Integrating gender into index-based agricultural insurance: A focus on South Africa

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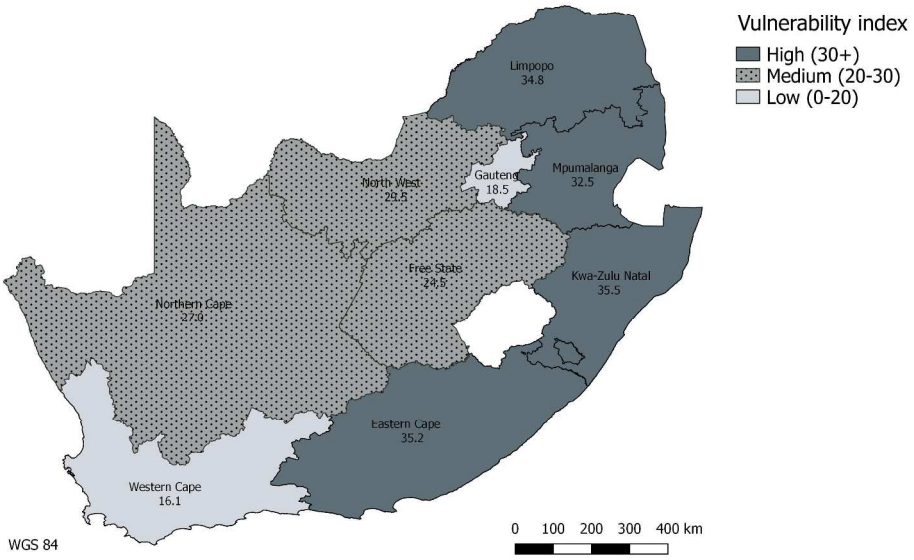

Figure 1: Relative climate shock vulnerability map of South African provinces using an index relevant to agricultural households with data from the Community Survey 2016: Agricultural Households by Statistics South Africa. The Vulnerability Index shown on the map is calculated by adding 6 percentage-based criteria relating to agricultural livelihoods in order to show relative vulnerability amongst the provinces. Low relative vulnerability is considered as a score below 20, medium between 20 -30 and high as over 30.

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Development in Practice

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Abstract

Index insurance is an agricultural risk management tool that can provide a safety net for smallholder farmers experiencing climate risk. While uptake and scale-out of index insurance may be slow amongst smallholders, we can learn from experiences that demonstrate where crop insurance can protect smallholders' livelihoods from climate risk. Integrating gender into climate risk management is necessary to ensure that the benefits of index insurance are experienced by both men and women. A dedicated intention to integrate gender may be required. Taking South Africa as a case study, the potential for gender-sensitive index insurance scale-out amongst smallholders is investigated.

Keywords: climate smart agriculture, resilience, climate change, gender, index insurance, agriculture, South Africa, risk management, private sector, smallholders

Agriculture insurance for climate change resilience

Catastrophic weather events can negatively impact on poor farming households with long-term and irreversible consequences when their crops or livestock are damaged or destroyed (Collier, Skees, and Barnett 2009). The barriers for smallholder farmers to increase their productivity are well known (e.g. lack of inputs, knowledge, information) and include lack of credit (Fakudze and Machethe 2015). Without credit, farmers are severely constrained from investing in agricultural inputs or technologies that may provide resilience to climate change. In a survey of 1,800 farm households in Ethiopia and South Africa, smallholder farmers cited a lack of credit and wealth as their main barriers to adaptation to climate change (Bryan et al. 2009). Access to credit via formal financial lending institutions can be limited for smallholder farmers, in particular women, who generally own less land and other fixed capital (Asfaw et al. 2015). In addition, smallholder farmers often sell their productive assets to protect their immediate consumption even if this undermines their longer term capacity to generate income and can generate poverty traps (Hellmuth et al. 2009).

Agricultural insurance provides a means of protection from financial loss (Singh 2010). Insurance can allow farmers to take risks that they ordinarily would not take, because it can provide a safety net that, for example can allow farmers to invest in agricultural inputs. Insuring against risk can help to incentivise the availability of, and demand for, credit (Carter et al. 2014). Index based weather insurance is a particular type of insurance that uses models of how climate extremes affect crop production to define certain climate triggers that if surpassed have extremely high probabilities of causing substantial crop loss. When harvest losses occur associated with exceeding the climate trigger threshold, the index-insured farmer would be entitled to a compensation payment. If the farmer's crops fail due to an insurance covered climate risk, they can have some assurance that they will not fall as quickly into a poverty trap.

Index insurance is considered a Climate Smart Agriculture (CSA) practice because this financial tool potentially offers the opportunity for smallholder farmers to increase their resilience and minimize their risk in relation to livelihood changes arising from weather shocks (FAO 2013). Unfortunately, index insurance schemes still fail to attract the clients (e.g. smallholder farmers) considered to be most in need of this climate risk management tool (Gine, Karlan, and Ngatia 2011, Delavallade et al. 2015, Akter et al. 2016). In this paper, we consider some gender issues that can affect the functioning of index insurance systems.

What is index-based insurance?

Conventional indemnity-based insurance, also known as multi-peril crop insurance, typically covers multiple risks or perils that affect farmers' crop yields and is based on individual yield shortfalls which are verified by an assessor (Hansen, Rose, and Hellin 2017). Due to high transaction costs associated with assessment and low purchasing power of smallholders, multi-peril insurance is expensive and considered unfeasible for smallholders farmers in low income countries (Hansen, Rose, and Hellin 2017). Index insurance links insurance payouts to an index, such as rainfall, temperature, humidity or crop yields, rather than actual yield

shortfalls. There are two main types of indices used in index insurance: 1) weather-based; and 2) area yield indices.

1) In weather-based indices, the chosen meteorological index is typically the indicator of yield that is affected by weather, i.e. that can indicate when there are particularly bad yields (Binswanger-Mkhize 2012, Leblois and Quirion 2013, Carter et al. 2014). Weather-based indices must be highly correlated to agricultural production, easily quantifiable, publicly verifiable, and not subject to manipulation by the insuree (Carter et al. 2014). In addition to numerous projects implementing index insurance as a viable commercial product, there are several studies using hypothetical weather index insurance products to gauge interest and more realistically determine the probability of success of a project or product in African countries (Skees 2001, Hill, Hoddinott, and Kumar 2013). See Yuzva et al. (2018) for more studies.

2) Area yield indices are based on historical average yield losses over a specific region and are usually for a specific crop (Wang et al. 2013, Tadesse, Shiferaw, and Erenstein 2015). Area-yield indices require data that is reliable and long-term, which is not always available (Wang et al. 2013).

Index insurance based on meteorological indices is a more common form of index insurance to date, because data relies on weather records, which tend to be more available (Wang et al. 2013).

Weather-based and area yield indices can also be combined into one index. In a study of index insurance in South African maize cultivation, Wang et al. (2013) found that multivariate weather indices (which involves observation and analysis of more than one variable at a time) are superior to single variables indices when considering correlation of the index to yield. Historical yield records in South Africa are only available at the provincial level and are not available yet at the finer-scale district level (Wang et al. 2013).

Although a promising CSA tool, index based agricultural insurance faces some challenges for scale out across multiple farms, farmers and agricultural landscapes. Weather indices do not provide a direct measurement of farmer's yields. The extent of correlation between the meteorological data used for an index and the crop yield attained can actually be quite weak which leads to a problem called basis risk (Leblois and Quirion 2013, Yuzva et al. 2018). At the location of meteorological monitoring (i.e. a rain gauge or weather station), rainfall levels may exceed the threshold (or trigger) level for defining a drought, while at an insured farm at a different location there could be a drought with farmers experiencing different losses (Carter et al. 2014, Bageant and Barrett 2016). However all farmers would receive the same pay-out from an index insurance scheme because they are all covered by the same index formula and data, irrespective of their specific geographic coordinates (Collier, Skees, and Barnett 2009, Carter et al. 2014, Greatrex et al. 2015). The risk that the index may not correlate well with yield losses increases where there is high spatial variability of weather patterns. This risk can be minimised by having many weather stations (Leblois and Quirion 2013), which is not always an option in poorer regions where there is little public or private investment for provision and maintenance of such weather stations.

Conventional agricultural insurance systems have high transaction costs because a qualified assessor must travel to each farm to assess damages when a claim is made. Index insurance has the advantage of not requiring on-site inspection as it protects against shared (weather-related) rather than individual risks. In index insurance systems, assessing damage in each field is not required. Instead data from satellites, weather stations and historical yields are used. Due to its lower costs of implementation and operation (Carter et al. 2014) index insurance may be more suited to smallholders than traditional loss-based insurance systems (Yuzva et al. 2018).

Another advantage of index insurance is that *moral hazard* and *adverse selection* are reduced. *Moral hazard* is a term used to describe the risk of farmers falsifying losses (Peterson 2012). With multi-peril insurance, some farmers may be tempted to let their crops fail because a pay-out is guaranteed (e.g. as an alternative to efforts to rescue a bad harvest). *Adverse selection* occurs when the insuree possesses hidden information about their risk exposure which the insurer does not possess, resulting in an inaccurate assessment of risk by the insurer (Carter et al. 2014). Adverse selection results in farmers with greater risks preferentially purchasing insurance which increases premiums and payouts (Hansen, Rose, and Hellin 2017).

Index insurance as an emerging CSA tool

It could be assumed that smallholder farmers are not overly interested in index insurance as a product due to the low rate of uptake (Zevenbergen 2014, Yuzva et al. 2018). Private sector agricultural insurance companies will have the most information on insurance demand, markets and potential clients, but due to the nature of private sector competition, information on insurance uptake is not always publicly available. Evidence is now emerging of scale out of index-based insurance for smallholders from different parts of the world, with the growth in uptake of index insurance from year to year looking promising (Hansen, Rose, and Hellin 2017). Some examples include the Indian National Index Insurance Programme (reaching 30 million farmers); the East African Agriculture and Climate Risk Enterprise (ACRE) (reaching 200,000 farmers); the R4 Rural Resilience Initiative in Ethiopia, Senegal, Malawi and Zambia (reaching over 40,000 smallholders); the Mongolia Index-Based Livestock Insurance Project (IBLIP) (15,000 nomadic herders); and the Kenya/Ethiopia Index-Based Livestock Insurance (IBLI) project (reaching poor nomadic pastoralists).

Greatrex et al. (2015) cite some reasons for the success of some index insurance schemes, including; explicitly targeting obstacles to improving farmers income; integration of insurance with other development interventions; giving farmers a voice in the design of products; investing in local capacity; and investing in science-based index development. Akter et al. (2016) highlight the potential for index insurance to bring social safety net benefits to women farmers who may have low adaptive capacities. Insured farmers involved in the ACRE project earned 16% more income and invested 19% more compared to uninsured farmers in the same area (Greatrex et al. 2015). However there was minimal

information on the types of farmers who purchase ACRE products, and a lack of any significant collection of gender aggregated data (Greatrex et al. 2015).

In India a range of index insurance schemes are in operation, with insurance reported to have reached approximately 24% of farm households (Greatrex et al. 2015). However this is not due to the private insurance sector alone. In India, scaling out index insurance can be attributed to a state subsidy of 75% of insurance premiums. Furthermore, in India, insurance is also a criteria to access agricultural credit from the state (Singh 2010, Binswanger-Mkhize 2012).

India apart, considering the number of smallholder farmers who are likely to be impacted by climate-related risk, the numbers of smallholders involved in insurance schemes remains low (Binswanger-Mkhize 2012, Greatrex et al. 2015). The uptake of index insurance in developing countries has been considered to be slow, with several studies reporting an uptake rate below 30% amongst targeted farmers in Malawi (Giné and Yang 2009) and India (Cole et al. 2013). While 30% is a relatively high percentage, this figure occurred in studies where farmers were specifically targeted, which seems to bode ill for future index insurance endeavours where a more passive delivery channel may be taken. Indeed, Akter et al. (2016) describe the market for index insurance as a stand-alone product as poor both in terms of demand and governance.

Several lessons have been learned as index insurance schemes have increased in number and studies are emerging with results. Scarcity of both long-term meteorological data and farmer yield data prove to be challenges for creating insurance products. Nieto et al. (2012) investigated drought index insurance for beans in Nicaragua and recommended combining modelled weather data (such as *'MarkSim'* and *'WorldClim'*) with a reliable crop model to produce predictions of risk that could be used in index insurance. Akter et al. (2016) investigated index insurance for crops in Bangladesh and recommended that index insurance schemes should focus on improving the credibility of institutions offering insurance as trust is an essential component of providing financial services.

Gender and scale-out of index insurance with smallholder farmers

Index insurance programs can experience difficulty in reaching their target clients who need insurance protection, which can often mean female smallholder farmers (Gine, Karlan, and Ngatia 2011, Delavallade et al. 2015). There is some evidence that participation of female farmers in weather index insurance pilot programmes in Africa has been lower than male farmers (Delavallade et al. 2015). For example, in a randomized field experiment conducted in Burkina Faso and Senegal, female participants had a significantly lower demand for insurance than male participants, spending 570 CFA francs less on insurance than men (Delavallade et al. 2015). This was noted by the authors as a sizable difference, being close to 30% of the average amount spent on insurance in the study. One possibility is that women may not farm the 'main' crop of the household and would prefer insurance for a different crop altogether. On the other hand, Bageant and Barrett (2016) found that index-based livestock insurance was equitably accessed by female and male pastoralists in Ethiopia, and that evidence for gender-differentiated demand was limited. Understanding

the factors, both financial and non-financial, that determine demand for insurance may help to improve smallholder's access such risk-mitigation products and to promote this CSA practice.

A slow uptake of index insurance may also be due to insurance providers not adequately considering gender issues (such as specific constraints that rural women face) or due to different communication channels being required to reach female farmers. Experts at a workshop in Senegal entitled "Scaling Up Climate Services for Farmers in Africa and South Asia" highlighted the necessity for emphasizing gender and social differentiation at the outset of climate service projects (Tall, Jay, and Hansen 2013). Key gender questions for index-based insurance that can usefully be asked, include; What are the different experiences and roles for men and women in agriculture which might have an effect on how they benefit from or get involved in index-based insurance? What are the implications of such differences for the scale out of index-based insurance? Given these implications, what do the institutions involved need to do when pursuing the piloting or scale out of index-based insurance to ensure equality of uptake amongst men and women?

A common reason cited for limited uptake of index insurance by smallholder farmers is that they cannot afford such a product (Hellmuth et al. 2009, Binswanger-Mkhize 2012). However, some practitioners argue that when index insurance is offered as part of a portfolio of risk management strategies, it will be tested by farmers (Hellmuth et al. 2009). For instance, ACRE in East Africa offers index insurance which is linked to agricultural credit provided by microfinance institutions (Greatrex et al. 2015). According to a recent assessment by Carter et al. (2017), removing risk through index insurance has the potential to boost smallholder income and investment by between 20% and 30%. In other contexts, subsidies may have to be used for the initial seasons until the product is viable. Another challenge related to affordability is the timing of when index insurance is offered to farmers. In a study with farmers in Ethiopia, paying the premium was not a problem when cash was available directly after the harvest (Patt et al. 2009, Hellmuth et al. 2009).

A lack of trust in insurance companies has been identified as a possible barrier to scaling out index insurance products (Carter et al. 2014), coupled with a lack of understanding of the core concepts regarding index insurance (Binswanger-Mkhize 2012, Carter et al. 2014, Bageant and Barrett 2016). Some form of financial literacy is required to assess the risks and understand the application procedures and the payout criteria. For example, both men and women need to more clearly understand that the purpose of the insurance is to protect against the risk or possible chance that they will lose their crops due to the climate. Financial literacy training could focus on unpacking associated terms with the aim of increasing confidence and knowledge when buying insurance. For instance, women and men need to understand terms such as 'premium', 'broker', 'term cover', 'interest' (often seen as a 'fee'), and 'insurance policy'. They also need to trust who is providing them with advice, and believe they are "on their side" in terms of the information provided on insurance products and their ultimate rights. Men and women also require clarity on what insurance policy actually covers, the price each week, or on each instalment, and how to make a claim or cancel. Financial literacy materials that have been specifically developed may help. According to Wentzel (2016) institutions in South Africa, (mainly banks and

insurance firms) are making the greatest efforts with regard to financial literacy for the general population, whilst professional bodies also participate in financial education (including the South African Insurance Institute). Wentzel however questions the effectiveness of financial education programmes, referring to erroneous errors about how the poor manage their money in particular how those in poverty manage small and unreliable flows of money.

Another factor for consideration is that index insurance products may be gendered in their crop choice. There are instances where women grow certain crops and men grow other crops in the region. There could be a gendered difference in the crop grown as seen in an index insurance workshop in Ghana, where farmers identify groundnuts as more often grown by women (Greatrex 2016). Index insurance products tend to focus on one or two primary crops grown in an area depending on their importance for food security, their prevalence and the potential for farmers to invest in products. Thus the chosen crops for index insurance may be grown only by men or only by women. It is important to consider these factors in designing and scaling out index insurance products.

South Africa provides an example where index insurance schemes have yet to reach smallholder farmers at scale. This paper focuses on South African agricultural sector, making the case for the improved consideration of gender-related factors in index insurance programmes with smallholder farmers.

Climate change challenges facing South African agriculture

The South African agricultural economy contributes approximately 2.5% of GDP (DAFF 2016) and is responsible for about 9% of formal employment (Wang et al. 2013). The agricultural sector contributes a further 12% to the GDP due to post-harvest manufacturing and processing activities which adds value (DAFF 2016). The agricultural economy of South Africa largely exists in two large sectors, with a well-developed commercial agriculture sector and a subsistence agriculture sector (Wang et al. 2013). Water availability is the key limiting factor for agricultural production in South Africa (Wang et al. 2013). The country is the 30th driest in the world (Hedden and Cilliers 2014) where rainfall is unevenly distributed on a spatial scale, generally increasing from west to east (Gbetibouo, Ringler, and Hassan 2010). Rainfall in South Africa displays strong inter-annual variability with prolonged droughts and dry periods (Gbetibouo, Ringler, and Hassan 2010).

Provinces in South Africa experience different levels of livelihood vulnerability due to differing social and economic development (Gbetibouo, Ringler, and Hassan 2010). Out of the nine provinces of South Africa, three provinces contain more than half of the agricultural households in the country, namely Kwa-Zulu Natal (23%), Eastern Cape (21.3%) and Limpopo (16.6%). These three provinces also have the highest number of female-headed agricultural households and the highest number of households headed by children. The climate shock vulnerability map in Figure 1 was developed to depict a vulnerability index of South African provinces using six criteria; (1) percentage of agricultural households per province, (2) percentage of households reliant on only rainfed agriculture, (3) percentage of

GDP dependent on agriculture per province, (4) unemployment rate per province, (5) percentage of agricultural households without access to a flushing toilet and (6) percentage of agricultural households which have experienced no schooling (Figure1; Supplementary Table 1). These six criteria were chosen to represent factors in smallholder farmers livelihoods that may affect their capacity to adapt to climate change. Also considered in criteria choice were some of the indices used by Gbetibouo, Ringler, and Hassan (2010) in a study of vulnerability of the South African agricultural sector. The indices chosen to be used were literacy rate, unemployment rate and provincial GDP share in agriculture. Given the high number of female-headed households in the three provinces which contain more than half the agricultural households, it is critically important that gender-related agricultural factors should be included in planning or initiatives for smallholders, including insurance provision.

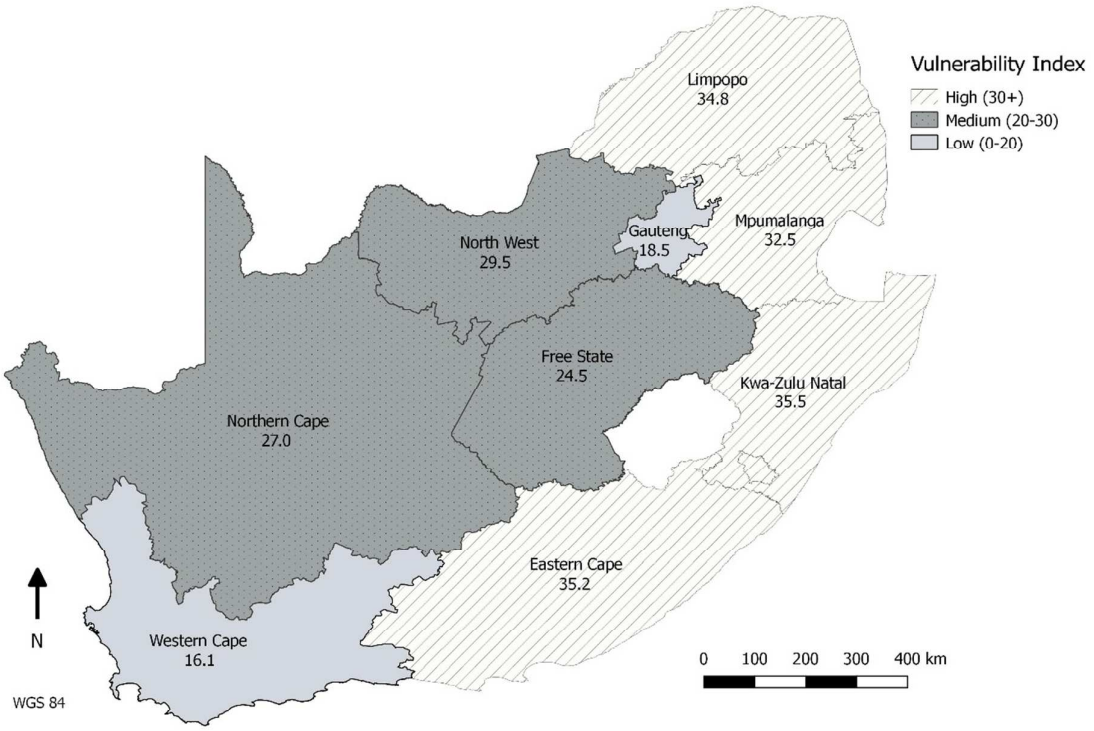

Figure 1: Relative climate shock vulnerability map of South African provinces using an index relevant to agricultural households with data from the *Community Survey 2016: Agricultural Households* by Statistics South Africa. The Vulnerability Index shown on the map is calculated by adding 6 percentage-based criteria relating to agricultural livelihoods in order to show relative vulnerability amongst the provinces. Low relative vulnerability is considered as a score below 20, medium between 20 -30 and high as over 30.

Companies providing agricultural insurance in South Africa

In South Africa, there are only a few private insurance companies that provide agricultural insurance to farmers and pastoralists. According to Roberts et. al (2016) the most popular insurance product held in South Africa is an account with a burial society, serving as a form

of social protection (Roberts, Struwig, and Gordon 2016). The share of respondents with an account with a burial society has grown over the period 2011-2015 (from 19 to 28 percent), with poorer populations purchasing this insurance.

Table 1 provides an overview of private sector insurance providers for the agriculture sector in South Africa. To date, agricultural insurance in South Africa has tended to focus on commercial farmers. The South African Insurance Association (SAIA)[1] has indicated that there are currently no index insurance programmes for agriculture in South Africa although a pilot project may soon begin with a partnership between insurers and national government (SAIA, pers. comm).

Insurance company	Agricultural insurance products offered	Website	Provinces insurance is offered	Types of farmer covered	BBBEE* certificate accessible online
Santam	Offers indemnity insurance to farmers. Asset, game, crop and dairy insurance	www.santam.co.za/	All provinces	Commercial	Yes
Standard Bank	Crop, livestock and farming equipment insurance	www.standardbank.co.za/	All provinces	Small-scale and commercial	Yes
MSB Insurance Administrators	Crop and livestock insurance	www.msbia.co.za/	All provinces	Commercial	No
Hollard	Livestock and pedigreed animal insurance	www.hollard.co.za/	All provinces	Small-scale and commercial	Yes
Old Mutual Insure	Crop, livestock, irrigation systems and building insurance	www.oldmutual.co.za/insure	All provinces	Commercial	Yes
Land Bank Insurance Company	Crop, livestock and asset insurance	www.landbank.co.za/	All provinces	Small-holder and commercial	Yes
AgriSeker	Crop and asset insurance	www.agriseker.co.za/	All provinces	Small-holder and commercial	No
First National Bank	Livestock, game, buildings and equipment insurance	www.fnb.co.za/	All provinces	Commercial	Yes
Nedbank	Property damage, machinery breakdown, crop and livestock	www.nedbankinsurance.co.za/	All provinces	Commercial	Yes

[1] SAIA represent all relevant stakeholders in the short-term insurance industry in the country

	insurance				

Table 1: Major private sector insurance companies offering agricultural multi-peril insurance in South Africa. It should be noted that while different types of agricultural insurance are offered in all provinces, the type of crop insured determines in which province a farmer can buy insurance. *Broad-Based Black Economic Empowerment (BBBEE)

Gender, Agriculture and South Africa

Identifying policy entry points that support a focus on gender equity in South Africa can be useful to map institutional entry points for an equality focus on smallholder farmers. Planning strategies and resource allocations in agriculture can influence service provision and private sector incentives (including insurance). A range of national mandates exist on gender equality and empowerment in South Africa.

The National Policy Framework for Women's Empowerment defines gender equity as "fair and just distribution of all means of opportunities and resources between men and women". The Draft Strategic Framework on Gender and Women's Economic Empowerment prepared by the Department of Trade and Industry of South Africa (DTI) was published in 2006. The Codes of Good Practice for Broad-Based Black Economic Empowerment (BBBEE) of 2003 describe practices for compliance with different levels of BBBEE for businesses. There is an emphasis on including black women, black youths and black people in rural areas as beneficiaries on BBBEE scorecards for businesses.

The Integrated Growth and Development Plan (IGDP) of 2012 for Agriculture, Forestry and Fisheries (DAFF) in South Africa identifies a lack of access to information as one of the barriers smallholders encounter in the pursuit of their own empowerment. The IGDP includes equity in the agricultural sector as part of its vision statement. Equity in terms of gender and access to information is identified as a challenge facing the sector. IGDP appears to only have gender disaggregated data for forestry where the percentage of black women engaged in different forestry activities is detailed.

The South African policy framework specifically mentions the lack of access that women have to credit, land, marketing information and technology, thus reducing their contribution to agricultural production. The National Policy Framework for Women's Empowerment and Gender Equality highlights that women continue to have limited access to land and control over resources in South Africa due to historical factors and unequal gender relations. Land tenure is often the only collateral accepted in debt markets or by banks. Women's land rights are described as limited and insecure by this policy framework.

Bearing in mind that it is difficult to define land ownership or legal right to land (Doss et al. 2017) women's ability to claim land entitlements can described as more variable because they often face more obstacles than men. In instances where women can inherit land, it is possible that they must forfeit control to male relatives. Land reform sometimes fails to include women, where women tend to have less information on procedures for accessing

land than men. Capacity building targeted at women is cited in the National Policy Framework as a way to increase their participation in land reform programmes.

South Africa has recognised gender equality and empowerment as policy issues; has a mandate to rectify inequalities; and codes of good practice for business exist. If index linked insurance in the agriculture sector is accepted as a relevant CSA practice, pilot schemes may first be necessary to determine whether such insurance is beneficial for smallholders in provinces that display livelihood vulnerability and high numbers of female-headed households. However such pilot schemes should be carefully designed. What can South Africa learn about gender and index linked insurance in agriculture from other countries?

Trust is a powerful currency that is linked to financial literacy

Multiple reviews of agri-insurance highlight lack of trust as a limiting factor to insurance uptake, particularly in the case of index-based agri-insurance (Greatrex et al. 2015). A study in Bangladesh found that the levels of trust associated with institutions could be categorised by gender (Akter et al. 2015). In this study, women who had been the victims of financial fraud before were less trusting (that the insurance scheme would pay out) than men (Akter et al. 2015). Women who had experienced financial fraud in the past tended not to trust local financial institutions when compared to those who had not experienced fraud, and preferred their insurance provider to be government banks (Akter et al. 2015). Three quarters of women in this study also stated that they rely on male household members to make the financial decisions, citing their lack of high education as a reason for this. To overcome these challenges, Akter et al. (2015) recommend investing in increasing institutional credibility; investing in programmes aimed at boosting women's financial literacy; and making weather index insurance forms and processes simpler for increased understanding. Cai, de Janvry, and Sadoulet (2014) found that modest financial training significantly improved the uptake of index insurance in a study of 200 villages in Jiangxi, China. Carter et al. (2014) suggest the importance of optimizing social networks for the circulation of knowledge about insurance and finance. Whether South African smallholders, particularly female-headed households would trust agriculture insurance products offered by insurance companies remains to be determined.

In some cases, when an initiative is endorsed by government, it is trusted, while in other cases some rural populations may not fully trust the government. Patt et al. (2009) suggest that clear regulations by the government or the insurance industry can help build trust and is a way to ensure that contracts are fair and transparent (and that claims are prompt and reliable).

Bundling services as a strategy for increased insurance uptake amongst smallholders

If trust in institutions is limiting insurance uptake, improved arrangements between the public and private sectors towards a shared objective for the improvement of livelihoods may be feasible. Such public-private partnerships can allow for the bundling of services and a reduction of risk. For example, partnerships between banks, research institutions, mobile network providers, government agencies and insurance providers can be formed to support index insurance. Patt et al. (2009) suggest that piggybacking insurance schemes onto pre-existing programmes (that have managed successful projects) to encourage trust in institutions providing insurance. Bundling provisions with burial insurance may be worthwhile to consider in South Africa, or introducing the concept of index insurance as an agricultural risk management tool via agricultural training and extension (Patt et al. 2009). ACRE attribute their rapid scaling and demand for agriculture insurance to their wide range of partners (Greatrex et al. 2015). The R4 Rural Resilience Initiative (R4) is an example of a public-private-partnerships for vulnerable women and men to manage risk in the face of climate shocks. Originally started in Ethiopia, R4 has expanded to Senegal, Malawi and Zambia. The risk management strategies in R4 means that insurance is bundled with credit and savings programmes, allowing for investment in inputs like improved seeds and fertilizers (R4 2016). The impact of R4 in Ethiopia on farmers and pastoralists includes an increased level of grain reserves compared to uninsured farmers and an increased number of oxen of insured farmers compared to the uninsured (Greatrex et al. 2015). How women are further benefiting from increased grain reserves will be useful information for the future, and may help in building confidence in index insurance, provided such information is transmitted via channels that women trust.

Designing an insurance pilot for smallholders

Focusing on bottom-up consultation may be important to ensure a pilot programme is carefully designed and focused on the right crops for both women and men. If land tenure is required, bottom-up consultations will demonstrate who actually has land rights. A yield-based insurance programme in Tamil Nadu, India showed high levels of satisfaction by farmers which was attributed to a farmer-driven design (Zevenbergen 2014). It is also important that the institutions offering index insurance make an effort to ensure that their product and concepts (like basis risk) are well understood by both women and men. There is evidence that role play or scenario games can be valuable tools in establishing trust and in increasing understanding of how index insurance works when first introduced (Peterson 2012, Tadesse, Shiferaw, and Erenstein 2015).

Indicators on male and female involvement and sex disaggregated data will help inform index programmes, in particular it may help design more farmer-driven and tailored products. Even if collected, an institutional challenge is to ensure that such data are analysed. In Tamil Nadu data for satisfaction levels for men and women farmers was not collected. Nevertheless, farmers had input into the design of the product, with a formal feedback and assessment process where chosen farmers could represent their community (Zevenbergen 2014). The R4 Rural Resilience Initiative in Ethiopia is tracking gender indicators. Their Quarterly Report of 2016 has gender-disaggregated data for each risk management strategy and for each region. For example, In Tigray there were 437 insured

farmers who were trained on savings, credit and income generating activities, 243 of which were women (R4 2016). Whilst such information is an important step, it provides a partial picture. The report does not yet fully identify the constraints women smallholders face in accessing risk management strategies, which may be useful for tailoring activities. To date, the focus seems to be mainly on participation of women, which is a useful starting point.

Before investing in an index-based agricultural insurance programme a 'dry run' is often recommended (Greatrex et al. 2015). The R4 Rural Reliance Initiative call the dry run the first year of the project, which involves consulting with farmers and local experts to design an initial index and develop capacity. The second year of the programme involves rolling out the programme to many more farmers while continuing refinement and scaling (Greatrex et al. 2015). This strategy of using a controlled environment to test feasibility appears to be effective as the number of farmers insured under the R4 initiative grew rapidly from 200 in 2009 to 24,000 in 2014 (R4 2016).

These types of consultative or participatory processes can be useful in designing and scaling out a viable index insurance programme, but may initially counter efforts to keep transaction costs low. However, just because the introduction of an initiative is consultative and participatory in nature, this does not necessarily ensure that the process is also gender sensitive (Cornwall 2003). Deliberately involving both male and female farmers in product design will be may important for scale out of index insurance in South Africa.

In addition to the use of participatory processes for product design, Yuzva et al. (2018) recommend the use of more sophisticated insurance contracts so that the index more accurately represents actual crop losses. Although, while this may reduce basis risk, Greatrex et al. (2015) argue that it is important that contracts are simple enough for farmers to understand and therefore trust.

Financial literacy and insurance payments

The use of mobile phones to deliver insurance pay-outs can increase efficiency and decrease transaction costs (Cole 2015), and could potentially help in scaling out index insurance. Murray (2015) has highlighted that mobile phone technology can make it easier to ensure cash payments go directly to women, contributing to 'economic empowerment'. It is often alleged that women generally have less access to and use fewer ICT's than men in developing countries (Huyer 2012). Despite the promise of weather forecast bulletins as potential benefits of mobile phones (UNCTAD 2014), literacy to read weather forecasts and cash payments can be low in some areas for rural populations. Gender differences are apparent from a number of studies of financial literacy. In some instances, financial literacy training may be lacking, where women have been found to have less fully grasped financial concepts than men (Akter et al. 2016), possibly due to women having fewer years in formal education. In contrast, a 2015 South African Survey on financial literacy study did not find any statistically significant correlation between financial literacy and gender (Roberts, Struwig, and Gordon 2016). Awareness of formal financial products was positively correlated with household resources. Wealthier individuals were more likely to answer

interest rate questions correctly, while marriage encouraged individuals to acquire better levels of financial knowledge (Roberts, Struwig, and Gordon 2016).

Limited phone reception could be a potential problem in using mobile pay-outs as farmers may live in areas not covered by cell phone service providers (Greatrex et al. 2015). The question of mobile phone ownership and use of smart phones in a region can be difficult to determine. In a study of the use of mobile phones by youths, Porter et al. (2012) found that slightly more females used phones than males in South Africa. The study looked at mobile phone usage in a week amongst 9-18 year-olds in South Africa and found that 62.1% of females interviewed had used a phone in that week compared to 51.2% of males (Porter et al. 2012). It should be noted that in addition to only investigating youths, this trend does not differentiate between rural and urban populations so is unlikely to be reflective of smallholder farmers' mobile phone use. Nonetheless, such studies illustrate that mobile phone usage (including for index based agricultural insurance) may be gender differentiation in different contexts. Trends in ownership disaggregated by region, age and sex should be considered when designing and scaling out index insurance programmes in South Africa. Gender aggregated data for mobile phone ownership by farmers in South Africa may be difficult to obtain, but efforts can be made through the various service providers and would be a useful reference point.

Institutions in South Africa for scaling out index insurance and for ensuring gender equality

A range of institutions in South Africa were identified as having potential to help to advocate or provide support for index insurance as an agricultural risk management tool in South Africa (Table 2). For instance, the Micro-Agricultural Financial Institutions of South Africa (MAFISA) aims to establish an agricultural credit scheme by offering loans to smallholder farmers from historically disadvantaged backgrounds. MAFISA's service could potentially be combined with insurance schemes to provide a bundled service package to farmers. This type of arrangement was put in place by the Agricultural and Climate Risk Enterprise (ACRE) in East Africa.

The Department of Agriculture, Forestry and Fisheries (DAFF) owns the Land and Agricultural Development Bank of South Africa (Land Bank). The Land Bank does not receive funding from the government and competes in the market for resources. As a government owned agricultural financier, the Land Bank aims to bring previously marginalized farmers into the mainstream agricultural sector. However, financial services are targeted at the commercial agricultural sector rather than smallholders. Financing by the Land Bank is aimed at 'historically disadvantaged' farmers, although this category of farmers does not seem to be fully defined in their policy. They also aim to remove the legacy of racial and gender discrimination in agriculture.

The Agricultural Research Council (ARC) is an institution that conducts research for the development of the agricultural sector in South Africa. ARC has participated in the Land Degradation Assessment of Drylands, submitting reports to international organisations for numerous regions in South Africa. These assessments have considered gender roles in land

resource management in the areas investigated, such as women weeding and managing the fields, and men fencing the fields and ploughing with donkeys in Ga-Kgatla Village. ARC could be useful in supporting the inception of a pilot index insurance product and guide the process of considering gender in the design and scale-up.

The South African Weather Service (SAWS) is an agency of the Department of Environmental Affairs (DEA) and provides public and commercial services and may be a useful partner for scaling out index insurance. Their weather stations could be instrumental in establishing a weather index and rolling out insurance pilots in South Africa. The Climate Systems Analysis Group (CSAG), based at the University of Cape Town, conducts research around weather forecasting and its use for farmers, both commercial and smallholder. For example, Ncube et al (2016) examined household vulnerability and CSA, taking gender into account in their vulnerability assessment.

According to the vulnerability index in figure 1, Limpopo, Mpumalanga, Kwa-Zulu Natal and the Eastern Cape are the most vulnerable provinces in the context of agricultural and socio-economic circumstances. A weather index insurance (WII) pilot in this these regions would have high potential to target the smallholder farmers experiencing climate risk most threatening to their livelihoods. Often WII programs do not attract clients most vulnerable to weather shocks (Akter et al. 2016) thus the vulnerability index here may provide a preliminary method for identifying farmers most in need of climate risk management. Maize is a staple food crop in South Africa and is grown across large parts of Mpumalanga, Kwa-Zulu Natal and Limpopo (Wang et al. 2013). Beginning with a WII product targeted at maize growers in vulnerable regions could prove effective as a pilot with potential to scale out and include more regions and crops.

Activity to support provision of index-insurance to smallholders in South Africa	**Example of institution that could support or implement the activity**
Participatory design of insurance products	Farmers co-operatives, National Agricultural Marketing Council, Southern African Confederation of Agricultural Unions, Land Bank, Department of Agriculture, Forestry and Fisheries
Designing indices for insurance product	Statistics South Africa, South African Weather Service, Forum for Agricultural Research in Africa, Agricultural Research Council, Climate Systems Analysis Group
Integrating insurance with development interventions	Comprehensive Africa Agriculture Development Programme, South African Development Community, Department of Environmental Affairs, Department of Agriculture, Forestry and Fisheries, Department of Rural Development and Land Reform, Consortium of International Agricultural Research Centres, Micro-

	Agricultural Financial Institutions of South Africa
Institutions for knowledge sharing and learning	Land Bank, Department of Environmental Affairs, Department of Agriculture, Forestry and Fisheries, Department of Rural Development and Land Reform, African Food Security Urban Network, African Union, Agricultural Research Council, Food, Agriculture and Natural Resources Policy Analysis Network , South African Insurance Association, Consortium of International Agricultural Research Centres, Micro-Agricultural Financial Institutions of South Africa

Table 2: Institutions that can support scaling out of index insurance in South Africa. African Bank

Moving beyond South Africa, the Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) is an inter-sectoral platform that has country-level nodes. FANRPAN promotes policy in food and agriculture by facilitating partnerships between government and civil society and supporting policy research. FANRPAN has organised training in the past for various stakeholders, targeting subjects ranging from conservation agriculture to climate change leadership and policy advocacy. The organisation addresses gender in climate change policy and could be useful for capacity development on gender, insurance or agricultural finance in the region.

The African Union established the African Risk Capacity agency to help improve the ability of African member states to plan, prepare and respond to natural disasters and extreme weather events so that food security of vulnerable populations is also protected (ARC 2018). The Conference of the Parties (i.e. 26 Member States) to the Agency are all part of an index-insurance initiative. Although South Africa is not a member of the African Risk Capacity, joining may have several benefits for South Africa including being part of a network that has experience in implementing insurance schemes for smallholders.

Conclusions

While index insurance is an agricultural risk management tool that holds potential for smallholder farmers in South Africa, it is not a panacea for all climate-related risks experienced by smallholder farmers. It is one tool amongst others which can be leveraged to help male and female vulnerable farmers to better respond to climate risk.

In this paper we have highlighted lessons learned from existing index insurance programmes (from Ethiopia, India and Bangladesh) from a gender equality perspective. Key issues identified included; ensuing information and technology reaches poorer smallholders, building trust of financial institutions amongst both male and female smallholder farmers, public private partnerships, and linking to existing institutions. Using national gender equality mandates to focus attention on female-headed households was also highlighted as important. In South Africa the lack of access women have to land, resources, and extension services may affect their interest in this form of insurance.

Male and female farmers need to better understand the risks associated with index-based agricultural insurance, i.e. that it covers specific events and that it is possible that they can experience a loss that is not covered (Patt et al. 2009). South Africa has yet to implement any index insurance projects for farmers. We have outlined institutions in South Africa that could potentially play a pivotal role in building trust, by including smallholder farmers in product design and maintaining communication with clients. Clearly, a high level of trust in an institution is required before farmers will purchase weather-indexed insurance. Trust can be built by emulating the consultative and participatory efforts that have been proven to work in pilot initiatives elsewhere. In some contexts, partnership with national government agencies may help to build trust. Public-private partnership initiatives may be effective for establishing trust in index insurance. In parallel financial education programmes need to be adapted in order to become more effective (Wentzel, 2016). If there are plans to begin implementation, which according to the South African Insurance Association there are (pers comm, 2018); a different approach involving financial literacy for smallholder farmers should be considered, building on lessons from those who have worked in this area (Wentzel, 2016).

However, index-based insurance as a CSA risk management tool may not be effective in every circumstance. There are still many challenges with index insurance such as basis risk, data management and communication with clients (FAO 2013). In addition, some of these challenges have gender dimensions. The authors consider that pilot based approaches for the scale out of index insurance in South Africa are necessary. Gender sensitive consultative methods should be employed to allow farmers involvement in the design of insurance products that serve their needs.

Data on the gender situation in agricultural insurance is lacking, and if collected would be extremely useful for addressing challenges and barriers to scale out of index insurance. It is important to stress that rural smallholder farmers are not a homogenous group, and that broad sweeping statements about women in agriculture may be counter-productive to developing and deploying index-insurance products that meet specific needs of specific smallholder communities. This is why a focus on gender can help those involved in index-based insurance to disaggregate smallholders (beyond binary male female ratios) and move beyond the “one size fits all” approach to scaling out of programmes. Further research is required to examine the nuances of gender in South African smallholder agricultural systems and associated implications for scaling out weather-index insurance, in particular methods which insurance companies can use to assess the implications of their products on different smallholder farmer communities.

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Supplementary Table 1: Indicators used to generate vulnerability index for smallholder farmers in different provinces in South Africa

Criterion		Western Cape	Eastern Cape	Northern Cape	Free State	Kwa-Zulu Natal	North West	Gauteng	Mpumalanga	Limpopo
1	% agricultural households per province (out of total households)	3.0	27.9	13.8	13.4	18.6	13.4	4.9	18.2	24.1
2	% agricultural households dependent on only rainfed agriculture per province	42.7	40.4	46.3	33.7	37.8	41.0	41.2	35.2	44.3
3	% of GDP dependent on agriculture per province	22.6	5.0	6.1	10.3	26.8	6.2	6.0	9.0	8.1
4	% unemployment per province	20.7	34.4	30.5	34.4	24.0	27.2	29.9	32.3	20.8
5	% agricultural households without flushing toilet per province	4.3	86.3	48.2	44.4	83.0	72.2	21.1	73.8	87.6
6	% agricultural households with no schooling per province	3.6	17.2	17.1	10.7	22.7	16.7	7.6	26.3	24.0
	Sum of all 6 percentage criteria	96.9	211.2	162	146.9	212.9	176.7	110.7	194.8	208.9
Vulnerability index out of 100* (Sum/6)		**16.15**	**35.2**	**27**	**24.5**	**35.5**	**29.5**	**18.5**	**32.5**	**34.8**

* The vulnerability index was calculated using the following formula for each province: (Criterion 1 + Criterion 2 + Criterion 3 + Criterion 4 + Criterion 5 + Criterion 6)/6 = Vulnerability Index out of 100

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