor farming households, and extreme weather events can affect entire geographic areas and thus preclude the possibility of seeking help from social networks or off-farm activities.

Therefore, innovative strategies and insurance mechanisms are needed to help smallholder farmers adapt to the effects of extreme weather events. Over the past few decades, weather index insurance has been increasingly regarded as an important alternative for protecting farmers against weather shocks and for enabling investment and growth in the agricultural sector (Greatrex et al. 2015). Weather index insurance can thus become an important part of the climate-smart tool kit for increasing agricultural productivity and incomes by allowing smallholder farmers to adapt and build resilience to weather shocks. In addition, the safeguards provided by insurance may enable farmers to access credit and adopt riskier but higher-yielding technologies, raising their productivity and improving their incomes.

Against this backdrop, this chapter highlights insurance opportunities for protecting smallholder farmers against weather-related risks. It is organized as follows: the next two sections outline the different types of, respectively, traditional and formal coping strategies against weather risk. Subsequent sections discuss Africa's experience with formal risk-coping strategies, including weather index insurance, and explore linkages and complementarities between weather-related risk-coping strategies and climate-smart agriculture, as well as new developments and opportunities for scaling up weather index insurance. The final section highlights key messages and policy implications for achieving the Malabo Declaration goal of enhancing the resilience of livelihoods to weather shocks.

Traditional Risk-Coping Strategies

In the absence of efficient and widespread tools to cope with weather risks, rural households in developing countries have traditionally resorted to a number of different informal risk-coping mechanisms for protecting their livelihoods from unexpected shocks.

The most universal of these is probably savings. Households around the world understand the benefits and generally pursue the holding of savings. Savings, however, can take several forms: although many people save in cash, others save by building up assets (even small-scale assets, such as poultry or livestock); although many prefer saving in a bank, some still choose saving under a mattress. A buffer of savings can certainly help when a negative event affects the household. Yet there are drawbacks. Banks fail; animals age and become sick; money stuck away can catch fire, get flooded, or become food for insects and other creatures. In addition, households exist socially, and readily available stocks of money are regularly under pressure for alternative uses by the household or for the needs of others.

A second strategy, closely related to savings, is formal or informal credit. Savings and credit are both mechanisms that turn a stream of small amounts of money into one larger lump sum. The difference is that in credit, the lump sum comes first, with the stream of small payments following it, whereas for savings, the process is the reverse. In addition, credit bears a cost in the form of interest, but so do savings, which are prone to the above-mentioned risks and subject to loss of value through inflation (in the case of cash) and price fluctuations (in the case of savings in kind).

However, neither credit nor savings is a good form of insurance, principally for reasons of timing: when needs arise unexpectedly, credit may be in high demand or simply not available, and savings stocks may not yet be sufficient to be of help. Moreover, formal credit is not available to all, particularly the poorest households, who often lack required collateral. Informal credit (that is, from local moneylenders) generally comes with high interest rates that can quickly turn a small, temporary shock into an untenable burden if not handled appropriately—particularly a problem in poor rural communities with low education levels and a lack of overall financial literacy.

To overcome these limitations, households resort to other types of informal mechanisms when disaster strikes, usually borrowing from other households in their social network, including family and friends. This type of informal insurance can be effective, timely, and overall, inexpensive relative to other alternatives. Nevertheless, though loans and gifts from other households have the potential to protect from idiosyncratic shocks (that is, unexpected losses that affect a limited number of households within a locality or social network), they are ill suited to protect against systemic (or generalized) shocks, which affect most households in a given region and thus undermine their capacity to support each other.

Certain types of semiformal insurance have sprouted over the last few decades (though they have much older historical roots). One example is burial societies, particularly common in Africa, whereby households come together into informal groups and regularly contribute a small amount in exchange for a—generally fixed—larger payment in the event of a death in the family. Unfortunately, these kinds of institutions are rarely available to handle agricultural risks. Other semiformal institutions prolific in Africa are rotating savings and credit associations (ROSCAs), which consist of a self-organized group of individuals who contribute a small amount of money at fixed periods of time (such as every week), the total of which is assigned each period to a different member of the ROSCA as a lump sum to be used at the individual's will. Even though several variations exist on the ROSCA model, they all generally suffer from the same issues as the other strategies mentioned above, such as imperfect timing and an inability to help under systemic shocks that affect all households.

A final important way in which agricultural households regularly protect themselves from weather and other risks is by diversifying their income sources. Diversification can take shape either through carrying out different agricultural activities (such as staggering the planting of crops or choosing a mix of crops with different sensitivities to weather events) or through engaging in other agricultural and rural nonfarm activities. A related strategy is that of reducing agricultural risk exposure by either planting crops less vulnerable to weather risks or choosing more resilient crop varieties. Unfortunately, these alternatives often generate lower profit and have lower yield potential, thus precluding the household from increasing its income and escaping poverty.

All in all, though they are important and essential for dealing with a large array of shocks, most traditional risk-coping strategies are costly and have limited risk-mitigation potential for systemic weather risks (Townsend 1994). Informal savings are perhaps too costly for a population that probably should better invest its resources in assuring adequate food intake for household members, in improving human capital, and in seizing productive opportunities. In addition, diversification strategies may come at an efficiency cost—that is, they may impede rural farmers from capturing the full range of benefits from specialization or keep them from investing in risky capital and technology with higher expected incomes.

Formal Risk-Coping Strategies

Formal risk-sharing mechanisms take advantage of the fact that, across a large enough population, only a fraction of individuals may suffer a negative shock. For example, in a given year, only a small fraction of drivers will be involved in a car accident. By pooling risks within a large population, formal insurance programs can provide an efficient risk-sharing mechanism in which all contribute with premiums but only those who experience a loss get compensated. Furthermore, because insurance markets can pool risks across a broad scope of activities and large geographic areas, they can lower the costs of dealing with systemic risks through diversification. The most common type of insurance is known as *indemnity insurance*, whereby compensation relies on identifying specific losses and indemnifying the individual against them.

Although in theory, the same principles should be applied to weather risks and rural populations, the reality is that most countries lack standard indemnity agricultural insurance markets (with the exception of certain developed countries or large subsidized systems in a few developing ones, usually involving considerable public intervention). Multiple-peril crop insurance, for example, which can protect against any source of risk affecting yields, has been unsuccessful commercially without large subsidies. Single-peril crop insurance, which covers against a specific factor affecting the crop (such as hail or wind), has had more success, though it has been developed only at modest scales (Smith and Goodwin 2010).

There are a number of reasons why agricultural indemnity insurance has failed to expand successfully in developing countries, including those in Africa. Possibly the most important is that among small farmers the costs of loss verification, which typically requires a site visit, can be substantial relative to the sum being insured, especially when rural infrastructure is inadequate. Moreover, the lack of formal financial service networks and legal records may add to the cost of premium collection and compensation disbursement. Second, indemnity insurance is prone to significant information asymmetry problems, such as adverse selection (whereby only the most at-risk farmers purchase insurance) and moral hazard (whereby an insured farmer may not exert optimal effort to reduce risk or mitigate its impact), both of which generally result in an increased cost (Hazell, Pomareda, and Valdes 1986).

In view of these market failures, an increasing trend has been to explore an alternative type of weather insurance product for smallholder farmers (Hazell et al. 2010). Under weather index insurance, a somewhat recent innovation that is possibly more suitable for rural areas in developing countries, farmers get a pre-specified compensation according to the value of a particular weather variable (the index).[26] For instance, an index insurance product against drought would pay farmers when rainfall (as measured at a specific weather station or by satellite images) is less than a certain predefined "trigger," generally with higher payments the lower the recorded rainfall is. The key assumption is that by carefully selecting a weather index, one should be able to estimate agricultural losses with a sufficient level of confidence.

Some regard index-based insurance as having great potential to reach smallholder farmers in developing countries because (1) payouts are based only on publicly observed data (the index), drastically reducing loss verification costs; (2) adverse selection and moral hazard problems are minimized;[27] and (3) compensations can be automatically determined and thus disbursed quickly to farmers, making insurance easier and cheaper to administer, and thus potentially more affordable for the rural poor. These characteristics of index insurance have attracted donors and governments alike. Over the past two decades, many international organizations, researchers, and microfinance institutions have conducted pilots in developing countries, including several African ones, to demonstrate the advantages of index insurance and learn the best implementation practices, with the general aim of scaling up these pilots (Hazell et al. 2010).

In general, index insurance pilots in developing countries have repeatedly experienced low uptake, which has been linked to certain constraints such as lack of trust in the insurance company, lack of understanding of the product, and liquidity constraints (Cole et al. 2013, Matul et al. 2013). Though all of these constraints are also applicable to traditional indemnity insurance, there is one disadvantage that is unique to index insurance: basis risk. Basis risk arises due to an index's inadequacy to perfectly capture the individual losses of an insured farmer, which can be related to a number of factors. First, the index is generally measured at a local weather station (or through not-fully-accurate satellite imagery), not at the farmer's plot.

26 A slightly different type of index insurance, area-yield insurance, does not rely on a weather variable as its index but instead focuses on whether the average yield over a specified area is greater or less than a threshold.

27 Because losses are assessed not directly but only through the value of an objective index, the farmer's effort does not affect the probability of a payout—thus moral hazard considerations are dealt with. Additionally, because the probability of a payout is assessed objectively from the historical values of the index, the insurance company should not be concerned about which type of farmer buys this insurance—thus adverse selection is dealt with. However, under some circumstances, temporal adverse selection may still be present, whereby farmers buy the insurance product only in seasons in which payouts are expected to be higher (relying, for instance, on weather forecasts or levels of soil moisture at the beginning of the season). Although such behavior would tend to undermine an insurance product's sustainability, it can be generally dealt with by, for instance, controlling the time frame during which farmers can purchase insurance.

Second, a simple weather index cannot capture the interplay of weather variables (temperature, rainfall, humidity, evapotranspiration, winds, and the like), nor can it account for variability in crop variety, soil quality, and farming practices. Third, other, nonweather events, such as pests and diseases, may impact crop growth. Hence there is a chance that a farmer, after having paid the premium, will not get a compensation even after experiencing a loss. On the other hand, it is also possible that a farmer will get compensation without experiencing a loss.

Despite these obstacles, there have indeed been a number of seemingly successful implementations of index insurance. In India alone, more than 9 million farmers annually purchase these hedging products to insure against weather risk (Clarke et al. 2012), although this high uptake can be partly explained by the fact that agricultural insurance is mandatory in order to gain access to subsidized agricultural loans from the government. In the United States, a large federal index-based insurance program protects farmers against a variety of weather risks, although the system is highly subsidized. In Africa, some index insurance experiences have been relatively successful, such as the R4 Rural Resilience Initiative, which has helped to increase the resilience of farming households to weather-related shocks in Ethiopia and Senegal. This and other examples of Africa's experience with risk-coping strategies are discussed next.

Africa's Experience with Risk-Coping Strategies

Insurance services are still very much underprovided in Africa. According to Assah and others (2017), in Senegal, 18,540 producers benefited from a policy against drought in 2015, whereas close to 700,000 farmers remained without coverage. In Mali, only 30,000 farmers, fewer than 1 percent of the total, were insured in 2014. In addition to information asymmetry problems, other factors constraining the development of insurance markets in Africa include illiteracy among farmers, their inability to service loans, limited solvency among insurers, and a hostile regulatory environment in some countries (Assah et al. 2017). Mahul and Stutley (2010) reported that government support for agricultural insurance premiums is very small in Africa. For example, governments cover only 3 percent of agricultural insurance premiums on the African continent, compared with 50 percent in Asia and 73 percent in the United States and Canada.

Nonetheless, promising examples are burgeoning across Africa, thanks to financial and technological innovations in the insurance sector, as well as overall economic progress. As argued above, one of the most promising innovations in agricultural insurance is index-based insurance. Therefore we focus below on successful index insurance case studies on the continent.

R4 Rural Resilience Initiative in Ethiopia, Malawi, Senegal, and Zambia (Formerly Horn of Africa Risk Transfer for Adaptation Project–HARITA)

In Ethiopia, several projects tackling agricultural resilience have incorporated index-based insurance (Table 6.1). Examples of these programs include the R4 Rural Resilience Initiative, the Horn of Africa Risk Transfer for Adaptation project (HARITA), and the Rural Resilience Enhancement Project, which have been implemented by the Ethiopian Insurance Corporation, the World Bank, the UN World Food Programme (WFP), Oxfam America, and the Japan International Cooperation Agency.

TABLE 6.1—PILOT AGRICULTURE INSURANCE PROJECTS IN ETHIOPIA

Subsector	Weather index insurance	Indemnity insurance
Crops	• World Bank initiative for maize in Alaba *woreda* • Nyala Insurance Company (NISCO) / World Food Programme / Lume Adama Farmers Cooperative Union for beans in Bofa (Boset *woreda*) • Horn of Africa Risk Transfer for Adaptation program by Oxfam America and consortium of partners in Tigray Region • International Food Policy Research Institute and consortium of partners for bundle of prevalent crops in SNNPR and Oromia regions	NISCO multiperil crop insurance for teff, wheat, lentils, beans, and chickpeas in Oromia Region
Livestock	International Livestock Research Institute's (ILRI) index-based livestock insurance (IBLI)	Pilot of high-value livestock insurance by World Bank and Association for Ethiopian Microfinance Institutions

Source: Bhushan et al. (2016).
Note: A *woreda* is a local administrative division in Ethiopia. SNNPR = Southern Nations, Nationalities, and Peoples' Region.

TABLE 6.2—EXPANSION OF HORN OF AFRICA RISK TRANSFER FOR ADAPTATION (HARITA) PROJECT / R4 RURAL RESILIENCE INITIATIVE

Year	Number of farmers insured	Total premiums (in US$)	Total sum insured (in US$)	Total payouts (in US$)	Countries
2009	200	2,500	10,200	0	Ethiopia
2010	1,300	27,000	73,000	0	Ethiopia
2011	13,000	215,000	940,000	17,000	Ethiopia, Senegal
2012	18,000	275,000	1,300,000	320,000	Ethiopia, Senegal
2013	20,000	283,000	1,200,000	24,000	Ethiopia, Senegal
2014	26,000	306,000	1,500,000	38,000	Ethiopia, Senegal
2015	32,000	370,000	2,200,000	450,000	Ethiopia, Senegal, Malawi, Zambia

Source: WFP (2017).

R4, in Ethiopia and Senegal, is perhaps one of the most successful initiatives for enhancing agricultural resilience. Before launching R4 in 2011, however, the Ethiopian Insurance Corporation, in partnership with the World Bank, had launched an index insurance program for Ethiopian farmers in the form of a deficit rainfall index insurance for maize in 2006. Unfortunately, this initiative encountered many challenges—especially lack of sufficient data—that limited its expansion. Greatrex and others (2015), for instance, highlighted inefficiencies in data collection from weather stations, limited financial capacity of cooperatives, and limited bank involvement due to the cost and time associated with incorporating weather risk assessments into their procedures.

Then in 2009, Oxfam America and the Relief Society of Tigray launched HARITA, initially covering 200 Ethiopian farmers. Building on the success of HARITA, Oxfam America and partners launched R4 in Ethiopia in 2011 and eventually expanded it to Senegal (Greatrex et al. 2015). By 2014, growth of the program was impressive: more than 24,000 farmers in Ethiopia and 2,000 in Senegal were covered (Table 6.2). And in 2015, R4 distributed about US$450,000 in payouts to 43,000 farmers in Ethiopia, Senegal, and Malawi. One of the key features that R4 borrowed from HARITA that is perhaps responsible for a large portion of its success was the concept of "insurance for work," which allowed poor farmers to afford insurance by paying for it through their own labor in resilience-related community projects.

Currently operating in Ethiopia, Malawi, Senegal, and Zambia, the R4 program is based on four risk-management strategies: building risk reserves (savings); promoting risk reduction (through growth of assets); prudent risk taking (relying on microfinance and diversification); and risk transfer (index insurance), which allows for the transfer of components of risk that cannot be mitigated by using the other strategies. In addition, the program is complemented by training for farmers on the properties and application of index insurance and on risk management principles.

Madajewicz, Tsegay, and Norton (2013) evaluated the impact of the R4 program and found that among insured farmers, the level of grain reserves had increased, savings had more than doubled (a 123 percent increase on average), and the number of oxen owned had increased by 25 percent. Vulnerable groups, particularly women farmers, had benefited significantly from the program. In comparison, uninsured farmers did not fare as well. In Senegal, an impact evaluation by WFP and Oxfam America (2015) revealed that in the presence of the same shocks, farmers who had enrolled in the R4 initiative fared better in maintaining their food security than those who had not enrolled.[28]

[28] In particular, enrollees' food consumption score (FCS) dropped from 59.02 to 56.24 between 2013 and 2015, whereas nonparticipants' FCS witnessed a decrease from 56.2 to 28.6 in the same period.

Agriculture and Climate Risk Enterprise (ACRE) in Kenya, Rwanda, and Tanzania (formerly Kilimo Salama)

In 2009, the Syngenta Foundation launched Kilimo Salama in Kenya, with a pilot project offering index insurance to 200 farmers. By 2012, the insurance program had more than 51,000 subscribers in Kenya and 14,000 in Rwanda (IFC 2013). In Kenya, premium payments averaged 19 million Kenya shillings (KSh) in 2011 and KSh 33 million in 2012. In 2014, the program was transferred to Agriculture and Climate Risk Enterprise Inc. (ACRE), a for-profit enterprise. By 2016, ACRE had more than 1 million subscribed farmers in Kenya, Rwanda, and Tanzania, insuring more than US$56 million in crops against various types of weather risks (ACRE 2017).

ACRE is an insurance agent and surveyor based in Kenya, Rwanda, and Tanzania. It operates as an intermediary institution among different stakeholders along the agricultural insurance value chain. ACRE's primary goal is to help insurance companies add index products to their portfolios, using actuarial and product development expertise. Participating stakeholders include local insurers (who carry risk, document policies, and pay claims), reinsurers (who price policies and reinsure risk), farmers (who access insurance services), and farmer aggregators (organizations insured on behalf of farmers, such as banks, microfinance institutions, and agribusinesses).

ACRE is considered the largest commercial (that is, with farmers paying a market premium) index insurance program in developing countries and the largest agricultural insurance program in SSA (Greatrex et al. 2015). It is also the first-ever agricultural insurance program to reach smallholder farmers using mobile phones. ACRE offers a wide range of products, such as indemnity coverage, dairy insurance, hybrid seed index insurance, and multiperil crop insurance, and uses several data sources for its indexes, including automatic weather stations and remote sensing technologies. Targeted crops under the program include maize, sorghum, coffee, sunflowers, wheat, cashew nuts, and potatoes, with coverage against drought, excess rain, and large storms. The insurance operates through three main channels: the distribution of seeds via mobile phone network location services; agribusinesses; and banks, microfinance institutions, and credit cooperatives along the agricultural value chain. By facilitating enrollment and electronic payment, M-Pesa[29] is arguably one of the most important factors behind the program's success. Overall, ACRE's success is credited to the involvement of a wide range of partners, including government institutions (ministries of agriculture and national meteorological services), financial institutions, mobile network companies, research institutions, and insurance and reinsurance companies.

Index-Based Livestock Insurance (IBLI) in Kenya and Ethiopia

The index-based livestock insurance (IBLI) program in Ethiopia and Kenya was launched in 2010 with the objective of improving the resilience of pastoralist households against droughts and facilitating investments in livestock and access to credit (Mude et al. 2010; Miranda and Mulangu 2016). The International Livestock Research Institute (ILRI) teamed up with the University of California, Davis, to design an index-based livestock insurance relying on the normalized difference vegetation index (NVDI). The NVDI is calculated from remotely sensed satellite measurements and used to estimate the availability of forage for livestock. The project derived a statistical relationship between the NVDI and livestock mortality data to serve as a basis for insurance payouts. In February 2017, the government of Kenya, in partnership with Kenyan insurers, announced payments to more than 12,000 pastoral households under IBLI.

At least 4,000 pastoralists in both Ethiopia and Kenya were covered by IBLI in 2015. The program provided substantial benefits to households, who were less likely to sell their livestock and in some cases increased their number of livestock and improved their overall food security (Janzen and Carter 2013). Thanks to the substantial learning process from experiences on the ground, the IBLI initiative keeps expanding across Kenya. After the historic 2016 drought in northern Kenya, which caused the worst forage scarcity in the region for 16 years, more than KSh 214 million was disbursed in payouts to 12,000 pastoral households in 6 counties.

In 2015, the government of Kenya, supported by the World Bank, launched the Kenya Livestock Insurance Program (KLIP) using a design based on the NVDI. In October 2015, KLIP covered the livestock of 5,000 pastoralists in 2 counties (ILRI 2017). Further expansions are planned in 2017.

Other Index Insurance Experiences in Africa

As a whole, the African continent has been at the vanguard of index insurance's upward trend during the past decade. Though the previous subsections have focused on the most important experiences, a detailed account of the remaining ones is beyond the scope of this chapter. In order to fill this gap, Table 6.3 summarizes other weather index insurance projects conducted across a number of African countries.

[29] M-Pesa is a mobile phone–based money transfer, financing, and microfinancing service, launched in 2007 by Vodafone for Safaricom and Vodacom, the largest mobile network operators in Kenya and Tanzania.

TABLE 6.3—SUMMARY OF KEY AGRICULTURAL INSURANCE INITIATIVES IN AFRICA

Country	Description
Ghana	• Under the Ministry of Food and Agriculture, the government launched the Ghana Agricultural Insurance Pool in 2011, with 19 Ghanaian insurance companies participating. • Pool products focus on drought index insurance for maize, soybeans, sorghum, and millet; however, there are few multiperil crop insurance plans for risk experienced by commercial farmers and plantations.
Kenya	• In addition to the projects described above, the government of Kenya launched the Kenya National Agricultural Insurance Program (KNAIP) in March 2016, focusing on insurance for maize and wheat crops and for livestock. • KNAIP will follow the area yield–based approach: the farming area is divided into insurance units, and if the average production in an insurance unit falls below a threshold yield (based on the historical average yield for that unit), the insured farmers within the insurance unit receive a payout. • Implementation of the program started in three counties, Bungoma, Embu, and Nakuru, and will be extended to 33 of the country's 47 counties by 2020.
Malawi	• In 2005, the World Bank, in collaboration with Malawi's National Association of Small Farmers, developed an index-based crop insurance contract. • The pilot was implemented in the areas of Kasungu, Nhkotakota, Lilongwe North, and Chitedze. • In 2005, 892 groundnut farmers purchased weather-based crop insurance policies for total premiums of US$36,600. • In 2007, the pilot was expanded to cash crops. By 2008, the number of participants had increased significantly, with 2,600 farmers buying policies worth US$2.5 million.
Mali	• PlaNet Guarantee (an international microinsurance facilitator) sold its first insurance products in 2011 for maize crops; roughly 14,000 farmers were insured in 2014. • A second product was launched in 2011, a satellite-based index insurance for maize and cotton in partnership with Allianz; 17,481 policies were sold in 2014.
Mozambique	• In late 2012, two pilot projects were started by Guy Carpenter & Company LLC in conjunction with the Asia Risk Centre, including weather index–based insurance products covering two crops: maize in the district of Chimoio and cotton in the districts of Lalaua and Monapo. • 43,000 cotton farmers and a small number of maize farmers were insured in 2012/2013; a total of 43,500 policies were sold. • In the future, the Cotton Institute of Mozambique plans to expand index insurance coverage to all cotton farmers in Mozambique, numbering approximately 200,000.
Nigeria	• The Nigeria Agricultural Insurance Corporation (NAIC) is the primary agency providing insurance. • Crop insurance packages currently cover 17 crops, including maize, rice, cassava, yams, and sorghum. • Livestock insurance packages currently cover 14 types of livestock, including cattle, poultry, pigs, rabbits, and sheep. • In May 2013, NAIC paid more than 500 million Nigerian naira (N) in claims to insured farmers who had suffered losses in the floods in 2012. • In 2014, NAIC paid N 80 million in compensation to a sugar farm in Adamawa State following natural disasters.
South Africa	• In South Africa, agriculture insurance began in the 1970s, operating at two levels: commercial and subsistence farming. • The government has implemented subsidized crop insurance to make it affordable to farmers. • Currently, South Africa has insurance against hail and winds, but not drought. Under the existing scenario, farmers in good agricultural areas with low risk do not need subsidized insurance. • Agri SA, a federation of South African agricultural organizations, focuses its insurance efforts on commercial farmers, who number about 40,000, representing 20 percent of the farming population and producing 80 percent of the country's food. • The livestock insurance market in South Africa, although limited, is growing; racehorses are insured, and there is a market for insurance of wildlife in game parks.
Tanzania	• Apart from the pilot projects mentioned above, agricultural insurance for smallholder farmers is generally absent from the market. • The National Insurance Corporation launched a livestock insurance product in 1996 targeting only zero-grazing livestock keepers. The program failed because the majority of livestock herders were migratory pastoralists.

Source: Authors' summary from Bhushan et al. (2016).

Africa's successful experiences with smallholder agricultural insurance against extreme weather events shows the importance of investments in weather station infrastructure, widespread and inexpensive distribution networks for collecting premiums and disbursing payouts, and reliable and timely data collection and analysis to help reduce basis risk (Hill 2010). Educating smallholder farmers on weather insurance and its benefits is key to increasing its uptake and thus making insurance less costly. In cases in which selling insurance on its own has been less successful, the example of Malawi shows the potential benefits of tying insurance to credit, which can encourage a virtuous cycle of credit, enabling farmers to purchase modern agricultural inputs and increase their productivity (Leftley 2009).

Despite these successful experiences, agricultural insurance is still largely at the pilot stage in several countries, including Benin, Ethiopia, Mali, Mozambique, Senegal, and Tanzania (Bhushan et al. 2016). Moreover, countries continue to depend on international assistance to deal with the effects of extreme weather, and governments have not made the much-needed investments to help develop effective insurance markets. Among these investments, creating an enabling policy and regulatory environment that supports the expansion of insurance markets and programs should be high on the agenda, including developing insurance products that better serve the needs of smallholder farmers. Governments will also need to lead the way in insurance infrastructure investments (such as weather stations and product distribution networks), building the capacity of insurance companies, and training farmers on insurance products (Hill 2010). Finally, some form of government insurance subsidy may be required to enable higher uptake of insurance, such as the uptake rates seen in developed countries with highly subsidized insurance programs.

The Road Ahead and Opportunities

The African experience shows that index insurance has potential as a formal, efficient risk management tool for farmers in developing countries. However, for it to be truly brought to scale globally, its limitations have to be addressed. This section describes a broad set of issues related to the opportunities for index insurance and the main innovations to consider in the future.

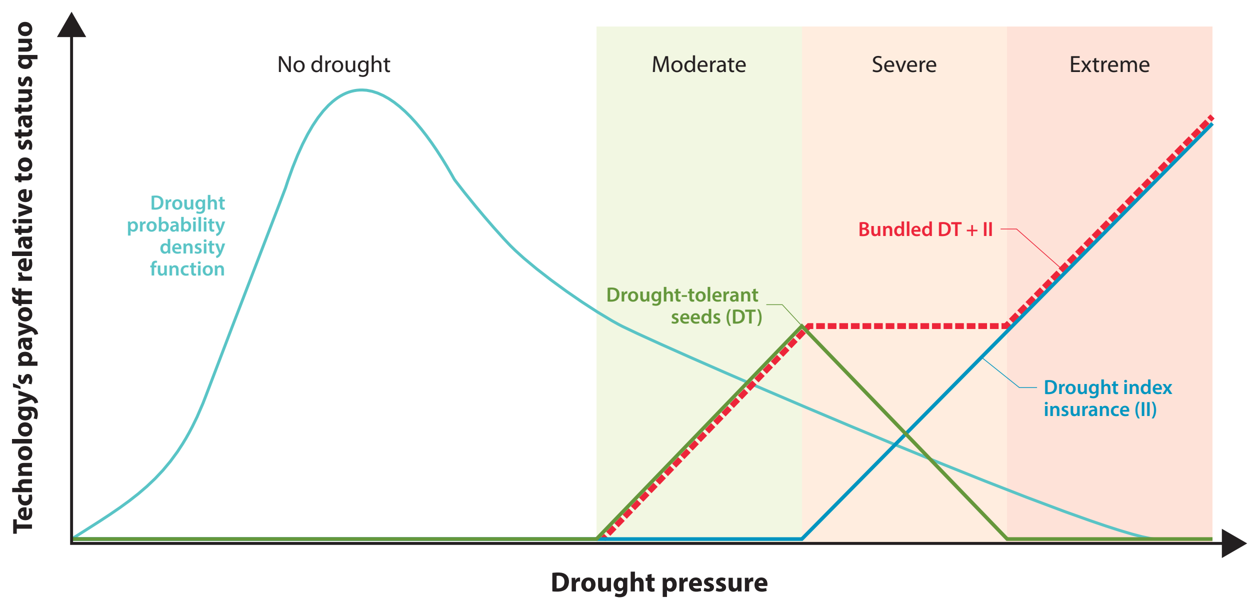
Complementarities with climate-smart agriculture. Climate-smart agriculture (CSA) has gained popularity during the past decade as an essential step toward climate adaptation by rural farming communities. CSA refers to agricultural technologies that are well suited to increase farmers' livelihoods in the face of a changing climate by (1) raising agricultural productivity, (2) building the resilience of livelihoods and farming systems, and (3) reducing carbon emissions. In some cases, these technologies involve reducing the vulnerability of crops to certain weather risks. In this regard, CSA shares a similar objective with crop insurance. Due to the similarities between these two families of technologies, a recent strand of work has focused on evaluating the potential for complementarities between them.

One of the most important examples of a complementarity between weather index insurance and a CSA technology is drought-tolerant (DT) seed varieties. DT seed varieties represent an important avenue of progress in seed breeding and are now available for a number of crops across several agroclimatic zones. DT seeds are particularly interesting from a development point of view because they can potentially bring about improved food security and protect rural livelihoods in the face of prolonged droughts.

Although the main characteristic of such seed varieties is their resistance to mild or moderate lack of soil moisture, crop failure is generally an inevitable result under an *extreme* drought, with the added consequence of farmers' being worse off due to having to repay the higher cost of DT seeds. Weather index insurance, on the other hand, is not very well suited to handle moderate drought because it tends to be expensive under a high frequency of loss (insurance premiums must be high to account for frequent payouts). Nevertheless, because extreme drought events occur much more rarely and are generally easier to identify through an index (compared with more moderate events that may or may not damage crops), weather index insurance boasts natural comparative advantages to handle this layer of risk. It is natural to see, thus, that a holistic system—wherein farmers rely first on DT seeds to inexpensively cover more frequent and milder drought risks, and in addition rely on reduced-cost catastrophic index insurance against extreme events—could provide farmers with more complete protection against all potential scenarios, thus more efficiently handling drought risk at a much lower cost than any of the above stand-alone technologies would be able to achieve (Lybbert and Carter 2015; Ward et al. 2015). Figure 6.1 shows a visual representation of this complementarity.

Other aspects of the synergies between CSA and index insurance are starting to be explored. One such exploration looked at a CSA practice known as conservation agriculture (CA) in a project in the wheat-rice system in the Indo-Gangetic Plain of India. Under CA, rice residue is left on the field at harvest and wheat seeds are sown directly through the residue into the soil using special machinery. Sowing the wheat seeds through this layer of residue has several advantages, including increased tolerance to high temperatures and reduced risk of lodging (bending of the plant due to wet soil and winds), because the plant sits deeper in the soil than under other planting methods. Similar to the DT scenario described above, adopting CA technology can inexpensively protect wheat from mild but frequent risks, and index insurance can complement this advantage by providing less expensive coverage against more extreme events.

FIGURE 6.1—COMPLEMENTARITY BETWEEN DROUGHT-TOLERANT SEEDS AND DROUGHT INDEX INSURANCE



Source: Adapted from Lybbert and Carter (2015).

Finally, another way in which index insurance can partner with CSA technologies is by encouraging CSA adoption. Many farmers generally refrain from adopting CSA practices due to the inevitable uncertainty and higher perceived risks than keeping to more traditional practices. In these contexts, index insurance can give a farmer the necessary peace of mind to try out a new technology. Such an approach could either complement or substitute for standard subsidies for encouraging CSA adoption; more research is needed to understand the optimal interplay between the two mechanisms.

New developments in index insurance. Confronted with the issue of low uptake and high basis risk, index insurance researchers and practitioners have developed some promising new ways to deal with these limitations.

An interesting new project led by the International Food Policy Research Institute (IFPRI) is Picture-Based Crop Insurance (PBI), currently being tested in the states of Punjab and Haryana, India. Under PBI, farmers take pictures of their insured plots every week using their own smartphones and a specially designed app that keeps the frame of view fixed on the same portion of the field. Using the pictures recorded over time, a farmer can then make a claim for any loss experienced, which can be assessed by agronomic experts or an automated machine-learning algorithm, based on the pictures and auxiliary information. This type of product can greatly reduce basis risk and encourage uptake by instilling in the farmer a sense of ownership of the insurance product and its results. Initial results are very promising, in terms of both the feasibility of the approach (Kramer, Ceballos, Hufkens, et al. 2017) and its sustainability, with no evidence of moral hazard or adverse selection (as would be expected from the product's resemblance to indemnity-based insurance), nor of picture tampering or fraud (Kramer, Ceballos, Krupoff, et al. 2017).

Another strand of projects has explored the potential of allowing for more flexibility as an alternative to current rigid, one-size-fits-all index insurance designs. Traditionally, index insurance products have involved a number of parameters and predetermined payout functions. These features sometimes make a product difficult to understand for farmers lacking sufficient education. More important, because the payout functions are fixed, the insurance product cannot adapt to the risk profile of many farmers the way an indemnity product would. In this context, a team at IFPRI has proposed a novel approach, wherein an array of much simpler products is offered, each covering against a specific timing and intensity of risk. Under such an approach, a farmer can create a portfolio of products (with different triggers, calibrated to protect against weather events of various intensities, and for different coverage periods) to suit his or her individual crop risk profile. Evidence from three projects suggests that farmers do indeed value this simplicity and flexibility.[30]

Gap insurance, consisting of a second tier of indemnity insurance on top of a regular index product, has been considered as a promising alternative to traditional index products.[31] Under such a program, when the first-tier index product is not triggered, farmers have the right to call for

30 For a theoretical framework and evidence from field experiments in Ethiopia, see Hill and Robles (2011). A pilot application of this approach in India is described in Hill, Robles, and Ceballos (2016). For a description of a commercial rollout in Uruguay, together with a structural analysis of the demand for these products, see Ceballos and Robles (2017).

31 For an application of gap insurance in Ethiopia, see, for instance, Berhane et al. (2015).

crop cuts in a reduced geographic area in order to assess losses locally.[32] A related idea is multiscale (or double-trigger) area yield insurance, under which a product combines two area yield indexes measured at different geographic levels—a broader geographic index with a higher trigger and a local index with a lower trigger—with payouts occurring when both indexes fall below their corresponding triggers.[33] Measuring yields at a very local level reduces basis risk, and the broader area index helps reduce moral hazard.

Finally, the increasing affordability of automatic weather stations and the expanding technologies for remote sensing of weather variables and crop growth (such as microsatellites and unmanned aerial vehicles) have an enormous potential to underpin innovative insurance products with reduced basis risk in the near future.

Meso-level products. A different approach to minimizing basis risk that has gained traction recently entails a shift from insuring individual farmers to insuring so-called aggregators—such as farmer associations, other formal or informal groups, and microfinance institutions.[34] For instance, an institution holding a significant portfolio of agricultural loans may be interested in insuring it against severe systemic shocks that may otherwise result in large loan write-offs. An advantage of such systems is that, with efficient mechanisms to identify individual losses and appropriate payout practices by the aggregators, individual (idiosyncratic) negative and positive basis risks can largely offset each other in the aggregate portfolio.

32 Taking crop cuts is a procedure to obtain an objective measure of crop yield by cutting a small, random sample of the field (for example, 1 square meter) right before harvest and weighing the produce in this sample. The process is repeated across random samples in an area to obtain an objective estimate of the area's yield for a given crop.

33 See, for instance, Elabed et al. (2013).

34 See de Janvry, Dequiedt, and Sadoulet (2014) and Dercon et al. (2014).

Macro-level products. One of the most important elements behind limited crop insurance uptake in developing and developed countries alike has perhaps been the state's traditional role as risk absorber of last resort. Once a major weather shock hits, it is fairly common for national, regional, or local governments to give in to the pressure for emergency assistance. This type of assistance is generally inefficient, difficult to administer, and prone to political favoritism and corruption. Most important, it is often uncertain—there is no guarantee that adequate assistance will be provided when there is a crop failure or livestock loss. Moreover, in many of these emergencies the state's budget capacity is also reduced due to lower economic activity and tax revenues. In this context, there has been an increasing trend around the world toward ex ante budgeting for natural disasters (through risk-coping instruments such as insurance), to the detriment of ex post assistance after a disaster strikes (Clarke and Dercon 2016).

One natural option has been macro-level insurance against weather risks, whereby the insured parties can be either different government levels (from national to local) or specialized government agencies. This type of insurance generally relies on an index and, upon the occurrence of an extreme weather event, makes a direct payout to the insured agency or local government to implement emergency relief and food security programs. Such arrangements are already being implemented in developed countries and are expanding into developing countries, particularly those prone to natural catastrophes (Hazell et al. 2010). Sometimes this type of instrument can be channeled directly through the international financial markets, through the issuing of so-called catastrophe (or cat) bonds. Such instruments resemble regular sovereign bonds in that the issuing government promises to pay the bearer (generally attractive) interest under normal scenarios, but under disaster scenarios, determined through well-specified conditions tied to the index, investors forgo the interest and some or all of the principal, in an arrangement resembling the structure of a typical insurance product.

The creation of regional risk pools is another approach that has been gaining steam. Under such a system, subscribing sovereign states commit funds, receiving in return a type of macro-level insurance. These regional risk pools are generally funded through specialized trust funds supported by international donors, or through reinsurance agreements. The way they work is similar to the macro-level products described above, whereby upon the occurrence of a negative weather event (generally defined in terms of and captured through specific weather indexes), the sovereign state receives financial assistance to put toward social protection and reconstruction costs. African Risk Capacity (ARC), established in 2012 as an agency of the African Union, is an example of such a pool. In addition to covering member states against the devastating consequences of droughts, it provides technical and financial assistance to state governments for early response systems and emergency management plans.

Conclusions

In the face of climate change, improving the resilience of African smallholder farmers should constitute a top priority in policy makers' agendas. In this regard, CSA constitutes a crucial step in the right direction. However, formal insurance mechanisms are needed to complete farmers' tool kit to cope with weather shocks.

Even though traditional crop indemnity insurance has not really taken off on the continent, other options have been brought forward in recent decades. Weather index insurance is a promising alternative with several advantages. First, it avoids moral hazard issues by decoupling insurance payouts from the farmer's behavior. Second, it is not subject to adverse selection: payouts depend on objective, readily and publicly available information, and are independent of the characteristics of the pool of insured farmers. Furthermore, the implementation and administration of index insurance is cheaper than that of traditional indemnity insurance because it does not require the insurance company to verify loss claims before making payouts.

Nevertheless, index insurance has its own limitations, especially in relation to basis risk: because payouts are based on the observed index, any given farmer's actual loss may not be completely compensated. Although a number of new developments intend to sort out this and other obstacles, it is perhaps too soon to take stock and understand whether they will be able to help improve smallholder farmers' resilience in an efficient and sustainable way.

Evidence from several insurance pilot programs shows that although the potential for innovative insurance mechanisms is real, additional work to understand their effectiveness and substantial scale-up efforts will be needed to achieve a sustainable expansion of efficient agricultural insurance markets in Africa. Across the continent, a growing pool of experts and professionals from both public and private institutions are actively engaged in bringing in innovations, improving index products, and finding effective ways to scale up insurance programs. Importantly, in the face of shifting weather patterns due to climate change, rating methodologies for index insurance products must adapt or run the risk of encouraging oversubscription and thus undermining long-term sustainability.

Governments, in particular, have an important role to play in creating an enabling policy and regulatory environment for the expansion of insurance markets and development of insurance products that better serve the needs of smallholder farmers. They will also need to lead the way in investing in weather stations, building the capacity of insurance companies, and training farmers on insurance products. By supporting the implementation of innovative weather insurance products aimed at addressing prevailing challenges, policy makers can actively contribute to the resilience of the rural poor facing weather extremes and provide them with much-needed opportunities to escape poverty through farming.

In this context, African policy makers should consider innovative weather index insurance tools as part of a comprehensive CSA package to help African farmers manage weather risks, especially in light of the potential complementarities between weather index insurance and agricultural technologies aimed at raising productivity and incomes. Such efforts can go a long way in helping the continent meet the Malabo Declaration commitment to enhance the resilience of farming livelihoods by 2025.