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Bundling Weather Index Insurance with Microfinance: Trekking the Long Road between Expectations and Reality – A Study on Sub-Saharan Africa

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Abstract

Food production in sub-Saharan Africa (SSA) is exposed to climatic variations and weather-related shocks which affect agricultural output beyond the manageable limits of smallholder farmers. To manage food production uncertainties, weather index insurance (WII) pilot projects have been launched across SSA since the early 2000s. Due to low adoption rates among smallholder farmers, insurance providers have partnered with risk aggregators such as microfinance institutions to foster the demand for and uptake of WII. Despite this, demand for WII remains low. This chapter seeks to explore the gap between the assertion, that WII is a promising risk transfer mechanism for smallholder farmers in SSA and the realisation that, even where microfinance is made available, subscription rates among smallholder farmers rarely rise. The practice of linking insurance with credit is considered to be important because, in principle, when smallholder farmers have access to insurance, they pose less risk to creditors. In this sense, insurance can crowd-in credit, the lack of which has long been identified as a major, if not the main, constraint for smallholders in developing countries.

Keywords: weather index insurance, microfinance, food systems resilience, climate change, risk transfer, smallholder farmers, sub-Saharan Africa

1. Introduction

Agriculture is a major source of food in Sub-Saharan Africa (SSA), and a primary source of livelihood [1]. The sector employs more than half of the total labour force and accounts for roughly a third of the gross domestic product (GDP) [2–4]. The share of agriculture in GDP varies significantly by country ranging from below 3% in Botswana to over 50% in Chad [5]. Due to the fragmentation of land caused by population pressure in most rural areas, farm sizes are typically less than 2 hectares each [6]. As a result, smallholder farms are dominant across the subcontinent [7]. They make up 80% of the farms, which translates to approximately 33 million smallholder

farms [8]. Although the widely accepted view is that, smallholder farmers produce the majority of the food, because they farm land very intensively resulting in high levels of productivity per unit of land [9, 10], their farms are often too small to provide a sustainable income at the household level, let alone food security [7]¹. In addition, smallholder farmers are known to face several challenges associated with missing markets for credit, insurance, information including economies of scale in marketing and transportation [10]. Problematically, they are also reliant on non-drought tolerant crops and seed varieties², non-mechanised farming systems and subsistence rain-fed farming³, factors which jointly contribute to the volatility of agriculture and the vulnerability of the smallholder farmers [13]. Having a full grasp of the character of risks that affect smallholder farmers is key to developing appropriate solutions to deal with risks. Similarly, it is important to understand how farmers respond to the solutions designed to ameliorate risk as this will help to establish the effectiveness and compatibility of the measures apropos the target market.

This chapter seeks to explore the gap between the assertion, that weather index insurance (WII) is a promising risk transfer mechanism for smallholder farmers in SSA and the realisation that, even where microfinance is made available, subscription rates among smallholder farmers rarely rise. The chapter pays attention to the risk response behaviour of smallholder farmers when presented with the option of purchasing WII that is bundled with microfinance. Weather index insurance is crucial because it potentially addresses welfare losses due to weather risk and complements existing informal risk management strategies [14]. The linkage between WII and credit has been discussed widely in theory but rarely investigated empirically, yet a lot of recommendations have been put forward by scholars for WII to be bundled with microfinance (see [15–19]). This is because, when smallholder farmers are believed to pose less risk to creditors when they have access to insurance [20]. In this sense, agriculture insurance can crowd-in credit, the lack of which has long been identified as a major, if not the main, constraint for smallholders in developing countries [21].

Access to agriculture insurance is crucial for smallholders because agriculture is generally prone to production failure due to the risk of catastrophic events such as those linked to extreme weather events [22]. Weather extremes have been repeatedly seen to have long-lasting impacts on farming livelihoods [23–26]. Sub-Saharan Africa is especially vulnerable to weather-related risks because of the strong reliance on climate-sensitive rainfed agriculture [27]. While extreme weather shocks are not new to this region, the frequency and intensity of the events have increased over the past few decades. Based on the Human Cost of Disasters 2000–2019 Report, there has been a sharp increase in weather-related disasters⁴ over the past 20 years. Notably, disasters

¹ Smaller farms are generally thought to have an advantage over large farms in per capita productivity due to higher labour utilisation (e.g., using family labour) and intensive farming on smaller pieces of land [9].

² Gollin et al. [11] revealed for example that, in 2000, only 17% of the area planted for maize had modern maize varieties in sub-Saharan Africa compared to 57% in Latin America and the Caribbean.

³ According to Demeke et al. [12] the irrigated area in this region which extends over six million hectares, makes up just 5 per cent of the total cultivated area, compared to 37 per cent in Asia 14 per cent in Latin America. Two-thirds of that area is in three countries: Madagascar, South Africa, and Sudan.

⁴ To be recorded as a disaster in EM-DAT, one or all the following must take place: 10 or more people must be reported killed, 100 or more people must be reported affected, a state of emergency must be declared by the State, and a call for international assistance made. Based on this delineation, hazards only become disasters when human lives are lost, and livelihoods are equally damaged or destroyed [28].

including extreme weather events rose from 4212 in the period 1980 to 1999, to 7348 in the period 2000 to 2019 [28]. Weather events figure large among the recorded disasters⁵.

Equally alarming are the rising patterns of loss and damage in the agricultural industry that are strongly correlated to the increasing catastrophic events [29]. For example, it is estimated that more than 75% of recent economic losses caused by natural hazards in Sub-Saharan Africa are attributable to climate change-induced weather events [30]. Outcomes linked to economic loss include livelihood insecurity, poverty, food insecurity and poor nutrition – cyclical patterns which can be ameliorated through adaptation financing [31]. What smallholders need therefore is access to perfect financial markets (savings, credit and insurance) and economic incentives to (re)invest in agriculture [7]. Reducing the economic impact of severe weather events is thus a crucial step towards supporting agricultural growth, sustainable livelihoods, poverty alleviation as well as bolstering food security and nutrition [32]. Given the foregoing, the vulnerability of smallholder farmers in lower-income countries is acute in part because they repeatedly lack access to financial mechanisms to efficiently manage production uncertainties [33]. In the absence of effective insurance and credit markets, households remain vulnerable to the financial consequences of high-magnitude loss events.

2. Understanding the nature of climate change risk in SSA

While SSA is not a single unit and challenges vary spatially and temporally, agriculture, and especially crop production in this region is predominantly rainfed and as such reliant on unpredictable climatic events [24, 31, 34, 35]. Under the current variable climate conditions, SSA already experiences a major deficit in food production especially in semi-arid and subhumid regions and areas [1]. This means a further drop in soil moisture due to mounting climate extremes will have devastating effects on agricultural production and will worsen food insecurity [26]. SSA is vulnerable to climate change also because the economies of most countries in this region are dominated by subsistence agriculture, the productivity of which is grossly susceptible to changing weather patterns [36]. Furthermore, the sub-continent is prone to complex natural climatic phenomena such as the El Nino-Southern Oscillation (ENSO), the West African Monsoon and the Indian Ocean Dipole [37], which influence climate variability (inter-annual and intra-seasonal rainfall), trends (upward or downward) and the persistence thereof [38]. The natural climatic phenomena give rise to regional climatic patterns which are impacted to some degree by climate change [37]. Because of the regional climatic phenomena, SSA has a long history of rainfall fluctuations of varying lengths and intensities (ibid) and is prone to cyclical drought patterns which are a frequent event in the semi-arid countries of the sub-continent [1]. The droughts in SSA have in recent times become more frequent and protracted, ostensibly due to climate change [39].

Climate forecasts have shown warming of approximately 0.71°C over much of the African continent in the twentieth Century [1], and an increase of over 1°C in the twenty-first Century [40]. Rather, average near-surface temperatures across parts of the continent have risen by more than twice the global rate of temperature increase

⁵ For example, floods were the highest recorded disaster event – 3254, followed by storms – 2043 (ibid).

in the twenty-first Century [41]. According to WMO [40], the year 2019 was among the three warmest years on record for the continent. Recent decadal predictions encompassing a five-year period from 2020 to 2024, signify continued warming and decreasing rainfall markedly over North and Southern Africa (ibid). Further predictions by Woetzel et al. [42] suggest that, due to climate change, the number and intensity of extreme weather events in SSA are set to increase. This is consistent with findings submitted in the Human Cost of Disasters 2000–2019 Report, which revealed that 1192 extreme weather events were recorded in Africa over the last 20 years (see [28]).

An enquiry on climate change and its likely impacts on SSA cannot be achieved by examining long term weather changes alone [43], as most countries in SSA suffer from intersecting stressors that give rise to low resilience and limited adaptive capacity to climate-related shocks [1]. Incidentally, climate change acts to exacerbate pre-existing conditions and has thus been dubbed a threat multiplier [25]. As such, the effects of drought and other climate extremes in SSA are exacerbated by endemic poverty, complex governance and institutional dimensions; limited access to capital, including markets, infrastructure and technology; ecosystem degradation; and complex disasters and conflicts ([36], p. 435).

SSA accounts for more than half of the world's extreme poor, amounting to approximately 400 million people, most of which are smallholder farmers [37]. Poverty is among the key reasons why a lot of smallholder farmers in SSA are continuously exposed to inter-annual variations and occasional shocks caused by weather which affect agricultural output beyond their manageable limits [30]. As a result, at the 25th session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) that took place in Madrid in December 2019, it was revealed that 7 out of the 10 most climate-vulnerable nations in the world are located in Africa [44]. The figure is consistent with findings published in the Human Cost of Disasters 2000–2019 Report, which pointed out that, the top 10 list of countries with the highest share of affected populations by extreme weather shocks over the last 20 years is dominated by Sub-Saharan African countries, which make up 6 out of the 10 countries on the list [28].

3. Risk response mechanisms used by smallholder farmers in SSA

Risk is the aggregate of the likelihood or possibility of a shock event occurring, and the severity of loss or impact caused by the event [45]. Three aspects make up risk, namely, threat, uncertainty, and loss. Climate change poses significant risks for food systems and has thus emerged as one of the greatest challenges of the twenty-first Century. Climatic extremes affect the primary sources of farm income, such as crops and livestock, and can further destroy household assets such as farming equipment – investments accumulated over time that are needed to generate future income [46]. Loss and damage due to extreme weather events can push farming households into cycles of poverty. According to GlobalAgRisk [47], households that are just above the poverty line can be pushed instantly below the poverty line by a major weather event. In the absence of perfect financial markets, including savings, credit and insurance, smallholdings in SSA generally struggle to recover from loss and damage caused by extreme weather events [34].

In the absence of perfect financial markets, an array of behavioural responses often emerge to fill in the gaps created by market failures [48]. Despite having

considerable experience dealing with weather extremes, smallholders are much less likely to plan for low probability, high consequence risks [49]. This is a result of a cognitive bias that causes people to ignore risks with low probability, except when the likelihood of occurrence is well-known [50]. This psychological phenomenon influences the willingness of poor households to spend their limited income to cover low probability risks. Be that as it may, from a risk perspective, behavioural responses to shocks consist of three types of choices, namely, risk mitigation, risk coping and risk transfer [51]. The behavioural responses are characterised as being *ex ante* or *ex post* based on chronology and functional objective [52]. *Ex ante* strategies are those measures taken before shocks occur to avoid, transfer or reduce risk exposure, while *ex post* strategies are measures taken after shocks occur to mitigate or insulate welfare impacts of the shocks [52–54]. According to Frankenberger et al. [54], *ex ante* strategies are about preparation, whereas *ex post* strategies are about coping and recovery.

Smallholder farmers in SSA are more susceptible to weather fluctuations than farmers in developed countries, who for instance, can more easily alter crop varieties, irrigate their fields, or secure crop insurance [42]. In more developed countries financial markets exist which allow farmers to insure against shocks *ex ante*, or to borrow *ex post* to achieve *quasi*-insurance through *ex post* loan repayment [55], increasing the options for recovery in the event of loss events. Because smallholder farmers in SSA are risk averse, they ordinarily choose to rely on traditional methods of risk management in the absence of ready access to savings, insurance and credit markets [21].

Faced with no savings, credit or insurance, they typically manage risk by smoothing consumption through choosing low-risk activities or technologies, which generally yield low to average returns [56]. Smallholder farmers in SSA also smooth consumption through asset attrition. According to Carter and Lybbert [57], since the rural poor have limited access to financial markets, consumption smoothing typically involves amassing assets in good times to use as a fallback in bad times. For example, a study on the impacts of drought on rural households in Burkina Faso showed that a good number of households that sell livestock do so to offset consumption shortfalls due to negative income shocks. Similar findings were observed in studies carried out in the rural Districts of Buhera and Nyanga in Zimbabwe where farmers mentioned the sale of livestock as a means of buffering income losses caused by production uncertainties [58]. Wealth for the rural poor is usually not in the form of cash or savings [47], but productive assets such as livestock [48]. Thus, when a severe weather event occurs, livestock is often sold off, often at a loss [59], because the distressed sale of large numbers of livestock at the same time flood the market, significantly reducing their value [60]. In contrast, insurance has been seen to positively influence households' behavioural responses to risk through enabling them to reduce the need to rely on costly coping strategies such as selling productive, as this undermines future productivity. Results from an index-based livestock insurance (IBLI) pilot in Marsabit District of northern Kenya, showed that insured households are less likely to sell livestock [61]. Nonetheless, because insurance is not readily available in most rural areas, and where available, demand for it is low, smallholders tend to rely more on on-farm risk mitigation strategies. Thus, to preserve assets, households may smooth consumption further by cutting back on meals and diverting children from school which undermines crucial investments in human capital, hampering current and future productivity (ibid). In terms of its functional objective, consumption smoothing involves creating a balance between spending and saving to achieve a higher overall standard of living and can for that reason be used as a welfare dimension to assess a household's preparedness to deal with climate change risk [62].

In addition to consumption smoothing, smallholder farmers in SSA also smooth income when dealing with climate change risk [44]. Income smoothing refers to the different strategies and approaches used by households to control the impact of extreme volatility in household income [48]. It is most often achieved *ex ante*, through diversifying economic activities and employment choices (ibid). Since most farming households in SSA lack access to savings, credit and insurance, they try as much as possible to prepare for loss events *ex ante* through income generation [63]. Thus, to smooth income, households take steps to protect themselves from adverse income shocks before they occur [47]. To achieve this, households can pool together labour supplies, allocating them across different local employers over time. However, as most farming households in SSA earn wages through agriculture (e.g., from working on neighbouring farms or plantations, and rendering services to local businesses that deal with agricultural supplies) pooling labour supplies across different divisions of the climate-sensitive agriculture industry will not solve their income problems in the event of climatic extremes. Diversifying into non-agricultural activities or more profitable alternatives is difficult for many rural households [64]. The barriers to entry include working capital and vocational skills and or education requirements. Examples from Tanzania and Ethiopia cited in Dercon's study support the view that the poor typically enter into activities with low entry costs such as those linked to subsistence farming or casual agricultural wage employment. Since diversifying income sources is costly for poor rural households, Village Savings and Loans Associations (VSLAs)⁶ are sometimes used as a collective means to smooth income. Fumagalli and Martin [65] share findings from a cluster randomised control trial (RCT) carried out between 2009 and 2012 in the Nampula Province of Mozambique, which shows the usefulness of pooling income. Based on the study, VSLA money has been used by households to buffer shortfalls in income due to unforeseen shocks. It is unclear, however, to what extent VSLAs would be effective in responding to covariate risk. If all households in a community are affected by a catastrophic event, informal risk-sharing activities are unlikely to be sufficient. Nonetheless, access to financial markets presents a greater opportunity for income smoothing and less vulnerability to weather shocks [62].

In all, there is an overlap between different types of shocks and behavioural responses to shocks. As the discussion above attests, high-frequency low losses are usually managed at the farm level and mitigated in part through access to household investments [63]. In an ideal world, residual risk (low frequency, medium loss) that cannot be retained by the farmer is better off transferred to third parties, usually insurance companies [45], which is not always an option for smallholders in SSA. Where insurance is an option, smallholders often deem it too costly for their limited income. Nonetheless, transferring a portion of income risk to a third party enables the farmer to have enough money to invest in higher-risk/higher-yield production technologies, such as improved seeds and inputs [20]. When weather-related shocks strike, households that receive indemnity payments have more response options, which notionally should reduce their reliance on detrimental coping strategies [66]. Although smallholder farmers in SSA have developed numerous adaptation mechanisms to cope with weather fluctuations over time, evidence has repeatedly shown that their methods are not adequate to deal with climate change [36]. If climate

⁶ VSLAs are typically composed of 15 to 20 self-selecting households, who meet regularly to pool income into a common fund, which can be lent out to group members at group agreed interest rates [65].

change adaptation investments are not made (e.g. by governments, multinational corporations and donor communities), the adaptation mechanisms used by smallholder farmers in SSA will not keep up with climate change impacts [22]. The Paris Agreement underlined the global importance of adaptation and contains provisions related to adaptation finance that follow guidelines from the Cancun Adaptation Framework [67]. Paragraph 28 of the Cancun Adaptation Framework stressed the need to explore options for risk-sharing and risk insurance, including options for micro-finance to reduce the devastating impacts of disasters among vulnerable populations [68].

4. Weather index insurance

Risk-sharing or risk transfer is a risk management strategy that involves the contractual shifting of risk from one party to another [51]. Risk transfer is most often achieved through an insurance policy, where the insurance carrier assumes the defined risks for the policyholder in exchange for a fee, or insurance premium [69]. Agricultural insurance is one risk transfer tool that farmers can use to manage risks that cannot be mitigated at the farm level [30]. It offers a promising means of cushioning in times of climate change-induced loss and damage for smallholder farmers [35]. Globally, however, less than 20% of smallholder farmers have any form of agricultural insurance [22]. Although the estimated global agricultural insurance premium volume almost doubled in the period 2004–2007, it remained low in African countries where it roughly reached an average of 0.13% of the 2007 agricultural GDP [70]. As a result, some scholars claim that only about 1.3% of the smallholder farmers in SSA have agricultural insurance [71]. Raithatha and Priebe [22] set the figure at 3%, while a more recent study suggests that the figure is around 3.5% which at any rate is far below the rates in Asia (46.2%) and Latin America (15.8%) [72]. Despite the low uptake of agricultural insurance by smallholder farmers in SSA, agriculture insurance is firmly believed can reduce the economic impact of severe weather events and help stimulate economic development through supporting agricultural growth, poverty alleviation, and the development of rural finance [14]. Based on the functional objective of agriculture insurance, it is an income smoothing *ex ante* strategy, actioned before the occurrence of a shock event [16].

There are various types of agriculture insurance, the main ones being, indemnity-based crop insurance (e.g., named peril crop insurance and multiple peril crop insurance) and index-based insurance (e.g., index-based livestock insurance, area yield index insurance and weather index insurance). This chapter looks specifically at weather index insurance (WII). Weather index insurance has been presented as an important risk transfer mechanism that can assist smallholder farmers to deal better with climate risk [22, 35, 73]. The underlying risk for a WII product is the behaviour of the specific weather variable that contributes to production losses [14]. WII focuses on weather-related shocks because rainfall and temperature patterns for instance pose a serious threat for farmers [20]. The pervasive nature of catastrophic weather events is especially well-suited for index products, which explicitly insure against covariate shocks (ibid). Unlike traditional insurance, index-based insurance compensates policyholders according to a pre-determined index value [69] that serves as a proxy for losses rather than upon the assessed losses for individual policyholders [51]. Thus, some of the advantages of WII are that it has low operational costs, fast claim settlement speed and low risk of moral hazard and adverse selection [35].

Low operational costs give WII a critical advantage over traditional insurance, yet the hedging effectiveness of weather index-based insurance tends to be diminished by the often imperfect correlation between the index and realised losses. This is caused for instance, by the non-insurable difference between the weather events happening at the farm site and those occurring at the reference weather station, which is referred to as geographical basis risk [74]. In light of this, some of the drawbacks of WII include high basis risk, high actuarial difficulty, and high set-up costs [75].

The earliest applications of WII in emerging economies in the Americas and Asia are said to have taken place respectively in Mexico in 2002, followed by India in 2003 [47]. In SSA, the first application of weather index is said to have taken place in Malawi in 2005 [76] followed by Ethiopia in 2006 [77]. Almost 2 decades later, however, index insurance markets are still very thin in most African countries. To lessen the limitations of WII, insurance providers have initiated changes to their products being guided by scholarly recommendations and emerging best practices. Some of the key recommendations submitted by the scholarly community include interlinking reliable weather data with location-specific crop and agronomic conditions using flexible geospatial crop modelling tools (see [78]), interlinking WII with subsidies (see [79]) and interlinking WII with microfinance (see [16]). The mixed results of many WII pilot projects to date, for example, as presented by the lack of widespread implementation of even those projects considered successful, followed by the consistently low adoption rate by smallholder farmers, warrant an investigation into the changes needed for the products to become more scalable and sustainable.

5. Bundling weather index insurance with microfinance: expectations vs. reality

Smallholder farmers often do not qualify for credit provided by mainstream banks due to the lack of usable collateral (e.g. savings, reliable earnings, effective land titles and other tangible and intangible assets) to guarantee loan repayments [49, 80]. In addition, the large fluctuations in farm revenue generally make it less commercially attractive to lenders, thus hampering credit provision to the agriculture sector [16]. Credit constraints discourage farmers from investing in higher-risk/higher-yield production technologies, such as improved seeds and inputs [20], which would otherwise boost their capacity to withstand the negative impacts of extreme weather events. In some instances, however, if no collateral is present, lenders may require crop insurance to securitize the repayment of the loan [16]. Thus, crop insurance can facilitate credit. Microfinance Institutions (MFIs) specialise in the supply of credit to segments of the population that is typically unattended by mainstream banks. The promise of microfinance is centred on the awarding of microloans to the poorest of the poor without requiring collateral [81]. What makes microfinance different from traditional forms of credit is its focus on small loans and other low-cost financial services which the poor can use to generate income and become self-reliant [82, 83]. However, while insurance may in some instances unlock credit, bundling microfinance with insurance is far from being the panacea for the credit constraint problem [21]. This is why more insight into the impact of linking insurance and credit is needed, particularly since the adoption rate of WII in SSA has remained low even in cases where microfinance has been made available.

Studies have indicated an uptake of less than a fourth of the smallholder population [80], which shows clearly that demand for WII is low. Actual demand according

to the preceding scholars varies from 2 to 40% or 50% maximum. In general, low demand is ascribed to several factors which include farmer budgetary constraints, lack of trust in financial institutions, poor understanding of the contract, and the often imperfect correlation between the index and realised losses (basis risk) [84]. Marr et al. [80] have gone on to group the reasons for low demand into 3 categories namely, (1) neoclassical (i.e., risk aversion, risk mitigation, basis risk and price), (2) behavioural (i.e., understanding, trust and education), and (3) pecuniary determinants capturing credit and liquidity constraints (i.e., wealth, liquidity, credit and income). To weigh in briefly on the effect of the given determinants of low demand, firstly, it has been noted already in this chapter that smallholders are generally risk averse, which causes them to depend more on traditional risk mitigation strategies. Secondly, because, their risk mitigation strategies are limited, they are among the most vulnerable populations to climate change. Thirdly, when presented with risk mitigation strategies such as insurance, smallholders are not always willing to pay for indemnity. Aside from being risk averse, they are poor and often credit and liquidity constrained. Inevitably, price is a crucial factor that the smallholders consider before signing up for an insurance policy. There are thus tensions between what must be charged to insure low-probability high-consequence events and the willingness of households to pay for insurance products designed to protect against losses caused by these events [33].

Fourthly, basis risk interacts with other factors such as price and is an important factor known to drive price beyond the reach of smallholders. To increase demand for WII, suppliers need to focus on minimising basis risk. Even as basis risk is an inherent problem for index insurance, it can be reduced through product design and application [47]. To increase demand for WII, suppliers need to additionally educate smallholders about the benefits of insurance, which should be followed up by cultivating relationships of trust [85]. There is a further need for suppliers to come up with innovative ways to make insurance more attractive to smallholders. This involves adapting financial services and products to match the risk profile of the market demographic [33], for example through bundling WII with microfinance.

5.1 Expectations

Bundling index-insurance with credit is a practice that is widely debated in literature but mainly at a theoretical level [80]. There are several benefits that come with combining microcredit with insurance, some of which have already been discussed in this chapter. Since both insurance and credit are recognised as important tools for smoothening and enhancing income [16], it is believed that when bundled together, they can enhance on-farm efforts (e.g., through increased input, improved seed varieties and investments in and specialised and diversified farming) to mitigate climate risks. Meyer et al. [21] are of the view that neither credit nor insurance markets can exist independently in low-collateral environments. This makes perfect sense considering that insurance can ensure the success of credit by promoting lending to smallholders in credit constrained environments where farmers have weak collateral to offer, and systemic risks are the main cause of loan defaults. While credit on the other hand can ensure the success of insurance by enhancing household income and protecting farmers against the financial risk of crop failure. Linking the two contracts thus seems beneficial for farmer productivity, food systems resilience and incidentally, the growth of rural financial markets. A potential downside of this practice, however, which cannot be overlooked by this chapter is that, if a loss occurs which is

not covered by the insurance because the index was not correlated to the realised loss and an indemnity payment was not triggered, the farmer may not be able to repay their loan. On its own, index insurance can harm farmers by extracting insurance payments while providing little or no actual risk coverage [20]. When combined with credit, the farmer may be worse off than if their loan were not insured because they have to pay the insurance premium as well as repay the loan [21]. This shows that while insurance could unlock credit and produce desired results such as higher investments, it could also produce undesired results such as higher default rates (*ibid*).

5.2 Reality

A few empirical studies have been carried out to understand the credit insurance linkage in different parts of SSA, and the results have been conflicted. Among these, a study by Giné and Yang [19] sought to test whether reducing risk through WII induces greater demand for credit among smallholder farmers in Malawi. Half the farmers were randomly selected to be offered credit to purchase high-yielding hybrid maize and groundnut seeds for planting. The other half were offered a similar credit package but were also required to purchase (at actuarially fair rates) a weather insurance policy that partially or fully forgave the loan in the event of poor rainfall. The uptake of credit was 33% for farmers offered a loan without insurance and 17.6% for farmers offered a loan bundled with weather insurance. The findings suggest that smallholders do not always value insurance as the demand for credit fell when bundled with insurance. An explanation for the behavioural response given by the authors is that farmers understood that they were implicitly insured by the limited liability inherent in the loan contract so that going for a loan bundled with insurance (for which an insurance premium was charged) would effectively increase the interest rate on the loan. On the other hand, the overall poor uptake rate could be taken to mean that smallholders generally do not trust financial institutions [86].

In a study carried out by Karlan et al. [87]. A randomised control trial was conducted to investigate whether price risk affected the demand for credit by smallholders in Eastern Ghana. Farmers were offered loans with an indemnity component that forgave 50% of the loan if crop prices dropped below a threshold price. A control group was offered a standard loan product at the same interest rate. Loan uptake was high among all farmers. The indemnity component had little impact on the uptake or other outcomes of interest. The indemnity product had incorporated insurance into the loan rather than as an add on, to avoid potential choice overload problems that arise sometimes when too many choices cause stagnation in decision making. Yet, findings showed a high take-up rate of credit despite indemnity, which made it difficult for the authors to assess heterogeneity in behavioural response. What is apparent from the findings is that insurance made no difference to the demand for credit. This again implying that smallholders do not always value insurance. To explain the outcome, the authors suggested among other reasons that, the farmers perhaps did not understand the contract.

In a different study carried out by Mishra et al. [88] in Northern Ghana, results also found no evidence that insurance has a significant impact on increasing the uptake of credit. The study investigated whether coupling agricultural loans with micro-level and meso-level drought index insurance can stimulate the demand and supply of credit and increase technology adoption. Based on empirical findings, if at all, bundling loans with insurance increased the likelihood of loan applications for female farmers. Gallenstein et al. [84] published a paper on the same population in

Northern Ghana. The authors investigated the willingness to pay for drought index insurance backed loans and found out that insurance lowered overall demand for loans. In fact, adding an insurance policy to an agricultural loan reduced the demand for credit as 75.3% of the population were willing to pay the market interest rate for the uninsured loan. What is also apparent from the findings of this study is that smallholders do not always value insurance. In this case, insurance had a bearing on demand for credit, albeit in a negative way.

Different results were observed, however, in a study carried out in Machakos County, Kenya by Ndegwa et al. [89]. The authors sought to investigate the causal effect of bundling WII with credit on uptake of agricultural technology among smallholders. 1170 sample households were randomly assigned to one of three research groups, namely, control, risk contingent credit and traditional credit. Based on the findings the average credit uptake rate was 33% with the uptake of bundled credit being significantly higher than that of traditional credit. In this case, insurance was seen to influence the uptake of credit. By and large, the study observed that risk rationing was among the key reasons responsible for the negative credit uptake among smallholders.

In another study, Pelka et al. [74] analysed the influence of weather variations on the repayment performance of credit among smallholder farmers in Madagascar. The farmers studied primarily grow rice in monoculture. The weather risk for rice cultivation in the central highlands of Madagascar is the excessive amount of rain in the harvest period (between the end of February to April), which reduces rice yields and, thus, leads to revenue losses for farmers. Findings demonstrated a high correlation between precipitation and credit risk, where credit risk is defined as whether or not a borrower can pay back all loan instalments by the due date. Thus, findings revealed in particular that, the credit risk of loans granted to smallholders increased in the harvesting period due to the excessive amount of precipitation. Based on the analysis given by the authors, credit risk would reduce significantly if the farmers had weather index insurance policies. This assumption is based on the hypothesis that, “the effect of weather events on the repayment performance of loans equals the effect of the returns of weather index-based insurance on the repayment performance of loans” Pelka et al. [74]. As such, the authors surmise that weather index-based insurance might have the potential to mitigate a portion of the risk in agricultural lending. In this study, the authors do not seem to argue for the bundling of credit and WII, but instead, propose that WII would be instrumental in mitigating credit risk in cases where lending is involved which would work only where the weather index is perfectly correlated to the realised loss. To avoid issues of credit risk, the weather index insurance programs in Malawi often bundle credit with mandatory weather index insurance [78]. However, while making insurance mandatory is good in that it assures worried lenders, the downside is that it may discourage farmers from seeking loans [21] as seen in experiments carried out in Malawi and Ghana earlier cited in this section.

6. Discussion and conclusion

A review of the literature showed mostly mixed results regarding the impact of bundling WII with microfinance among smallholders in SSA. The literature confirmed the premise that, even where microfinance has been made available, the demand for WII has remained consistently low across the sub-continent. Thus, a wide gap still exists between the expectations of what WII can achieve for smallholder

farmers in dealing with climate change risk, and the reality that is on the ground, which is that current demand varies from 2 to 40% (50% at the most). While WII may not provide complete protection against losses, it can improve the financial protection coverage needed for smallholders to effectively deal with the financial consequences of high-magnitude climatic loss events. In this way, WII can play an instrumental role in creating an enabling environment for rural financial services including banking and microfinance. For WII to work, it must complement existing risk management strategies, to ensure all round cover against climate change risks.

The chapter focused mainly on demand side dynamics paying considerable attention to the risk behavioural responses of the smallholders. It is crucial to understand how farmers respond to solutions designed to mitigate against risk as this will help to establish the effectiveness and compatibility of the measures apropos the target market. Based on the reviewed studies, the determinants of low demand for WII are many, ranging from risk aversion, liquidity and credit constraints, lack of trust in financial institutions, poor understanding of the indemnity contract to risk rationing. To improve demand for WII, suppliers need to design products to match the needs of target markets. A needs-based approach or deficit model recognises all needs, including underlying needs as valid claims. And so, insurance providers must be fully cognizant of community needs in their entirety for them to package WII more attractively. This would entail tackling more than just weather risk. Some insurance providers are already doing this. For example, research has shown that the uptake of WII is higher in Ethiopia when insurance is channelled through group-based informal insurance schemes *iddir* (a funeral society) or when bundled with input schemes [78]. Bundling insurance with microfinance is another way of catering to a community's secondary needs through targeting liquidity and constraints. However, evidence has shown that, this does not always work in communities with lower risk-taking behaviour. This is why a needs-based approach should be carried out alongside a people-centered market research of the target population.

Demographical information and behavioural economics make generalisations about populations which can help insurance providers to know what the customers are looking for and how their product meets customer needs [90]. Since WII takes on an anti-poverty approach, insurance providers should go beyond tactical strategies, and understand and view things from the perspectives of smallholder farmers. Thus, customer empathy is a requirement for the design of WII packages that meet the underlying needs of customers, while factoring in customer feelings about the products being offered. A typical market research seeks to understand the obvious characteristics of population (e.g., age, sex, income, employment, level of education, farm size, cropping activities). While a person-centered market research would seek to understand further information such as, how cultural beliefs and attitudes/religious views/willingness to adopt change/willingness to pay for change/value placed on change (in monetary terms) influence technological preferences. Other information that could be sought by insurance providers include, household structure/headship and gender practices, to ascertain who does what? who has what? and who decides what? at the household level. SSA is home to more than 500 million women who account for about half of the continent's population [91]⁷. Based on data

⁷ According to Menashe-Oren & Stecklov [92], SSA is characterised by balanced sex ratios at birth, so the primary factors creating divergence in rural/urban age structures are sex differences in mortality and migration.

from 45 countries in SSA for the periods 1980–2015, until the ages of 15–19, there are more boys than girls in the rural sector and fewer boys than girls in the urban sector, which changes dramatically between the ages 20–24 [92]. This suggests that in a lot of countries in SSA, there are more women than men who live and work in rural areas from the age of 20 onwards. This is consistent with reports which state that, in SSA, women are responsible for much of the food production in rural areas [93]. According to WorldBank [91], the share of labour varies across countries, ranging from 24% in Niger to 56% in Uganda, but remains consistently well below the commonly cited 60–80%. Despite their contribution to agriculture, women in male headed households have very little say in decision-making compared to women who head their own homes (female headed households) [94]. The point is, if women are a major demographic in rural areas, gender differences and practices are important factors that should be incorporated into the design and application of WII in SSA. In a study on Northern Ghana carried out by Gallenstein et al. [84], bundling loans with micro-insurance was seen to increase the likelihood of loan applications for female farmers more than men. An analysis into such behavioural patterns could help WII providers to package their products in a gender sensitive manner so as to appeal to the needs of both male and female smallholders, which will potentially increase demand.

The more information is understood about the characteristics and preferences of the target population, and the more inclusive the insurance product or package is, the more likely it is to influence demand in a positive way. For as long as WII suppliers do not genuinely put the people first, combining WII with other innovations will not increase demand. Bundling WII with key farm inputs such agricultural inputs (i.e., fertilisers, seeds, loans, etc.), key agricultural institutions (e.g., Agri-banks, input suppliers, farmers' organisations, etc.) has not boosted demand for WII in Malawi [27]. From the lessons learned in this chapter, a 'One Size Fit All' WII design does not work well in SSA – what worked in Machakos County, Kenya did not work in Eastern and Northern Ghana.

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Conflict of interest

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