Final Report

Livestock Insurance for Smallholder Farmers in Southern Africa

Supported by the Swiss Capacity Building Facility | SCBF

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Contents

Executive Summary

The "Feasibility Study - Livestock Insurance for Smallholder Farmers in Southern Africa" assesses the viability of introducing an index-based insurance solution to address drought risk faced by smallholder livestock farmers across Namibia, Botswana, and the southern region of Mozambique. The study is financially supported by the Swiss Capacity Building Facility and aims to provide insights on the demographics of smallholder farmers, livestock markets, potential distribution partners, and possible index insurance product structures. A survey of 207 smallholder farmers and bilateral discussions with various stakeholders are used to arrive at the findings.

The project team focuses on meteorological droughts, using satellite-derived vegetation density data (NDVI – Normalized Difference Vegetation Index) as a proxy for upcoming drought conditions impacting cattle health. MODIS NDVI is considered to be the most suitable underlying data source for the time being, whereas future products will be based on Sentinel 3 NDVI data. The study finds that Namibia, Botswana, and the southern region of Mozambique have suffered multiple droughts between 2001-2020, with the most severe droughts being reflected well in the NDVI data.

Among the three countries, Mozambique has the highest density of smallholder farmers, followed by Namibia. The largest cattle population and average herd size held by smallholder farmers is found in Namibia, with Botswana being a distant second. Namibia and Botswana have well-developed livestock markets, with smallholder farmers primarily engaging in the domestic market in Namibia, and those in Botswana contributing more strongly to exports abroad. However, the number of smallholder livestock farmers in Botswana and their cattle population have seen a gradual decline since 2012. Predominantly localized livestock markets with a limited degree of commercialization across the value chain are found in the southern region of Mozambique.

Among the target areas, Mozambique is the only country where index insurance is sold to retail clients. In Namibia, a strong momentum towards exploring such insurance structures is being driven by Namfisa, the country's insurance regulator. Standard insurance products covering drought are not provided in any of the three countries, except for the exploration of crop weather index insurance solutions in Mozambique during the last five years. In Botswana, the Government offers dry-land farmers a credit guarantee scheme targeting drought-related defaults.

The study assesses four distribution channels for each country. In Mozambique, collaborating with the public/development sector or selling the index insurance as a stand-alone product are the most viable options. In Namibia, bundling index insurance with agriculture loans will have the most substantial scalability potential. In the mid-term, bundling the index solution with products or services offered by livestock service providers is also seen as a possibility, as is a public sector-led scheme. In Botswana, the high involvement of the public sector in the livestock market and drought resilience limits the scope for private sector initiatives in the short term. The mid-term potential to factor index insurance concepts in public financial resilience initiatives remains viable.

The applicable policy period is similar for all three countries, with coverage between 1st October and 31st March, ensuring that vegetation growth during the wet season can be observed. A potential insurance payout, triggered by a severe shortfall in vegetation growth, would be received within one month of the coverage expiring. For the product structure proposed by this study, the insured area is based on sub-provincial administrative boundaries. Establishing a more risk-focused insured area, defined by drawing a radius around the farm location, could be a more applicable approach for certain distribution strategies.

Among stakeholders, index insurance is generally seen as an innovative approach to address the existing drought protection gap in the market. The affordability of the product remains the most frequently voiced concern, independent of the distribution channel selected. To account for price sensitivity, the proposed structure focuses on severe droughts only, with an attachment threshold set at a 10-year return period and an exit at a 25-year return period.

For the southern region of Mozambique, the study proposes to launch a pilot project in collaboration with a well-established agriculture service provider. The index insurance solution would be sold as a stand-alone product, representing a novel distribution partnership in Mozambique to reach smallholder farmers. Accompanied by a dedicated education and marketing campaign, the project could play a crucial role in increasing climate risk awareness and financial resilience among smallholder livestock farmers in the country.

A second pilot project is possible in Namibia, building on the current momentum in the market. Bundling index insurance with agriculture loans is an appealing option, requiring the product to be extended to both crop and livestock farming, essentially covering drought-induced loan defaults. The project team aims to continue engaging with various stakeholders in Namibia to open up additional distribution channels in the mid-term.

Despite the limited potential for a private sector initiative in Botswana, index insurance concepts could play a relevant role within public financial resilience initiatives. The project team suggests gaining further insights into existing schemes targeting drought-related loan defaults. The potential pilot projects in Mozambique and Namibia are subject to further discussions with the distribution partners in question, local risk capacity providers, and regulators.

Acknowledgements

The project team would like to express our gratitude to the Swiss Capacity Building Facility for supporting this study. The technical assistance grant provided was imperative in enabling CelsiusPro AG and Hollard Moçambique Companhia de Seguros SA to explore innovative insurance solutions for smallholder farmers. We would like to extend a special thanks to the SCBF Project Monitor, Reto Schneider from Allianz Re, for the excellent guidance and insights provided.

This study was supplemented with inputs delivered by independent consultants, Hans Smith, for Namibia and Botswana, and Fion de Vletter, for Mozambique. Inputs on the use of SAR data were provided by Francesco Holecz and the team at Sarmap SA and their willingness to provide a detailed example of the differences to NDVI is highly appreciated. Advice on the survey with smallholder farmers was provided by Rupsha Banerjee.

The engagement with smallholder farmers as part of this study would not have been possible without the commitment and dedication of the surveyors. We would like to extend a special thanks to the Agriculture Underwriting Team at Hollard Mozambique, including Israel Muchena, Garicai Guidione, Carlos Cossa, and Sulemangy Abubacar, for reaching out to farmers across the southern region of Mozambique. They were supported by the translation services provided by Crimilda Rafael Manhique in Mabalane district. Likewise, we are very grateful to Sam Kauapirura from Hollard Namibia for travelling to the Omaheke and Otjozondjupa regions to conduct the survey and for Khumoyame Masonya for posing the questions to smallholder farmers across Botswana.

The project team was led by Gian Sandosh Semadeni from CelsiusPro and Israel Muchena from Hollard Mozambique. The study's report was produced with contributions from Annemarie Büttner and Samuel Brown from CelsiusPro as well as continuous inputs, advice and reviews by a number of colleagues at CelsiusPro and Hollard Mozambique.

Introduction

The “Feasibility Study - Livestock Insurance for Smallholder Farmers in Southern Africa” is the product of a joint collaboration between CelsiusPro (CP) and Hollard Mozambique (HM) along with supported grant funding provided by the Swiss Capacity Building Facility (SCBF). Representatives from CP and HM (“the project team”) are collaborating to assess the viability of introducing an index-based livestock insurance product for smallholder farmers in Southern Africa. The study focuses on three different markets, covering Namibia, Botswana, and three southern provinces of Mozambique.

This study covers a range of aspects relevant to assessing the feasibility of livestock insurance, starting with details on the project background. Next to outlining the tripartite collaboration between CP, HM and SCBF as well as their respective roles, the first section of the study outlines the project objectives. To supplement the research and gain a better understanding of the situation faced by smallholder livestock farmers, a survey covering 207 such individuals is included within the study, with the findings factored in the relevant sections. Furthermore, insights from various discussions held with relevant stakeholders in all three countries, including local primary insurers, regulators as well as potential distribution and development partners are included across the study’s report.

The proposed insurance product aims to strengthen the financial resilience of smallholder farmers against droughts by utilizing satellite-derived (remote sensing) vegetation density data. Therefore, the groundwork requires understanding the drought risk in the three countries and the link to their vegetation growth periods. The drought risk section of the study also reviews historical droughts since 2001 and outlines the impact of drought on cattle health.

The following section includes background on the demographics of smallholder livestock farmers, providing details on the number of farmers, cattle populations, and highlighting the relevant actors within the local livestock markets in Namibia, Botswana, and the southern region of Mozambique. Details on each country’s insurance landscape and regulatory environment are subsequently delineated. The project team prioritizes the potential distribution channels and related potential partners, which is a critical aspect of implementing an innovative and novel insurance scheme. The study describes and evaluates four different distribution channel options individually for each market, and includes an assessment of the short- and mid-term potential within the report.

The livestock insurance product borrows many conceptual aspects successfully introduced for pastoralists in Ethiopia and Kenya (Kenya Livestock Insurance Program). An overview of index insurance, the existing livestock insurance schemes and the vegetation density data (NDVI) is provided. An alternative dataset (SAR data) is then portrayed and compared to NDVI data, using the 2019 drought in Namibia as a brief case study. The subsequent sections of the study walk through various considerations related to the structuring of the index-based livestock insurance product. The presented arguments highlight the reasons for focusing on severe droughts only and draw-out the product components which could be modified. An overview of the initial technical premium, prior to any additional loading or margins, is included therein.

The final section of the study’s report highlights key lessons learned by the project team relating to both the product concept and project management. Finally, the study concludes with a feasibility assessment for Namibia, Botswana, and the southern region of Mozambique, noting the next steps proposed by the project team to advance index insurance addressing drought risks in the three markets.

Project Background

Tripartite Collaboration

CP and HM have been jointly working towards establishing an index-based[1] livestock insurance product since 2019. Both organizations recognize the high vulnerability of livestock farmers to drought conditions, with severe events potentially damaging their livelihoods across multiple years. This threat holds especially true when cattle are held by smallholder farmers[2] without the material capabilities to introduce mitigation measures decisively. Low insurance penetration among these smallholder farmers and a lack of drought coverage within traditional indemnity insurance[3] policies encouraged CP and HM to target this specific sector.

In October 2019, on behalf of HM, CP conducted a pre-feasibility study for livestock insurance in Mozambique. The report found that the three southern-most provinces of Maputo, Gaza and Inhambane have the highest density of cattle in Mozambique, with farmers relying more strongly on livestock than crop compared to the central and northern regions of the country. CP reviewed both vegetation and precipitation datasets, concluding that MODIS NDVI is best positioned to observe the health of the pasture the cattle graze on. The vegetation density data provided by MODIS NDVI, allows for the pasture growth cycle to act as the basis of an index-based product, with significant deviations from the mean vegetation density acting as a drought proxy. The pre-feasibility study proposed a basic product structure and assessed how the product would have performed during past droughts in Mozambique.

Encouraged by the initial findings, the project team looked to launch a more detailed feasibility study, looking to expand both in-depth and breadth. A joint proposal for a study covering Mozambique, Namibia, and Botswana was proposed to the Swiss Capacity Building Facility (SCBF), a public-private partnership that CP joined as a member in June 2020. Receiving grant funding from the development sector allowed CP and HM to alleviate some of the financial risks of introducing products with higher hurdles. This holds especially true when targeting smallholder farmers, which tend to belong to the lower-income segment of society. The decision to focus on these three countries was based on their comparable climatology (see section Drought Risk in Southern Africa) and the presence of Hollard subsidiaries in these three countries. South Africa was not included due to a pending regulatory request for index-based livestock insurance with the Financial Sector Conduct Authority (FSCA).[4] A tripartite contract between SCBF, CP and HM was signed in November 2020 with the study being initiated a month later.

[1] Index-based insurance is also known as parametric insurance. This report exclusively uses the term “index insurance” or “index-based insurance”

[2] This report uses the term “smallholder farmer” to refer to individuals/households engaged in farming activites without a farm or herd size qualifying them as commercial farmers. The term “smallholder farmer” covers local terminology such as “communal farmers”, “traditional farmers” and “emerging farmers”.

[3] The term “indemnity insurance” is used to refer to non-index insurance, where the policyholder is indemnified based on a claims submission detailing the incurred losses. Non-life indemnity insurance is also known as “shot-term insurance” in certain markets.

[4] Submitted by Land Bank Insurance Company and supported by CelsiusPro AG.

Highlight Box 1 – Swiss Capacity Building Facility

SCBF SWISS CAPACITY BUILDING FACILITY
Innovating Financial Inclusion

SCBF is a public-private development partnership and its intervention strategy is to give grants to technical assistance (TA) providers to work with partner financial institutions to develop and upscale client-centered financial products, channels and services. The organization and its members, Swiss private sector institutions and the Swiss Agency for Development and Cooperation (SDC), aim to increasing financial inclusion in developing and emerging countries, among others also by increasing access to insurance.

SCBF's goal at an impact level is to improve the quality of life of low-income and vulnerable households, smallholder farmers and MSMEs, with a focus on female and rural clients. This improved quality of life is generated by three principle impact objectives:

1. Building Resilience to Protect Living Standards
2. Increasing Income and Assets Building for Economic Empowerment
3. Accessing Essential Services to Improve Current / Future Generations' Living Standards

Since its inception SCBF has supported over 160 projects across 47 countries in Sub-Saharan Africa, MENA, Asia, and Latin America. 69% of these projects focus on scaling up innovative financial products, channels and services, 14% support feasibility studies, and 17% related to financial education. A total of CHF 17.3 million of grants have been provided, averaging CHF 108,821 per project.

Source: Swiss Capacity Building Facility

Project Objectives

The study's overall objective is to gain a clear understanding of the market potential for livestock insurance across the three target countries. While the need to increase livestock farmer's financial resilience against droughts varies, it is largely undisputed that higher temperatures and increasing population figures will require public and/or private solutions to be found. Therefore, the crucial question is related less to the size of the market potential but rather to the viability of- and most suitable channel to introduce drought insurance solutions within the existing environment.

To address this question, the project team split the study into three main activities:

1. Desktop research on the target group, the current livestock market and potential distribution partners in each of the three countries. With the aim of compiling relevant figures and information on the current market environment.
2. In-field surveys with the target group to gather direct insights on their livestock and drought management. Looking to understand the livestock farmer's current socio-economic and drought-related situation, not focused on their willingness to purchase insurance.
3. Design of a well-structured index-insurance product adapted to local circumstances. Targeting an affordable and effective insurance product to strengthen drought resilience.

Ultimately, CP and HM are seeking to identify which markets and distribution partners are best suited for a pilot project and subsequent product upscaling. The introduction of index-based livestock

insurance can only efficiently be implemented by forming strong partnerships with the right partners and within a favorable policy environment.

Key Stakeholders

The core project team consists of members of CP's Consulting Team and HM's Agriculture Insurance Unit. Within the tripartite SCBF contract, CP acts as the grantee, managing grant funds and the interactions with SCBF. HM is declared the partner financial institution within the contract, contributing financially via various outlays related to the study. Supervision and guidance is provided by Reto Schneider, Regional Head Agriculture at Allianz Re, the designated SCBF project monitor for the study.

Both CP and HM contribute to Activity 1 and draw on the expertise of local consultants to provide background information on the livestock markets and potential distribution partners in the southern region of Mozambique, Namibia, and Botswana. Hans Smit, an experienced risk analyst with experience in index insurance, is based in South Africa and covers the desktop research on Namibia and Botswana. Fion de Vletter, a development researcher with an extensive track record covering agriculture and livestock markets, is based in Mozambique and eSwatini and covers the Activity 1 content related to Mozambique. Both consultants also utilize their existing network to provide the project team with relevant contacts among potential distribution partners.

CP assumes the role of project manager and executing Activity 3, as per the project objectives. HM is responsible for driving forward Activity 2 and for the coordination across the different Hollard subsidiaries involved in the study. Hollard Namibia and Hollard Botswana play key roles in facilitating the interactions with their respective insurance regulators and/or supporting the surveys conducted with livestock farmers in both countries.

Drought Risk in Southern Africa

Regional Climatology & Droughts

The focus area of the study across Namibia, Botswana, and the southern region of Mozambique has a very diverse climatological footprint. According to the Köppen climate classification, which is shown in Figure 1, Namibia and Botswana are subject to warm desert and warm semi-arid climate. Along the coastline in the southern region of Mozambique, tropical savanna climate is found, with warm desert climate, warm semi-arid climate dominating the inland areas in the provinces of Gaza, Maputo, and Inhambane. Remote teleconnections such as the El Niño Southern Oscillation (ENSO) can significantly influence the climate through a chain of interactions. Further details on the local climatology per country can be found in Appendix 1 – Climatology. A warm semi-arid climate still allows for limited rain-fed crop farming and provides pasturelands with sufficient water to enable livestock farming on a larger scale. However, the high rainfall variability in such areas results in a considerable drought risk for both crop and livestock farming.

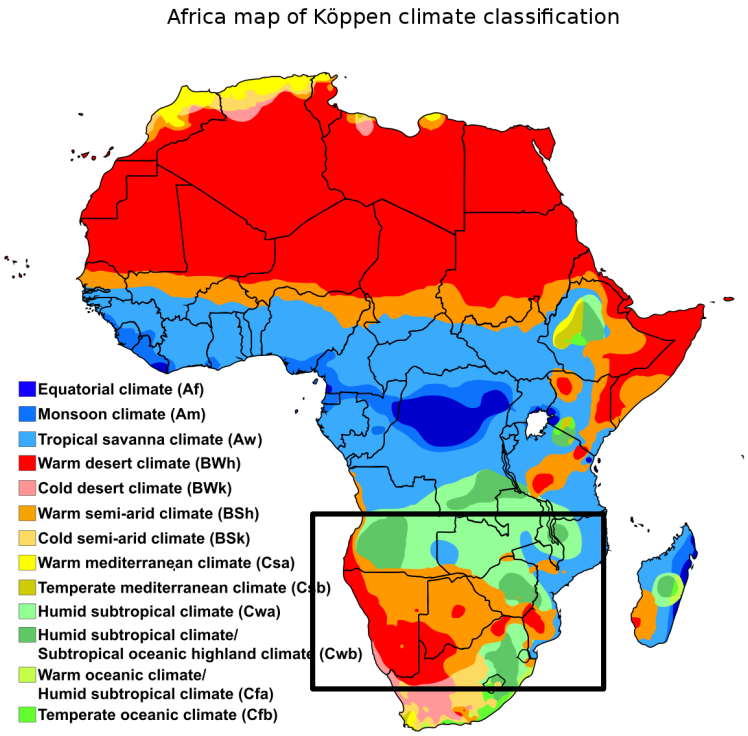

Figure 1: Köppen climate classification of Africa. The black rectangle highlights the study area of (Namibia, Botswana and Mozambique). Source: Wikipedia Commons.

Droughts are complex natural disasters influenced by several factors such as precipitation levels, ground and soil conditions, and water management. The slow-onset nature of droughts, gradually increasing over time, makes defining the beginning and end of an event difficult.[5] Furthermore, droughts are usually characterized as a deviation from normal conditions, resulting in a localized definition of which conditions constitute a drought.

[5] Veit Blauhut et al. "Estimating drought risk across Europe from reported drought impacts, drought indices, and vulnerability factors" in Hydrol. Earth Syst. Sci. 12 July 2016.

They can be broadly classified into four common types: meteorological drought, agricultural drought, hydrological drought, and socio-economic drought.[6]

Meteorological droughts occur when there is a prolonged period with below-average precipitation levels. Less precipitation will consequently lead to conditions of low moisture conditions for plants reducing plant growth. Agricultural droughts describe the impact of soil water deficit resulting from below-average rainfall as well as evaporation and transpiration on crops. Agricultural droughts are also impacted water management aspects related to irrigation or inappropriate soil management. Hydrological droughts focus on the shortfall of water uptake due to the deficiency of groundwater connected to lakes, reservoirs, and aquifers. Such droughts are particularly drawn out and can persist for multiple years. Finally, socio-economic droughts related to a lack of weather-dependent economic goods such as water, forage, food grains, fish, and hydroelectric power. Naturally, socio-economic droughts are strongly influenced by demand and other societal factors.

This study focuses on meteorological drought, seeking to identify a suitable proxy for the impact of below-average rainfall on smallholder livestock farmers. To measure the severity and duration of droughts, several ground-based and remotely sensed indices exist. Monitoring developments in remote areas is crucial to the project team, with the Normalized Difference Vegetation Index (NDVI) being selected as one of the commonly applied remotely sensed drought indices.[7] Further details on NDVI can be found in the section NDVI Data Source.

The vegetation period in Namibia, Botswana, and the southern region of Mozambique represent the onset and end of the suitable and sufficient moisture conditions to enable the growth of crops and natural vegetation. The pasturelands across warm semi-arid regions depend strongly on the vegetation period and are influenced by several soil-animal-vegetation feedback processes.[8] By observing the historical vegetation growth via NDVI data reaching back to August 2000, the project team notes that the relevant vegetation period across the three countries begins around September-October and lasts until March-May. Further details on the relationship between precipitation levels and vegetation growth can be found in Appendix 1 – Climatology.

Highlight Box 2 – The Impact of Climate Change on Droughts

Climate Change is projected to significantly increase in both frequency, severity, and duration of droughts in Southern Africa. Increased natural stressors such as reduction of surface water and groundwater resources, superimposed by socioeconomic conditions and environmental degradation will adversely impact the availability of water resources, food production, energy generation, the environment, overall incomes and livelihoods. Certain research on the impact of higher temperatures in East Africa indicate that climate change could result in the "dry get drier and wet gets wetter" paradigm, with drought conditions being particularly exacerbated in arid and semi-arid climatic zones.

Sources:
IPPC, "Impacts of 1.5°C of Global Warming on Natural and Human Systems". 2018
Gebremedhin Gebremeskel Haile et al. "Projected Impacts of Climate Change on Drought Patterns Over East Africa" in Earth's Future. 26 May 2020

[6] Puyu Feng et al. "Machine learning-based integration of remotely-sensed drought factors can improve the estimation of agricultural drought in South-Eastern Australia" in Agricultural Systems. July 2019.

[7] Ibid.

[8] Robert J Scholes, "The Future of Semi-Arid Regions: A Weak Fabric Unravels" in Climate. 13 March 2020

Historical Droughts

Historical drought events (EM-DAT)

A key source for historical disaster information is the Emergency Events Database (EM-DAT) compiled by the Centre for Research on the Epidemiology of Disasters (CRED).[9] The quality of the data is highly dependent on the availability of information and may use estimated values where information is limited. Table 1 shows some of EM-DAT's data covering significant droughts in the noted locations. Droughts took place in all three countries with a frequency of very roughly every five years and typically, several provinces are affected. Another high-level observation from Table 1 is that multi-year droughts are relatively commen, as seen in 2001/2002 for Namibia, 2005/2006 and 2009/2010 for Mozambique. This phenomenon can be explained by the compounding effect of low soil moisture after a drought year, increasing the impact of limited precipitation during the next wet season.

Table 1: Historical droughts including their specific locations and whether it was an ENSO positive season. Source: EM-DAT

Year	Namibia	Botswana	Mozambique	ENSO
2019	*Hardap, Kavango East, Khomas, Kunene, Ohangewna, Omusati, Omaheke, Zambezi*	*Okavango Delta*		*Yes*
2016			*Maputo,Gaza, Inhambane, Sofala, Tete*	*Yes*
2015	*Erongo, Hardap, Karas, Kunene provinces (South and Western part of the country)*	*All country*		*Yes*
2013	*Kavango, Ohangwena, Oshikoto, Kunene provinces*	*Regional*		*Yes*
2010			*Maputo, Imhambane, Gaza*	*Yes*
2009			*Maputo; Gaza, Inhambane, Sofala, Tete*	*No*
2007		*Regional*		*No*
2006			*Gaza, Imhambane, Sofala, Maputo, Manica*	*Yes*
2005			*Maputo, Gaza, Inhambane, Sofala, Zambezia, Tete*	*Yes*
2004				*No*
2002	*Otjozondjupa, Oshikoto, Oshana, Omusati, Ohangwena, Kunene, Kavango, Caprivi provinces (North)*			*No*
2001	*Otjovanatje, Otjorute, Okapundja, Otjekwa, Okaurukwa locations (Ruacana district, Omusati province)*			*No*

[9] D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: The CRED/OFDA International Disaster Database, Université Catholique de Louvain, Brussels, Belgium

Survey livestock farmers

As part of the study, a survey with smallholder farmers is conducted, as described in the section Survey with Smallholder Livestock Farmers. The survey highlights the perceived drought years among participants. Naturally, recent years are more present in people's memory and amplified more acutely as drought years. In Mozambique, almost all of the recent five years are perceived as drought years by the smallholder farmers questioned (see Figure 2). Only 2017 seems to feature as an exception, with 2019 and 2020 mentioned almost as frequently as the severe drought year in 2016. The answers by smallholder farmers in Botswana (see Figure 3) are more evenly spread out across the past 15 years, with 2017 being mentioned as the most intense drought season. This could be due to the severe drought conditions from 2016 being felt in 2017 as well, with the latter year remaining more prominently in memory. Only anecdotal evidence could be collected from farmers in Namibia, hinting at 2013 as well as the period between 2018 – 2020 being perceived as drought years in recent history.

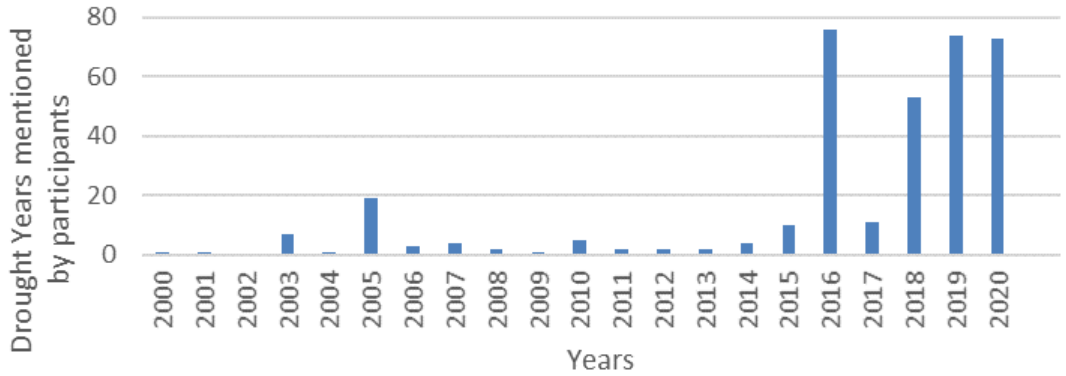

Figure 2: Mozambique – Survey respondents' assessment of drought years

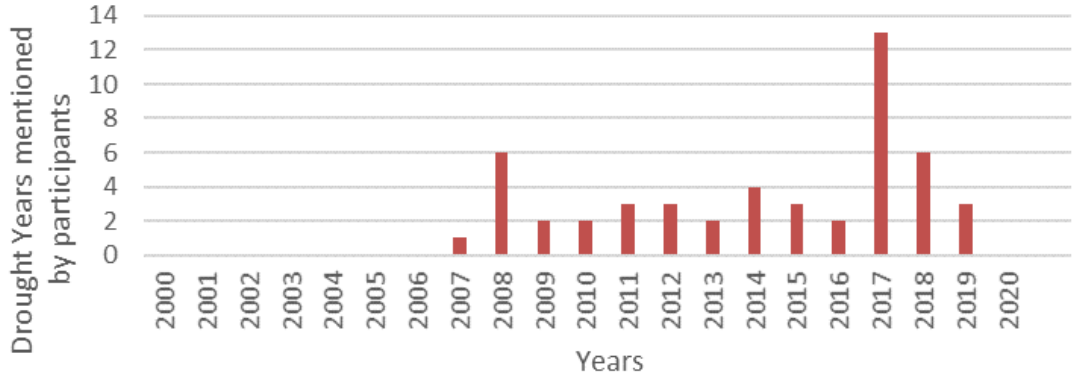

Figure 3: Botswana – Survey respondents' assessment of drought years

Comparison of NDVI to survey and EM-DAT data

In this study, the NDVI is the selected as the underlying datasource for the index insurance product (see section NDVI Data Source). When comparing the historical drought events from Table 1 with the NDVI anomalies depicted for every country in Figure 4, clear overlaps can be recognized for the most severe droughts. It must be noted that Figure 4 uses normalized NDVI values across the country, which might explain certain deviations between more localized droughts and the NDVI values. In Mozambique, the 2016 and the 2006 events are clearly below the yearly anomaly of average NDVI values. In Botswana, 2016 is noted as one of the most significant droughts with historical records highlighting 2015. This mismatch could be due to different definitions to which year a drought is counted to, a common difficulty with slow onset disasters.

For Namibia, the recent 2019 drought is outstanding in both independent datasets, while also the events at the beginning of the century are clear landmark events.

To conduct an accurate comparison between NDVI data and historical droughts, more details on the drought definitions would be required. A dataset with a consistent definition of the onset and end of droughts would then need to be compared to the NDVI values of the actual regions affected by the disaster.

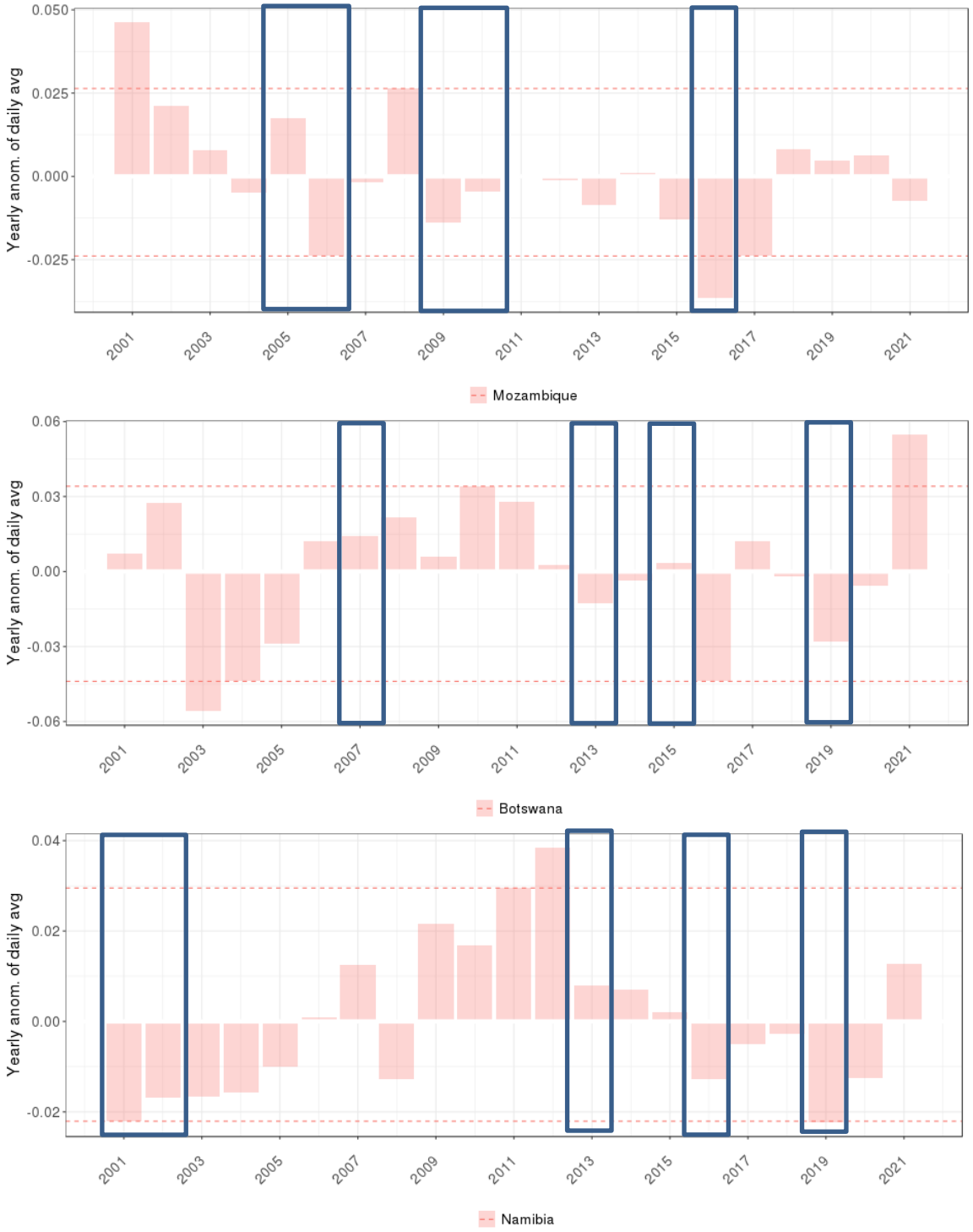

Figure 4: Yearly anomaly of daily NDVI average for Mozambique, Botswana and Namibia. Blue boxes depict the drought seasons from Table 1. Note that the definition of a drought year might not always overlap with the vegetation growth cycle in question.

Impact of Droughts on Cattle Health

A prolonged lack of rainfall and the resulting drought conditions have numerous impacts on the environment, livelihoods of people and the economy. As part of this study, the nexus between droughts, pasture greenery and cattle health are of primary interest. The health condition of livestock can vary quite significantly during an average season, especially for animals held largely in free-range by the farmers, allowing them to graze pasturelands. Consequently, the quality of their food intake varies depending on the available forage throughout the seasons. During the dry season, the quality of the available forage deteriorates and the animals must survive on stored fat to supplement their lower quality diet.

Therefore, the health of pasturelands during the growing season is imperative to cattle building up fat to sustain themselves during the leaner months. Below average pasture growth or a shortened growing season might still provide sufficient forage to sustain the cattle during this season. However, the lack of fat reserves and acutely drier pasture begin to truly impact livestock towards the middle of the dry season, with the effects of gradual malnutrition beginning to surface. The cattle frequently begin ingesting larger quantities of sand, dirt, and plants not suited for consumption as they scour the dry pasturelands. This further weakens the animals as drought conditions prevail, making them frail, prone to physical injuries, and limiting the ability to transport them or lead them to water.[10]

Malnutrition opens the door to various consequential issues, with a higher predisposition to infectious disease and parasite infestations presenting a considerable challenge to livestock farmers. Such outbreaks can have a devastating impact on an entire region and can result in much higher mortality rates within a herd than starvation-induced mortality. Drought-weakened cows also limit their milk production, impacting both the health of their calves as well as the farmers depending on milk as a food and/or revenue source. A malnutrition-induced drop in calves health and the fertility of cows, can have effects lasting well beyond just a few months of a severe dry season. Cattle herds are grown slowly over the years, as the gestation period for a cow is nine months, with the reproduction capacity of cows only gradually increasing following a phase of acute malnutrition.

The study's survey reveals some interesting differences in how smallholder farmers in different countries mitigate the impact of droughts. Access to fodder, supplementary feed, and veterinary services helps livestock farmers maintain the health of their animals during a drought. Farmers in Botswana make particular use of these options, building on government support related to fodder and veterinary drugs as well as finding their own fodder sources to maintain their cattle's health. Namibian farmers, on the other hand, seem to primarily seek additional food for their herds by moving larger distances to find pastureland.

Naturally, access to water is crucial too. But during a drought, pasturelands are first to be impacted, with the water levels of lakes, rivers, boreholes and wells dropping as drought conditions persists. Survey responses highlight that finding access to such water sources is the primary drought mitigation strategy of farmers in Mozambique, mostly via access to boreholes and wells, but also by seeking out nearby lakes and rivers. Given the longer-lasting water availability, a severe shortfall in pasture growth during the wet season has the most immediate impact and knock-on effect on the health of cattle held by smallholder farmers.

[10] Agriculture Victoria, Australia "Animal health in a drought". 21 January 2021. https://agriculture.vic.gov.au/livestock-and-animals/livestock-health-and-welfare/animal-health-in-a-drought

Smallholder Farmers and Livestock Markets

Mozambique

Demographics

In Mozambique, smallholder farmers account for approximately 88% of the country's total cattle population. Farmers hailing from Mozambique's three southern provinces of Gaza, Inhambane and Maputo are well known for their affinity for holding cattle, rooted in both local customs and climatological circumstances. An estimated 107'000 smallholder livestock farmers breed cattle in the three provinces, holding approx. 700'000 cattle (ca. 45% of the country's total). The typical smallholder livestock farmers apply a free-range production system, depending solely on natural pasture to feed their cattle, with no supplementary feed provided.

A higher share of smallholder farmers in the South engages in livestock farming, which is especially pronounced in Inhambane and Gaza, where between 19-26% of all smallholders breed them. The average herd range indicated in literature finds an average her size of 6.6 heads of cattle per smallholder farmer.[11] The study's survey finds larger average herd sizes of 13.2 heads of cattle per household, with Mabalane (Gaza) reaching 15.9, Magude (Maputo) 13.3, and Funhalouro (Inhambane) 11.5. It can be concluded that Gaza and Maputo generally have larger herd sizes, which might also be influenced by these two provinces accounting for a high share (60-70%) of the large breeders in the country, having a knock-on effect on the herd sizes of smallholder farmers. Additional details on the demographics of the smallholder livestock farmers, their motivations to maintain cattle and the cattle production system usually applied can be found in Appendix 2 – Mozambique Smallholder Farmer and Livestock Markets.

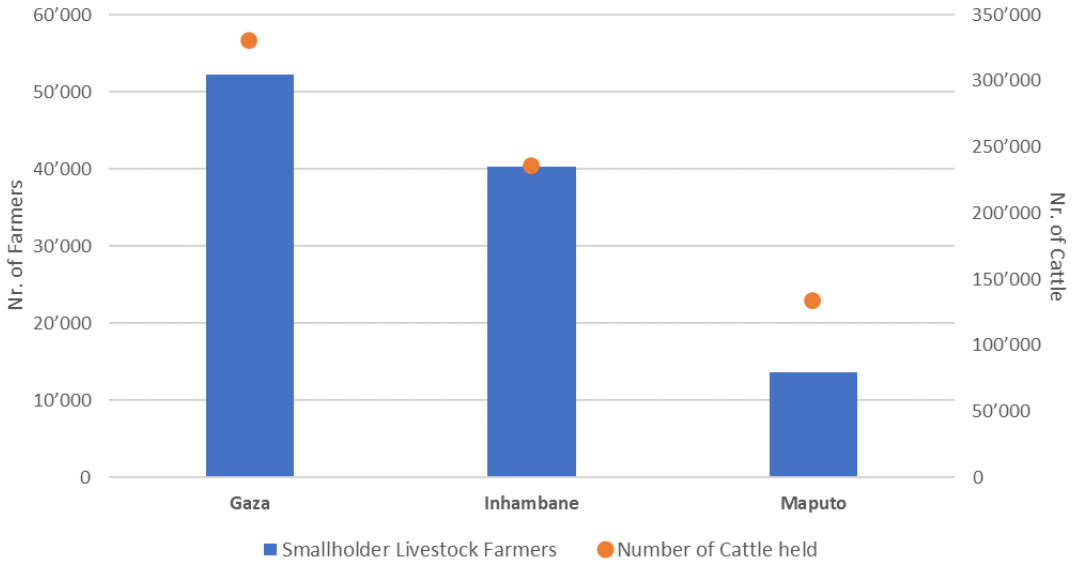

Figure 5: The number of smallholder livestock farmers and cattle population in the southern region of Mozambique: Source: Minister of Agriculture and Rural Development, "Integrated Agricultural Statistics Survey (IAI)". 2015.

[11] Minister of Agriculture and Rural Development, "Integrated Agricultural Statistics Survey (IAI)". 2015.

Livestock Market

Smallholder livestock farmers in Mozambique largely operate within localized networks, with a low degree of commercialization and reliance on input suppliers and traders. They are usually not organized within cooperatives or associations, as bundling their negotiation power is not a relevant concern for most. Unsurprisingly, only 4 out of 160 interviewed farmers in Mozambique are found to be part of an association. Since most smallholder farmers require only limited livestock-specific product or services, agriculture inputs suppliers focus primarily on crop production. Similarly, the sales channels available to smallholder livestock farmers remain largely localized and without a high degree of commercialization. There are five main sales channels for cow breeders in the southern region of Mozambique:

1) **Bush butchers**
2) **(Informal) Cattle traders**
3) **Local Markets**
4) **Municipal Slaughterhouses**
5) **Larger private slaughterhouses**

The prices received by smallholder farmers for their cattle vary depending on the size of the animal and can range between MZN 5,000 to 30,000. Average prices seem to be around MZN 15,000 – 20,000. Prices also vary over time, regions and from one farmer and trader to another. Stakeholders within the largely informal value chains do not tend to know their own cost basis and do not have a clear overview of their costs, nor are they willing to disclose this. However, there are indications that prices for cattle can collapse during severe droughts, when many farmers are looking to offload and the health of the animals is already impaired. For example, anecdotal evidence suggests that during drought enforced sales one cow could only fetch MZN 2,000 instead of the usual MZN 20,000 – 30,000 received from the farmer.[12] Additional details on Mozambique's livestock market, beef production and details on the five sales channels can be found in Appendix 2 – Mozambique Smallholder Farmer and Livestock Markets.

Namibia

Demographics

Despite Namibia's vast landmass and comparatively low overall population density, the approximately 62,000 smallholder livestock farmers in the country are relatively concentrated in the Northern Regions of Omusati, Ohangwena, and Oshikoto, which account for over half of the population (see Table 2). This is partially also due to the historical land-use allocation and Veterinary Cordon Fence (previously known as the "red line"), which has resulted in communal land being predominantly located in the Northern Regions of the country (Northern Kunene, Omusati, Oshana, Ohangwena, most of Oshikot and Kavango, north-eastern Otjozondjupa, and Zambezi). Only cattle from south of the fence, held by approx. 4,000 commercial farmers and smallholder livestock farmers from the Central-Eastern Regions qualify for the exports to prime beef markets such as the European Union, the USA, and China.[13]

[12] FAO, "FAO promotes resilience practices for livestock farmers in Maputo and Gaza". 10 May 2017. http://www.fao.org/mozambique/news/detail-events/en/c/887022/

[13] Meatco, "The VCF vital to the sustenance of the Namibian meat industry". 16 March 2018. https://www.meatco.com.na/news/399/The-VCF-vital-to-the-sustenance-of-the-Namibian-meat-industry/

The VCF remains contested and its removal or adjustments is tabled repeatedly.[14] Out of the 2.7 million cattle in Namibia, 36% are found south of the VCF, resulting in a cattle population of approx. 1.76 million north of the VCF.[15] A rough estimation, based on the assumption that approx. 50,000 – 55,000 smallholder farmers reside north of the VCF, which results in approx. 31 head of cattle per farmer. In the Otjozondjupa and Omaheke regions, where the study's survey with smallholder farmers is focused, the Herero-speaking people generally do not divulge their herd numbers. The herd size is considered out-of-bank savings and is not publicised. The interviewer, a livestock farmer himself, estimated the average herd size of approx. 100 heads of cattle based on an assessment of their farms. The estimations ranged from 10 heads of cattle to 300, with a median of 70. The survey also indicates that cattle in Namibia are mainly used to supply the farmers with milk and meat, aside from being sold to generate income.

Most smallholder farmers let their animals' range freely on communal land with limited rotational grazing, which can lead to pasturelands being overutilized, especially when drought conditions prevail. The study's survey among smallholder farmers in Otjozondjupa and Omaheke found that they primarily hold their cattle in semi-intensive production systems, with feeding also taking place at the farm in addition to grazing on pasturelands.

Table 2: Number of smallholder farmers and households with cattle. Source: Namibia Statistics Agency, "Namibia Census of Agriculture 2013/2014". November 2015.

Regions	Total Farming Households	Farming Households with cattle	% of Households with cattle
Omusati	43 339	14 354	33.1
Ohangwena	34 480	10 927	31.7
Oshikoto	23 984	9 392	39.2
Oshana	15 699	5 350	34.1
Kavango West	10 026	4 908	49.0
Kavango East	9 760	4 428	45.4
Zambezi	8 051	4 037	50.1
Kunene	4 909	2 627	53.5
Otjozondjupa	3 444	2 400	69.7
Omaheke	2 562	2 315	90.4
Erongo	1 424	780	54.8
//Kharas	1 253	377	30.1
Hardap	459	220	47.9
Khomas	94	14	14.9
Namibia	**159 484**	**62 129**	**39.0**

[14] Martha Nangolo, Ndapwa Alweendo, "Agriculture in Namibia: An Overview" in Democracy Report (Namibia). February 2020.

[15] Meatco, "Annual Report 2019/2020". 31 January 2020.

Livestock Market

The Namibian livestock industry is well structured in terms of input and service providers. The Meat Board of Namibia brings together the relevant stakeholders from across the industry and has the regulatory responsibility related to livestock products in the country. The Meat Board is involved in various development projects, managing them on behalf of the government. Their mandate includes both the commercial sector and the activities of smallholder farmers related to the meat industry. Agriculture inputs, including for livestock, are provided by country-wide organizations such as Agra and Kaap Agri. Smallholder farmers frequently stop by their vast network of supply stores. With a history as an agriculture cooperative, Agra is also heavily involved in the auctioneering of livestock in Namibia. The recurring auctions are used for trading cattle across the country and organizing the sale of live cattle to South Africa. Alternatively, smallholder farmers may have access to local auctions which are strongly driven by the area's current supply/demand.

When selling cattle for slaughter, Meatco plays a dominant role in the market. The company is 70% owned by a cooperative, combining the various livestock producers, with the government holding a 30% share. The company controls the major abattoirs in Namibia and plays a major role in exporting live cattle to South Africa and prime beef to markets further abroad. In the 2019/2020 season, Meatco estimated that 61% of all sold cattle in Namibia were live exports, mainly to South Africa, with export abbatoirs making up 24%, local abattoirs 9% and local informal slaughter 6%.[16] Smallholder farmers north of the VCF benefit from Meatco's mobile abattoirs, which are used to access remote communities and slaughter between 1,000 – 2,000 cattle per year for the local market. While prices for cattle can vary strongly, Meatco paid an average of NAD 6,762 in the 2018/2019 season for each cattle, which satisfies the quality standards of its mobile abattoirs. This compares to an average price per head of cattle of NAD 9'458 for export-oriented commercial farmers in 2019/2020, an 19% premium above South African parity prices.[17]

Botswana

Demographics

A key feature of Botswana's agriculture and livestock landscape is the strong involvement of smallholder farmers within the industry and high policy focus on the sector. The 55'000 smallholder farmers, 29,000 (53%) of which hold cattle. They are geographically spread across a number of sub-districts, as depicted in Figure 6, and use roughly 92% of the total area classified as agricultural land, of which only a small share is suitable for extensive crop cultivation. There are only between 100-200 large-scale commercial farms in Botswana, which are responsible for 20% of the cattle and 40% of the crop production.[18] Therefore, despite the relatively low numbers of smallholder farmers, they play an important role in the livestock market in Botswana, including for the export of live animals and beef abroad.

[16] Meatco, "Annual Report 2019/2020". 31 January 2020.

[17] Ibid.

[18] USAID, "Botswana" Land Links. September 2016 https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_Botswana_Profile.pdf

The total cattle population held by smallholder farmers has been a continuous decline since 2011, with number decreasing from 2.2 million head of cattle in 2008 to 935'000 in 2019.[19] The 15% drop in the cattle population from 1.1 million in 2017 was driven by higher death and sales rates, which could be driven by drought conditions, among others. However, the smallholder livestock farming sector seems to be in systemic decline in Botswana.

The average smallholder farmer holds 32 heads of cattle. Surprisingly, the lower number of smallholder farmers in the drier regions of the country, such as Kgalagadi and Ghanzi, have among the highest average number of cattle per farmers in Botswana (averages of 53-83 heads of cattle). The study's survey indicates that smallholder farmers in Botswana hold an average of 95 heads of cattle, however, a large range between 12 to 450 is provided. The median of 65 head of cattle is closer to the country-wide average.

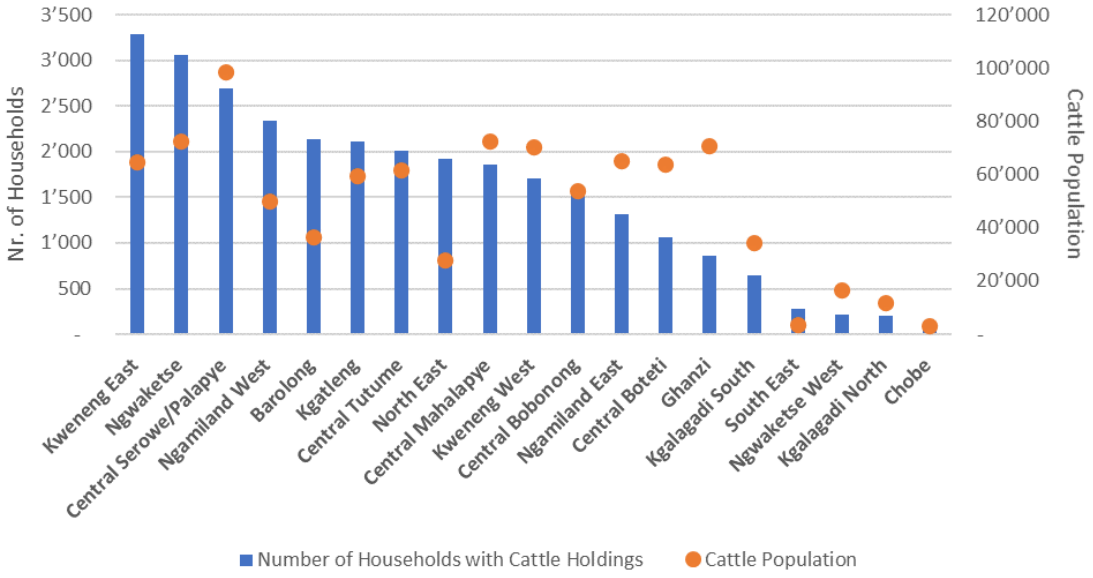

Figure 6: Number of Smallholder Farmers and Cattle Population. Source: Statistics Botswana, "Annual Agricultural Survey Report 2019: Traditional Sector" November 2020.

Based on the study's survey, most smallholder farmers in Botswana keep cattle to sell and trade, indicating their high involvement in Botswana's livestock production (see Figure 7). The sale of milk and the cattle's role as an emergency reserve are also key factors considered by the farmers, with the latter predominantly accounting for the second most important purpose of livestock.

[19] Statistics Botswana, "Annual Agricultural Survey Report 2019: Traditional Sector" November 2020.

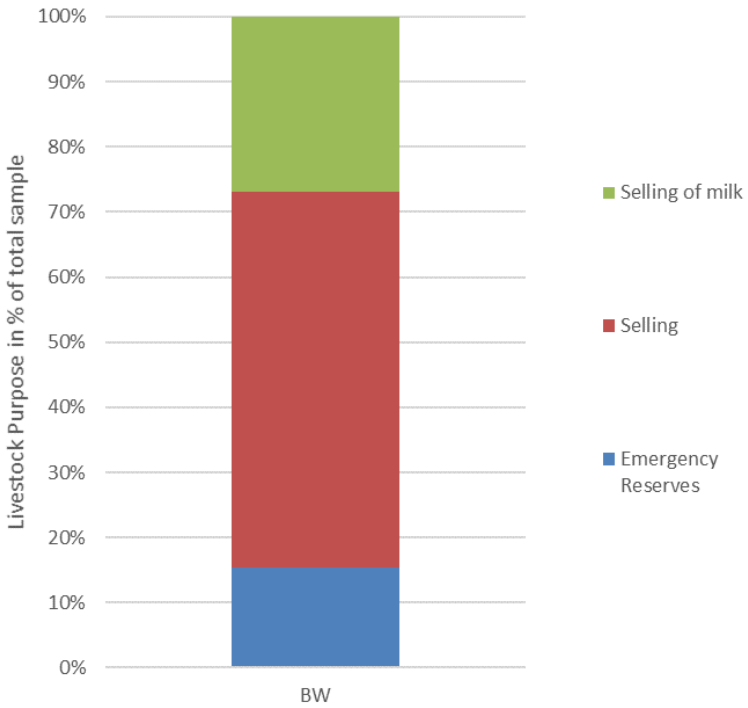

Figure 7: Survey respondents' primary purpose for holding cattle.

Livestock Market

The Government of Botswana plays a vital role within the livestock market in the country, not only diligently keeping track of the relevant statistics but also directly supporting the livelihoods of smallholder livestock farmers. The Botswana Agricultural Marketing Board (BAMB) is one of the primary tools utilized to this end, providing farmers in the country with goods and services related to their crop and livestock farming needs. The state-owned organization accesses farmers via its 14 branches and 23 sales offices across the country. Moreover, it acts as the primary agri service provider and plays a considerable role as a purchaser of crops, further cementing its vital role for smallholder farmers.[20]

The Botswana Meat Commission (BMC) is the second major state-owned organization of relevance for the smallholder livestock farmer, representing the sole exporter within Botswana's meat industry. The company is not profited-oriented and has the mandate to promote the development of Botswana's livestock industry. Both smallholder and commercial farmers sell their cattle directly to BMC, which runs the country's abattoirs. While the centralized sales structure of the market provides smallholder farmers with a reliable partner, BMC is facing certain challenges. Farmers raise concerns related to late payments, low-sales prices and delivery challenges, with drought and disease resulting in BMC struggling to maintain its production targets and high meat quality. The company's revenue from red meat exports has dropped from $130 million in 2010 to $80 million in 2018.[21] The Government is considering regulatory amendments to the meat industry in the coming years in the hope to revive this traditionally important sector of Botswana.

[20] BAMB, "2018/2019 Annual Report". 31 March 2019.

[21] Reuters, "Bostwana to liberalise beef exports - minister". 28 February 2020. https://www.reuters.com/article/botswana-beef-idAFL5N2AS75H

Outside of BMC, the trade of live cattle within Botswana is driven by local supply and demand, with other farmers, district-level butchers and feedlots acting as purchasers. The national livestock market cannot build on a high level of commercial infrastructure to facilitate price setting, trade, and transportation, which is partially due to the limited number of commercial farmers in the country.

Survey with Smallholder Livestock Farmers

Methodology

Directly engaging with the smallholder livestock farmers is considered a key component of the study. The survey's objective is to better understand the farmer's socio-economic situation, their cattle management, and the local drought risk. The questionnaire is based on various research papers that conducted surveys with livestock farmers (see Appendix 3 – Survey Questionnaire). Feedback on the questions is provided by Ruphsa Banerjee from the International Livestock Research Institute (ILRI) and Reto Schneider, the SCBF Project Monitor.

The target areas for the surveys are identified based on the approximate density of smallholder livestock farmers on the most granular administrative unit possible (constituency, sub-district etc.) combined with the drought vulnerability of the area in question. The final selection of towns and villages is left to the interviewer conducting the survey. The questions are shared with the farmers during individual interviews, requiring approximately 20 minutes per interview.

Between February and April 2021, a total of 207 smallholder livestock farmers were interviewed across three countries and eleven different provinces/districts/regions. The 160 interviews in the southern region of Mozambique were conducted by HM's agriculture team including Israel Muchena, Garicai Guidione, Carlos Cossa, and Sulemangy Abubacar. The team covered various towns in the sub-districts of Magude (Maputo), Mabalane (Gaza), and Funhalouro (Inhambane).

The 26 interviews in Botswana were conducted by Khumo Masonya, a local contact working with smallholder farmers in the country and cover locations in the Central, Kweneng, Kgalagadi, Ghanzi, and Southern Districts. Sam Kauapirura, Hollard Namibia's Head Transformation & Corporate Communication, conducted 21 interviews in the Otjozondjupa and Omaheke regions due to their closer proximity to the Hollard office than the farming regions in the north of the country.

Survey Results

The survey results are factored in the study report within the applicable sections. The following graphs and analysis focus on insights derived from the survey which are considered to be of relevance but have not been included in other segments of the report.

Out of the 207 interviewees, 48 female smallholder farmers are included, representing 23% of the total (see Figure 8). A large divergence between the three countries is recorded, with 38% female interviewee rate in Nambia, 24% in Mozambique, and only 4% in Botswana. A considerable difference is also observable in the average family size provided by the smallholder farmers, with approximately nine family members living within one household in Mozambique. The same question returns an average of approx. four family members in Botswana and almost 15 in Namibia.

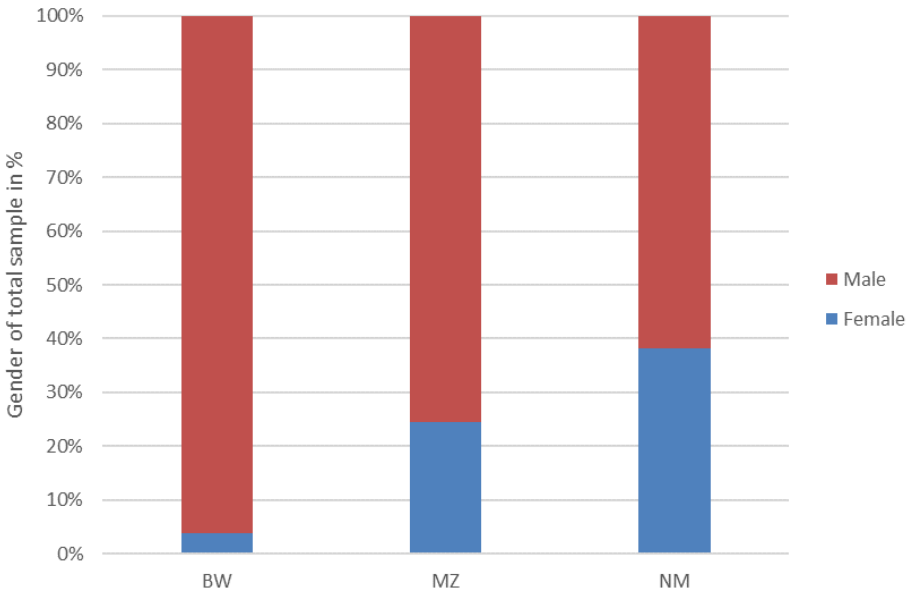

Figure 8: Survey respondents' split by gender.

An interesting finding can be drawn from the survey on the primary income source of smallholder farmers interviewed. Despite all interviewees holding a considerable number of cattle, averaging 13 in Mozambique, 95 in Botswana, and estimated by the interviewer at approx. 100 in Namibia, their primary source of income is not found to be predominately derived from livestock. Crop farming seems to be viewed as the main source of income for most farmers in Mabalane (Gaza) and Funhalouro (Inhambane), even though many of them mention cattle farming as a second- or third-income source. Only in Magude (Maputo), cattle farming is mentioned as the primary source of income (see Figure 9). Likewise, in Botswana and Namibia, livestock farming does contribute to smallholder farmers' incomes, but other sources of income seem to be more relevant to the farmer (see Figure 10).

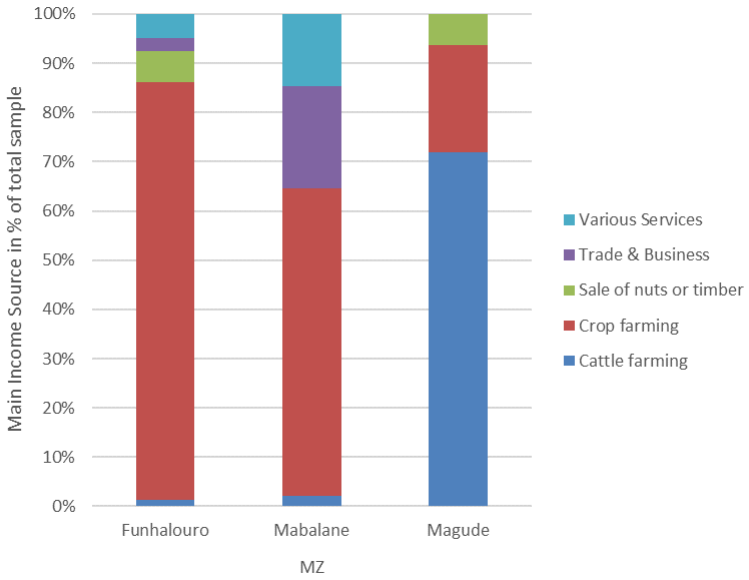

Figure 9: Survey respondents' primary source of income (southern region of Mozambique)

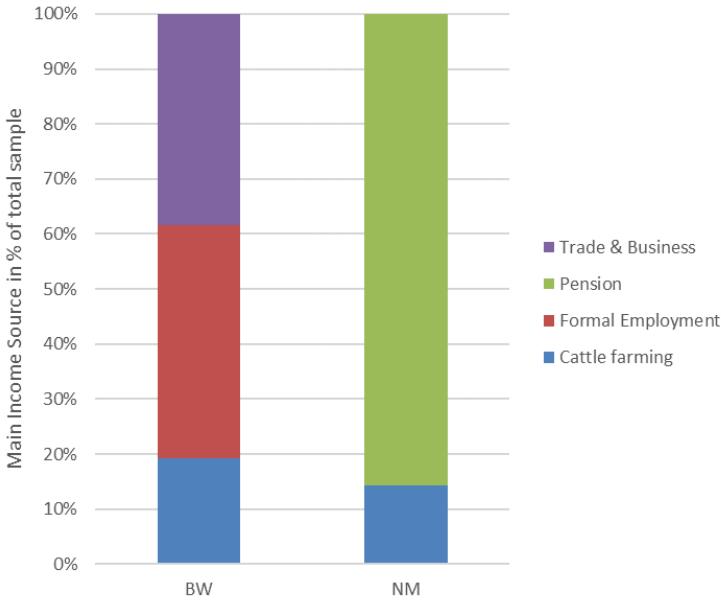

Figure 10: Survey respondents' primary source of income (Botswana and Namibia)

Insurance Markets and Distribution Channels

Insurance Landscape and Regulatory Environment Per Country

Mozambique

The Government of Mozambique recognizes the importance of the agriculture sector in achieving poverty alleviation and national socio-economic growth in the country. These priorities are developed in the Strategic Plan for Agricultural Development (PEDSA - 2011-2020). The goal is to convert subsistence farming into a market-oriented agriculture sector, ensuring food security, securing farmers' income, and achieving an annual growth rate of 7%. The National Livestock Strategy specifically outlines the Government's objectives for this sub-sector, seeking to increase market-oriented production systems, enhance the quality of livestock products, grow both the smallholder and commercial cattle population.[22]

The insurance industry plays a key role in securing assets and growth achieved in the agriculture sector. Currently, agriculture insurance, which includes crop and livestock coverages, plays a limited role in Mozambique's insurance sector. Larger insurers, such as HM, offer a suite of products to commercial farmers and agri-businesses in the country, which include policies to protect their crops and livestock. However, smallholder farmers largely fall outside of the insurers' scope. HM has tested and rolled out innovative solutions to provide smallholder farmers with financial protection, as described in the Highlight Box 3. As the state-owned insurer, Empresa Moçambicana de Seguros (EMOSE) plays an important role in providing risk capacity towards sector of strategic interest to the Government.

ISSM, Mozambique's insurance regulator, is actively looking to support the development agriculture insurance in the country. There is a recognition that the insurance industry must play a role in supporting the Government's development objectives. Mozambique does not have specific regulations related to index insurance or a regulatory sandbox framework. Nonetheless, ISSM has demonstrated its commitment to innovative solutions by providing Hollard Mozambqiue's weather index product with a regulatory exception.

[22] FAO, "Strategic Plan for the Development of the Agrarian Sector 2011-2020 (PEDSA)". 1 May 2011. http://www.fao.org/faolex/results/details/en/c/LEX-FAOC169514/

Highlight Box 3 – Hollard Mozambique's Crop Weather Index Insurance Product

In 2016-17, with support from the University of California Davis, Hollard Mozambique piloted an index insurance product for rain-fed crop farmers in the country's Central region. Subsequently, from 2018 onwards, as part of a project supported by the World Bank, Hollard Mozambique launched the country's first local crop index insurance in the Central and Northern provinces. By 2020, the number of insured farmers has increased to more than 34,000 following coverage provided via an agricultural input supplier, a local agricultural development project (Sustenta) and the Rural Resilience project of the UN World Food Programme. Casa do Agricultor is one of the major input suppliers for the Sustenta project. Recent growth in the number of insured farmers was supported by an innovative project that bundles index insurance with sale of seeds provided by Phoenix Seeds Lda via an agricultural development project supported by USAID and implemented by the development agency NCBA CLUSA. Partially funded by premium subsidies, the crop index insurance product has enabled Phoenix Seeds to substantially increase the volume of seeds sold in Mozambique.

The index insurance product provides farmers with protection against loss or damage caused by a significant lack of rainfall or excessive rainfall during critical stages of germination and development of crops in covered areas, subject to appropriate geo-referencing. The index is based on satellite-derived climatic data, allowing for even remote areas of the country to be monitored and for potential payouts to be automatically transferred to the farmers. For the past few seasons, Hollard Mozambique has been relying on a combination of satellite systems for monitoring precipitation and evapotranspiration. There are plans to also include a soil moisture index for the approaching 2021/2022 season.

Source: Hollard Mozambique

Namibia

The severe drought during recent years has drawn the attention of the Government of Namibia to the acute exposure of the country's agriculture sector to such disasters. Via the Ministry of Agriculture, Water and Land Reform and the Office of the Prime Minister, the national drought relief program compensate farmers for the loss of their assets. As part of its long-term development strategy, "Vision 2030" and to reduce public expenditure for future droughts, the Government is looking at various avenues to increase the climate resilience of commercial and smallholder farmers in the country.[23]

The insurance sector, which includes 16 non-life insurance companies in Namibia, one state-owned insurance company (Nasria), and almost 3000 intermediaries, is expected to contribute to these efforts.[24] The sector is supported by the national reinsurer NamibRe, which has the right of first refusal on all business originating from Namibia. While the Namibian insurance industry remains supportive of the government's efforts to address drought risk, local primary insurers are well aware of the accumulation risk posed by severe events. Traditionally, all major insurance companies in Namibia serve the country's commercial farming and agri-business sector, providing a range of short-term insurance products against theft and damage of property, stock and vehicles required by farmers.

[23] Office of the President (Namibia), "Namibia Vision 2030: Policy Framework for Long-Term National Development". 2004.

[24] Namfisa, "Annual Report 2018". August 2018.

However, drought coverage related to crop and livestock are not included within policies. Instead, farmers and the public sector pick up those losses inflicted by such disasters. Commercial farmers have reacted to the current circumstances by adjusting their farming practices and land management to minimize their drought risk.

Nonetheless, there is currently a concerted effort underway in Namibia to assess the viability of utilizing index insurance to provide drought coverage. Under the leadership of the regulator, the Namibian Financial Institution and Supervisory Authority (Namfisa), a dedicated working group is bringing together private and public entities from the banking and insurance sector. The group reviews use cases, product structures, and affordability aspects of index insurance for droughts and floods. Customer protection remains a central concern for Namfisa, with the regulator needing to ensure that retail customers can understand and benefit from index insurance products.

Currently, index products can be sold in Namibia as derivatives, limiting their marketing to commercial entities. International reinsurers such as SwissRe have the authorization to sell weather derivatives in the country. If customer protection and affordability concerns are overcome, Namfisa has a sandbox framework in place to test innovative insurance products. A well-structured product and distribution strategy submitted by an established Namibian insurer, in collaboration with NamibRe and international reinsurers, is a prerequisite to be accepted within the sandbox framework.

Botswana

The Government of Botswana is seeking to strengthen agricultural activities to both increase the productivity of the substantial beef sector and decrease the country's dependency on crop imports. The Government is well aware of the drought risks faced by the sector and has a track record in seeking measures to increase the resilience of farmers. A prominent example thereof is the Agriculture Credit Guaranteed Scheme (ACGS), which enables the National Development Bank of Botswana (NDB) to apply for coverage against drought-induced defaults when lending to rain-fed smallholder crop farmers. The scheme, first established in 1986, is explicitly intended for loans related to crop farming and does not directly include livestock-related activities. The Government of Botswana charges an annual cost of 10% of the annual loan installment, split equally between the NDB and the farmer in question. Following the end of the cropping year, experts assigned by the Government perform a drought assessment and recommend a payout level of between 0-85% of the annual loan installment. However, the scheme is estimated to be highly loss-making, with drought being declared in 2 out of 3 years (66.67% annual probability of a payout), highlighting the importance of basing index insurance products on impartial data.[25]

Next to the accumulation risk of droughts, the high level of government support is one of the primary reasons for the lack of drought coverage provided by the insurance sector in Botswana. The sector is regulated by the Non-Bank Financial Institutions Regulatory Authority (NBFIRA), which oversees the 12 licensed non-life insurance and three reinsurance companies in the country.[26] Both commercial and smallholder farmers have access to various short-term insurance products against theft and damage of property, stock and vehicles. Selected insurers targeting the agriculture sector, such as Botswana Insurance Company, offer dedicated crop and livestock insurance coverages that provide protection against various perils, including floods, windstorms, and hail. Drought, however, remains excluded from any crop and livestock insurance coverage.

[25] Reason L. Machete, "Towards a Sustainable Agricultural Credit Guarantee Scheme", IDEAS Papers. August 2020

[26] Axco, "Non-Life Insurance Market Reports – Botswana". May 2021

The current insurance laws do not make provision for index insurance products, but regulatory approval can technically be requested with NBFIRA. In Botswana, index products can be sold as derivatives outside of insurance regulations. For example, SwissRe has permission to sell such products to the commercial sector in Botswana. To be considered for a regulatory exemption, a well-documented use case would need to be submitted to NBFIRA, also outlining the potential impact on the financial sustainability of the local primary insurer in question.

Distribution Channel Options

As part of the study, several potential distribution channels are considered for an index-based livestock insurance product. Ensuring a strong distribution agreement can be achieved is a central objective of the project team, given the importance of maintaining the product's affordability as well as accurate and transparent marketing of index insurance to retail clients. The smallholder farmer purchasing the coverage needs to understand four key aspects of the product:

- The benefits of risk transfer solutions
- The reasons for paying a certain premium amount
- Under which drought conditions the policy results in a payout
- How they can expect to receive payment

The entity handling the direct client relationship with smallholder livestock farmers must have the technical capacity to outline these aspects and the ability to establish a mutual level of trust with the client. These aspects are especially critical when dealing with a complex risk such as drought. Accounting for these considerations, the project team has outlined four primary distribution channel options to consider in each of the three countries included within the study:

- **Distribution Channel 1 - In collaboration with the public sector and/or development agencies**
  Index insurance schemes targeting the low-income sector are frequently rolled out in collaboration with government-related entities and/or development agencies interested in enhancing financial resilience. Such a distribution strategy aims to supplement existing drought relief programs, benefiting from the trust and interactions already built up with the smallholder livestock farmers.

  Potential distribution partners: Ministries, public entities, or development agencies with directly interacting with smallholder livestock farmers or organizations involved in drought relief programs.

  Opportunities: Ability to operate with high levels of trust from the onset, lower costs thanks to potential subsidies and higher purchasing power, secure multi-year scheme once established.

  Challenges: Long lead time prior to implementation, the influence of political priorities, potential sustainability issues without subsidies, opportunity costs of public or development funds invested in the scheme.

- **Distribution Channel 2 - Bundled with products provided by livestock service providers**
  A well-established distribution channel for index-based crop insurance is to bundle the policy with products already being purchased by the farmer, either as a voluntary add-on or a mandatory inclusion (e.g. seeds or fertilizer).

In the case of livestock farmers, the index insurance policy could be combined with input supplies such as supplementary feed or veterinary drugs required regularly by the farmer. Alternatively, livestock purchasers such as the meat industry could be utilized.

Potential distribution partners: Agriculture and livestock inputs suppliers with a wide network of stores, livestock purchasers with recurring interactions with the farmers such as the meat industry.

Opportunities: Higher relevance due to bundling with a tangible service or product, ability to increase affordability by offering a combined price, high scalability potential once use case is proven.

Challenges: High dependency on service provider, potentially subject to exclusivity agreements i.e. limitations to scale across multiple service providers, strong sales incentives and high training requirements to align interests.

- **Distribution Channel 3 - Bundled with loans provided to livestock farmers**
  Index insurance can hedge a loan or a portfolio's drought risk, respectively reduce the default risk when lending to livestock farmers. Insurance coverages can either improve the creditworthiness of borrowers or act as a collateral/security for the lender. The policy can be purchased on a voluntary basis, with payouts being transferred to the farmer. Alternatively, the drought coverage could be mandatory with the premium costs included in the interest rate charged and the payout being transferred to the lender.

  Potential distribution partners: Any entity lending to smallholder livestock farmers such as agriculture banks, commercial banks, and micro-finance institutions.

  Opportunities: Combining two financial products with relevance to the farmer, high financial literacy of distribution partner, efficient policy execution, very high scalability potential with mandatory bundling.

  Challenges: High dependency on lender, potentially subject to exclusivity agreements i.e. limitations to scale across multiple lenders, risk of only indirectly benefiting the farmer if the lender receives the payout.

- **Distribution Channel 4 - Sold directly to the livestock farmers as a stand-alone product**
  The index-insurance product can also be marketed directly to the farmers by the distribution partner. The premium costs would not be bundled with any existing service or product, but offered as a separately via the partners existing point of sale, earning the organization a distribution fee for each policy sold.

  Potential distribution partners: Agriculture and livestock inputs suppliers with a wide network of stores, service providers such as telcom companies with recurring interactions with the farmers.

  Opportunities: Building on established partner's high trust and existing point of sales, clear division of responsibilities among the parties involved, ability to engage multiple distribution partners once use case is proven.

  Challenges: Lower affordability due to stand-alone premium costs, very strong sales incentives needed to encourage active marketing by the partners, high training requirements to ensure customer protection, limited scalability potential in the short-term.

Recommended Distribution Strategy Per Country

The following section outlines the distribution channels and partners seen as most suitable for an index-based livestock insurance product in each of the three countries. The list is non-exhaustive and represents a snapshot of the situation upon drafting this report based on the stakeholder conversations held to date.

Mozambique

Distribution Channel 1
In Mozambique, the regulator and the insurance sector have gained some initial experience with index insurance to cover drought and excess rainfall crop damages (see Highlight Box 3). Building on the success of past index-insurance pilot programs, Distribution Channel 1 is identified as possible mid-term solution by the project team (see Table 3). Especially if the program can be tied into wider disaster risk management schemes in the country and can tap into the network developed by the Sustenta project. The project is supported by the World Bank and seeks to integrate smallholder farmers into agricultural production value chains while also providing financial support in case of a crisis. While SUSTENTA is primarily focused on crop farming, the recent expansion to the whole country opens the door to argue for a strong livestock focus in the three southern provinces. A further key actor to develop Distribution Channel 1 is the Financial Sector Deepening Mozambique (FSD Moc). Funded by donors, FSD Moc plays a key role in developing the financial sector in the country, among others, supporting the regulator (ISSM) and ministries within the Government in their efforts to foster innovation and enhance financial inclusion across the insurance sector.

Distribution Channel 2
The county's smallholder livestock farmers operate along predominantly localized value chains, with limited inputs being required to maintain their cattle. Commercial agriculture services providers and purchasers are mainly absent in the southern provinces, aside from Casa do Agricultor (CdA). Therefore finding a suitable input product to bundle index-based livestock insurance with remains a large hurdle, especially in the short-term. These considerations limit the viability of introducing index insurance via Distribution Channel 2.

Distribution Channel 3
Smallholder livestock farmers rarely use their cattle to generate a regular source income, utilize them for ploughing and other farm work, supply meat and milk for themselves, and store wealth as an emergency reserve. This limits the need to borrow external funds to invest in the maintenance and expansion of the herd. Even on the crop farming side, smallholder farmers do not seek loans to manage their farms, aside from buying inputs supplies on credit from suppliers. Therefore, banks in Mozambique do not lend to smallholder farmers at all, making Distribution Channel 3 irrelevant.

Distribution Channel 4
Casa do Agricultor (CdA) is identified as the only distribution partner within the agriculture service sector with the rural reach and professionalism to collaborate on index-insurance. A unique feature is the Farmer School which CdA operates to trains smallholder farmers on best practices and sustainability issues. The company has more than 30 years of experience and is present in the southern region of Mozambique with stores and warehouses in Maputo and Macia (Gaza), also serving the provinces via 21 associated agro-dealers. CdA is motivated to strengthen its clients' financial resilience and is looking to offer relevant insurance products to their clients via their shops, agro-dealer partnerships, and online offerings.
Aside from Casa do Agricultor, other partners for Distribution Channel 4 include Recarga Aki and Vodacom. Recarga Aki works with a network of 4,200 agents and mobile terminals to provide clients with easy access to pay for pre-paid airtime, television, electricity, water and life insurance products (via Hollard and Emose).

Its technology platform has been operating since 2015, it is integrated directly into our various suppliers' systems and is recognized as stable and reliable. Vodacom, a major telcom in the country, collaborates with Viamo to operate a platform which provides farmers with free information on agriculture. The text and audio information also enables farmers to gain information on new markets, agri inputs, best practices, weather relevant as well as relevant financial services. The project team foresees challenges related to transparently providing index-insurance relevant information via both Recarga Aki and Vodacom. At best, the product would be featured among a large variety of different services and products, not providing the relevant background information required to launch a new insurance product concept.

Table 3: Assessment of distribution channel options and primary insurers – for the southern region of Mozambique

Distribution Channel	Potential for index-insurance distribution (1-5)	Key Stakeholders	Comments
1 - In collaboration with the public sector and/or development agencies	3 – Mid-term 1 – Short-term	FSD Moc SUSTENTA (World Bank) GIIF – IFC	Higher mid-term potential given the timelines required to gain the support of the major development partners in the agriculture and financial sectors
2 - Bundled with products provided by livestock service providers	2 – Mid-term 1 – Short-term	Casa do Agricultor	The potential could increase marginally if the livestock sector becomes more commercialized with smallholder farmers beginning to require inputs such as supplementary feed
3 - Bundled with loans provided to livestock farmers	1 – Short- & Mid-term	None	Initiatives to systematically lend to smallholder farmers are not expected in the mid-term
4 - Sold directly to the livestock farmers as a stand-alone product	4 – Short- & Mid-term	Casa do Agricultor Recarga Aki Vodacom	With a sufficient amount training and capacity building, the product concept could be tested with some of the larger agri and telcom service providers
Primary Insurers	4 – Mid-term 5 – Short-term	Hollard Mozambique (HM) Empresa Moçambicana de Seguros (EMOSE)	High short-term potential due to HM's active role in testing index insurance products. The mid-term prospects depend on products' demand and performance in the coming years.

Based on the assessment of distribution partners and the livestock market in Mozambique, the project team recommends following two distribution channels in parallel. The dialog with the development sector and public entities should be continued to position index-based livestock insurance as an effective tool to improve the financial resilience of smallholder farmers in the southern region of Mozambique. Next to HM, with its index insurance expertise, the state-owned insurer EMOSE can be expected to be involved in providing risk capacity towards insuring smallholder farmers in the region. While the exact form of the scheme remains open at this stage, the interest and existing use cases for index insurance in Mozambique bode well to develop an index-based livestock insurance program in the country.

The primary focus in the short term is on Casa do Agricultor to establish a joint pilot project in the southern region of Mozambique. A collaborative effort could determine how best to market the insurance among livestock farmers, which benefits appeal to them most and how awareness could be raised. Initially, the livestock product would be offered as a stand-alone product (Distribution Channel 4) together with the weather index insurance for crops already developed by HM. HM would work closely with the international reinsurers already providing risk capacity for the existing index insurance product.

Namibia

Distribution Channel 1

The Government of Namibia is actively looking to address the country's drought and flood exposure. Namfisa is leading the coordination efforts among private and public stakeholders to enhance financial resilience and limit the growing public expenditures related to the national drought relief program. The dedicated index-insurance working group includes entities such as Agribank of Namibia and Nasria, the state-owned special risk insurer. Efforts to establish a public-private drought insurance scheme will require close cooperation with Namfisa, with Distribution Channel 1 seen a viable mid-term option by the project team. Nasria, with a history in providing coverage for high accumulation risks such as political violence and terrorism, is expected to be a further key entity within any public-private program. Upon receiving the mandate by the Government to expand into climate risks, Nasria has initiated a feasibility study in collaboration with K.M Dastur to evaluate various product options to address drought insurance.

Distribution Channel 2

The bundling of index-insurance with agri inputs suppliers or purchasers is conceptually possible but requires further detailed discussion with the key organizations in the country. On the agri input side, Namibia has several large agri service providers with a vast rural network and frequent interactions with smallholder farmers. For example, Agra acts as the first stop for agricultural and livestock supplies for many farmers, with 20 retail outlets across the country. Given that certain smallholder farmers in Namibia apply a semi-intensive cattle production system, additional fodder and supplementary feed are provided to their cattle and grazing on pasturelands. The organization has experience in distributing insurance, offering transportation coverage provided by Alexander Forbes to farmers participating in its livestock auctions. Kaap Agri Namibia, a subsidiary of South Africa's Kaap Agri, is a further well-established agri provider with 17 branches in the country.

On the purchaser side, Meatco is the primary national-level buyer of cattle, including from smallholder farmers via its mobile abattoirs. The company is actively seeking to integrate more smallholder farmers in the meat industry, also via its own foundation, and has a direct financial interest in maintaining cattle health during a drought. The project team has a preference to bundle index insurance with input suppliers since the partnership could be structured similar to products bundled with crop inputs. However, a limiting factor for this distribution channel remains the long lead time to find a suitable bundling option with both livestock inputs or cattle purchases.

Detailed discussion with these organizations would be required before a final call can be made on the feasibility of such a distribution strategy.

Distribution Channel 3

Agri lending has a long track record in Namibia, with the sector receiving access to capital from a range of public and commercial banks. Both commercial and smallholder farmers benefit from the banking sector, however, the latter can fall below credit eligibility due to the absence of regular income or assets which can be pledged as collateral. Drought risk is a crucial concern for public and private lenders alike, restricting the lending scope available to them. Banks utilize mandatory short-term indemnity insurance as additional security when providing loans for farming vehicles and machinery. Given the lack of drought insurance, they are actively evaluating the potential to utilize index insurance to limit their drought risk, allowing them to expand their portfolio.

While many banks in Namibia are active in agri lending, Agribank and FNB Namibia take a leading role in the market. Agribank is a state-owned lender with a mandate to develop the agriculture sector in the country. During droughts, they also receive the authority from the Government to provide emergency lending to farmers in need. FNB Namibia is the largest commercial bank in the country with a substantial agri portfolio and ongoing initiatives to support SME's as well as smallholder farmers. The potential to bundle index insurance with agri loans or other clients with high drought exposure is seen as high.

Distribution Channel 4

Agri inputs suppliers, such as Agra and Kaap agri, could also sell index-insurance as a stand-alone provide via Distribution Channel 4. Additionally, farmers associations in Namibia could help strengthen their members' financial resilience and strengthen their negotiating power. Umbrella organizations focused on smallholder farmers, such as the Namibia National Farmers Union (NNFU), enjoy stellar trust levels among smallholder farmers and could work with the various local associations within the network to promote drought insurance. Extensive training and capacity building would be required with a suitable incentive structure to establish Distribution Channel 4 successfully. Further detailed discussions are required prior to making a final judgment call on the feasibility of such a distribution partnership.

Table 4: Assessment of distribution channel options and primary insurers - Namibia

Distribution Channel	Potential for index-insurance distribution (1-5)	Key Stakeholders	Comments
1 - In collaboration with the public sector and/or development agencies	4 – Mid-term 3 – Short-term	Namfisa GoN Nasria	Funding challenges hinder the mid-term potential to be higher. Strong current momentum on index-insurance warrant a high short-term potential for a certain degree of public involvement.
2 - Bundled with products provided by livestock service providers	4 – Mid-term 2 – Short-term	Agra Kaap Agri Meatco	Long lead time in determining a suitable bundling option limits the short-term potential. High mid-term potential if a good use case is found.

3 - Bundled with loans provided to livestock farmers	5 – Mid-term 4 – Short-term	Agribank FNB Namibia	Primary challenge is addressing the affordability issues. The additional cost of index-insurance cannot increase the interest rate charged by much.
4 - Sold directly to the livestock farmers as a stand-alone product	3 – Mid-term 2 – Short-term	Agra Kaap Agri NNFU	Long lead time and training needs required to establish the product among the potential partners.
Primary Insurers	5 – Mid-term 3 – Short-term	Nasria Hollard Namibia Santam Namibia	Namfisa's strong interest in index insurance raises the mid-term prospects of testing such solutions in the market. However, further analysis by the insurers is required before any product launch.

The general momentum for index insurance in Namibia results in a high potential to introduce such drought insurance solutions. Among the primary insurers, Nasria is expected to be at the forefront of developing index insurance products, informed by their ongoing feasibility study. The involvement of the national reinsurer, NamibRe, to manage the accumulation risk of droughts will be crucial for any product launch, independent of the distribution channel selected. The project team suggests dedicating attention to all four distribution channels going forward, with the aim of introducing index insurance broadly across the market. Despite this general stance, the immediate focus should lie on bundling index insurance with agri and other strongly drought exposed loans. The demand for such solutions has been flagged, hopefully allowing the product concept to be tested in the market.

Botswana

Distribution Channel 1

The Government of Botswana has long been involved in supporting the financial resilience of its agriculture sector. Programs such as the Agriculture Credit Guaranteed Scheme (ACGS), channeled via the National Development Bank (NDB), are aimed at securing loans extended for crop farming. Despite these schemes not being directly related to livestock farming, this does underpin the high level of government involvement and its high-risk appetite to assume drought losses suffered by smallholder farmers. While the insurance regulator NBFIRA judges index insurance to be innovative and intriguing, there are no active initiatives to promote such products to address drought risk. These circumstances limit the potential of Distribution Channel 1 in the short term. However, the high governmental commitment to the sector and willingness to utilize public funding to address drought risk, resulting in a strong mid-term potential. However, this would require considerable dedication and an extensive dialog with various public entities and ministries.

Distribution Channel 2
The agri input and purchaser markets in Botswana are dominated by public entities in the form of BAMB and BMC. Smallholder farmers in the country make extensive use of BAMB's network of outlets to purchase inputs such as fodder and supplementary feed for their cattle. The organization acts as a provider of agriculture inputs and as a purchaser for crops produced by the farmers, further boosting their relevance to communities. BMC's monopoly on beef exports results in its primary position as the buyer of cattle from smallholder farmers. The organization also a direct interest in maintaining cattle health during droughts, having had suffered from limited supply during recent drought years. Despite their prominent market position, the project team remains uncertain regarding their capacity and willingness to cooperate with the private sector to bundle index insurance, challenging the potential of Distribution Channel 2. Further detailed discussions need to be held with both organizations.

Distribution Channel 3
The NDB is a fully government-owned bank with the mandate to strengthen the agriculture sector in the country. Smallholder farmers with financing needs largely rely on the NDB, with selected private commercial banks focusing on the commercial farmers and larger agri-businesses while others do not target the sector at all. Addressing the drought risk of agri loans could be interesting for lenders such as FNB Botswana, the country's second-largest commercial bank. But since commercial farmers face less challenges related to creditworthiness and posting collateral, the appeal of testing a new bundled solution is limited. Once a bundled index-insurance loan product is tested and commercialized in another market, the solution could be introduced in Botswana too. The drought risk of smallholder crop farmers in the country are largely addressed via the NDB's ACGS program provided by the Government. The project team concludes that any solution covering livestock needs to align with the existing ACGS, limiting the potential for a private-sector solution.

Distribution Channel 4
Next to the previously highlighted challenges related to BAMB and BMC, Distribution Channel 4 could seek partnerships with farmers cooperatives and associations. Unfortunately, the absence of strong national level umbrella associations or livestock marketing cooperatives limits this possibility, given the challenges of engaging with highly localised or specialized association. Engaging with other non-agriculture service providers to the farmers, such as telcom companies, is seen as having a skewed relationship between high implementation costs and limited number of smallholder livestock farmers in Botswana.

Table 5: Assessment of distribution channel options and primary insurers - Botswana

Distribution Channel	Potential for index-insurance distribution (1-5)	Key Stakeholders	Comments
1 - In collaboration with the public sector and/or development agencies	3 – Mid-term 1 – Short-term	GoB NDB	The high level of drought risk assumed by the GoB limit the possibility of introducing a public-private scheme. Proposing index-based livestock insurance or guarantee might be viable in the mid-term.

2 - Bundled with products provided by livestock service providers	3 – Mid-term 2 – Short-term	BAMB BMC	Long lead time in determining a suitable bundling option limits the short-term potential. Mid-term potential depends on the willingness of state-owned organizations to work with the private sector.
3 - Bundled with loans provided to livestock farmers	2 – Mid-term 1 – Short-term	FNB Botswana NDB	Virtually no prospects for bundling with agri loans in the short term. Mid-term potential with commercial banks only once the product concept has been fully tested.
4 - Sold directly to the livestock farmers as a stand-alone product	1 – Mid-term 1 – Short-term	BAMB BMC	State-owned organizations with low incentives to sell a stand-alone product. No alternative national level association or service provider.
Primary Insurers	3 – Mid-term 2 – Short-term	Hollard Botswana Botswana Insurance Company	Insurers in Botswana are expected to cautiously approach drought risks, limiting the short-term potential to test index insurance without the Government's involvement.

In Botswana, the project team recommends establishing a continued dialog with BAMB and BMC to gradually work towards an appealing bundled solution. Distribution Channel 2 remains the option with the highest potential in the country, which would also require further discussions with primary insurers in the country. In addition, insights from NDB's ACGS should be drawn and alternatives to exclusively funding drought risk via the public sector discussed with the bank. The Government's assumption of drought risks faced by smallholder farmers and the accumulation potential of this peril limits the scope for the private insurance sector to independently test index insurance solutions in Botswana.

Livestock Insurance Product

Index Insurance & Livestock Schemes Overview

Overview

Traditional indemnity-based insurance is focused on paying out a claim based on the value of the loss incurred. Defining the exact value of the loss takes time and costs money, which is reflected as an additional cost in the premium paid by clients for insurance coverage. Index insurance is different. It pays out based on the occurrence of an event, as measured by an objective trigger or index, delivered by independent third-party data provider.

With traditional indemnity insurance, the customer is paid based on the actual damages incurred and covered by the policy. Indeed, in many countries, it is a regulatory requirement that the loss is equal to the financial payout. With index (index) insurance, the amount paid out is generally not defined by the financial cost of the loss but is determined by the severity an event or performance of an index (for example NDVI). A well-designed index is structured so that the payout closely correlates to the loss suffered. The potential shortfall between customers' financial loss and the index payout is termed the basis risk. Customers will usually tolerate some basis risk in return for the benefits that index insurance brings but it is a possible barrier for widespread adoption.

Currently, index insurance is best suited for providing cover when there is no alternative, or it is cheaper than, traditional insurance. This has resulted in many insurance schemes in less mature markets, especially agricultural & livestock insurance and NatCat space. In many cases, governments endorse index insurance initiatives as part of their disaster recovery framework and grant subsidies for the premium. This results from improved technology, better data and modelling techniques and higher market acceptance of index insurance.

In conventional indemnity insurance, pricing the risk of a loss from the customer and their assets (both tangible and intangible) is hard. The customer usually has the advantage of knowing more about their own risk than their insurer. For index insurance, this information asymmetry is considerably reduced. Both parties have access to the same information about the likelihood of an event occurring and a trigger being breached. Further benefits of index insurance can be summarized as follows:

- **Pay-out**: Rapid post-disaster payout, within days/weeks, not months.
- **Claims process**: Payout is pro-actively provided by the insurer, no claims submission required.
- **Loss Assessment**: No claims dispute due to pre-agreed payout conditions.
- **Event Based:** Provides disaster-specific coverage for a certain pre-agreed event severity. Premium costs are based on the probability of the event occurring during the policy period.
- **Flexible Policy Duration**: The policy duration can be adjusted to the client's needs, ranging from a few months to multi-year (subject to insurer's risk appetite).
- **Flexible Coverage**: The coverage can protect a variety of assets or incomes at threat from the disaster in question, depending on the client's needs. Premium costs do not change depending on the asset covered.

Livestock Insurance Schemes

Agriculture insurance for smallholder farmers faces numerous practical and affordability challenges. Recent innovations in the index insurance space have fueled interest in the potential of insuring vulnerable farmers. One such innovation is utilizing vegetation density data (NDVI) as the basis for an index-based livestock insurance product, which has been tried and tested in East Africa.

IBLI Ethiopia

The Index-Based Livestock Insurance (IBLI) project in Ethiopia explores index products for livestock of pastoralists to improve resilience and lead to market expansion. The project is funded by USAID and uses satellite data monitoring the vegetation based on ground cover. The project was launched in the Borana zone of Ethiopia in August 2012 under a partnership headed by ILRI and Oromia Insurance SC.[27] Since then, 11,067 pastoralists purchased IBLI to protect their animals in Borana, as depicted in Figure 11, and the total sum insured amounts to roughly USD 1,7 million (as of 2018). Oromia Insurance SC has paid out USD 170,000 to farmers during drought events between 2012 and 2018. These payouts are linked to measurable benefits to the farmers such as:

- 36% reduction of 'distress' sales of livestock to raise cash in times of drought
- 25% reduced likelihood for the farmers and their families to having to eat significantly smaller meals
- 33% reduction in the dependence of the farmers and their families to rely on food aid.

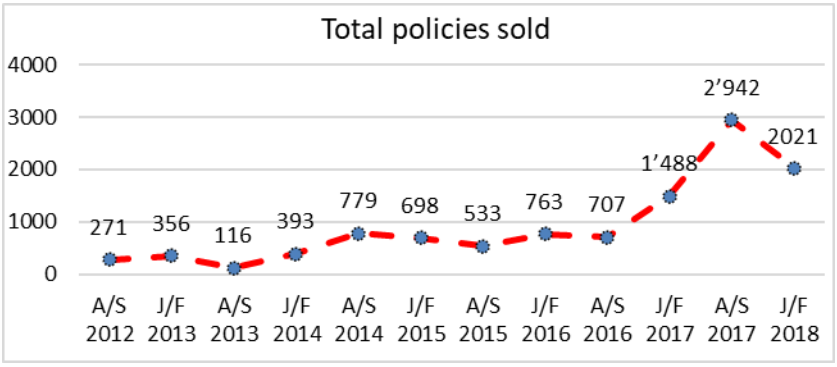

Figure 11: IBLI Ethiopia number of policies sold between 2012 and 2018. Source: ILRI, "IBLI Poster". July 2018.

Kenya Livestock Insurance Program (KLIP)

KLIP is a index insurance scheme in Kenya focusing on pastoralist communities. The program is funded by the Government of Kenya and the World Bank. Based on several studies and Proof-of-Concept projects of Index-Based Livestock Insurance, KLIP was launched in 2015 in two Kenyan counties protecting 5,000 pastoralists against droughts. Since then, the product based on vegetation density (NDVI) has helped pastoralists gain access to fodder, water, and veterinary services as drought conditions develop Kenya, allowing them to protect their cattle.

[27] Abayineh Amarea et al. "Index-based livestock insurance to manage climate risks in Borena zone of southern Oromia, Ethiopia" in Climate Risk Management. 12 June 2019.

The product covers both the long rain season between March to September and the short rain season between October to February, covering vegetation shortfall with an anticipated return period of 5 years (20% annual probability of occurrence).[28]

The number of households and livestock covered under the program has increased in the years following its launch. Since 2018, the number of beneficiaries is stagnating, primarily due to the Government plans to make some changes to the scheme. Currently, the premium is fully subsidized for up to 5 heads of cattle, with pastoralists usually not requesting additional unsubsidized coverage. The Government has now floated plans to reduce the subsidies to max. 50% of the premium, while also widening the eligibility criteria.[29] This new scheme should then offer universal access to a partially subsidized product rather a fully subsidized scheme for a select group of beneficiaries. The current beneficiaries are distributed across the north-east of Kenya with especially many in Tana River and Isiolo (Figure 12).

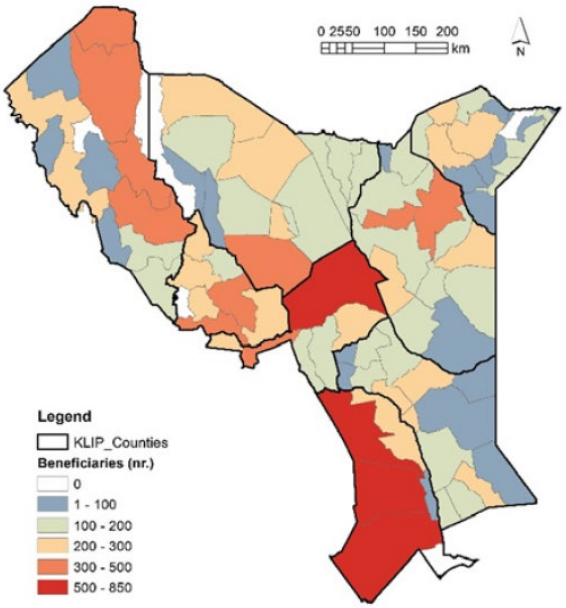

Figure 12: Distribution of the KLIP beneficiaries across the north-east of Kenya. Source: Francesco Fava et al. "Building financial resilience in pastoral communities in Africa". World Bank. February 2021

The premium income generated by KLIP has increased with the number of beneficiaries since the programs launch in 2015 (see Figure 14). Over the course of the years, the total earned premium amounts to USD 9.5 million. This compares with a total payout of USD 10.94 million. Most of the payouts were incurred in the 2016-2017 and the 2018-2019 drought seasons. The locations where KLIP made a payout are shown in Figure 13. The white areas in the payout map of the 2016-2017 drought (left) reflect areas that KLIP did not yet cover at the time. Some regions were hit during both events, but overall, the maps highlight the wide disbursement of payouts across multiple counties.

Overall, KLIP has reduced livestock mortality by 25-40% compared to drought events without insurance coverage. A loss ratio of 115% means that during the limited history of KLIP, the payout has exceeded the premium income. KLIP's premium rates have increased from 10% to 19%, but the number of pastoralists has remained at the maximum since 2017 (see Figure 14).

[28] Francesco Fava et al. "Building financial resilience in pastoral communities in Africa". World Bank. February 2021.

[29] Ibid.

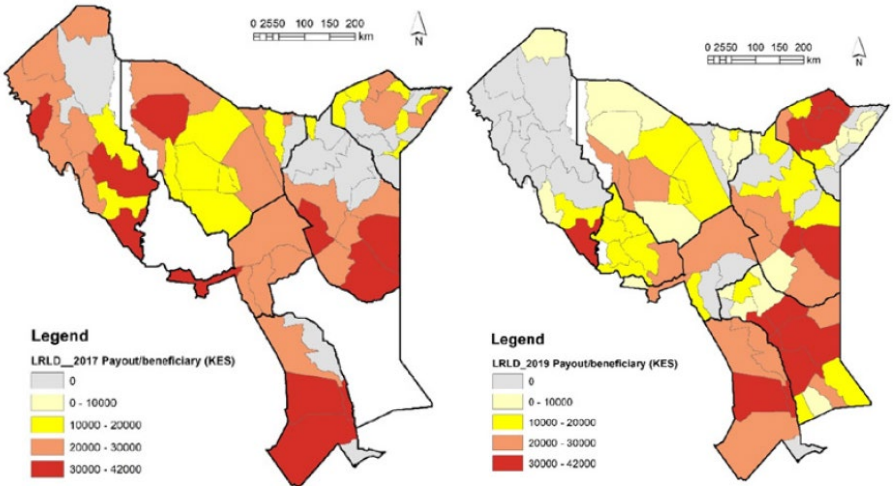

Figure 13: KLIP payout per beneficiary during the 2016-2017 and the 2018-2019 droughts. Source: Francesco Fava et al. "Building financial resilience in pastoral communities in Africa". World Bank. February 2021

Year	Season	No. of counties	No. of households	No. of TLUs	Total sum Insured	Premium[a]	Payouts[a]	Loss ratio (%)
2015–16	Short rains	2	5,000	25,000	5.59	0.56		6.24
	Long rains	2	5,000	25,000			0.035	
2016–17	Short rains	6	14,010	70,050	8.92	1.64	2.150	320.95
	Long rains	6	13,776	68,880			3.130	
2017–18	Short rains	8	18,012	90,060	12.61	2.46	1.750	71.02
	Long rains	8	18,012	90,060				
2018–19	Short rains	8	18',012	90,060	12.61	2.41	0.880	160.75
	Long rains	8	18,012	90,060			2.990	
2019–20	Short rains	8	18,012	90,060	12.61	2.41	0.000	0.00
	Long rains	8	18,012	90,060			0.000	
Total					52.34	9.5	10.940	115.25

Note: a. US$, million.

Figure 14: Summary of KLIP's development, premiums, seasonal payouts, and loss ratios. Note: TLU stand for Tropical Livestock Unit. Source: Francesco Fava et al. "Building financial resilience in pastoral communities in Africa". World Bank. February 2021

Despite the basic product being fully subsidized, KLIP faced some initial challenges in ensuring pastoralists took up the coverage. This was primarily due the low insurance awareness among pastoralists and challenges in reaching them. Due to the limited payment infrastructure in place, the transfer of payouts to farmers faced certain hurdles too, especially related to falsely recorded personal details. Key lessons that can be directly transferred to other livestock insurance programs include the need to create awareness and strengthen capacity across the stakeholders involved and the importance of accurate product design, especially to tailor the product to local circumstances. The need for effective implementation is also emphasized, with well-developed premium collection and payment infrastructure being imperative to reap the benefits of index insurance.[30]

[30] Francesco Fava et al. "Building financial resilience in pastoral communities in Africa". World Bank. February 2021.

NDVI Data Source

Data sources such as NDVI and SARmap data can give insights to the spatial distribution of drought conditions. In the following, we provide an introduction to each of these datasets.

Normalized difference vegetation index (NDVI) is a simple graphical indicator that can be used to assess whether the target area contains live green vegetation or not. The NDVI varies between -1.0 and +1.0. Typically, the NDVI of an area containing a dense vegetation canopy will tend to positive values (say 0.3 to 0.8) while clouds and snow fields will be characterized by negative values. The values are provided in regular intervals, e.g. every 10 days, and accessed for different spatial resolutions, e.g. 250m x 250m. Monthly NDVI values for a specific area of interest are derived by averaging the three 10-day period measurements over the full month for each grid cell. The NDVI value can then be aggregated up to the area of interest, such as a province or district, averaging out the NDVI values for all grid cells that fall within the area's boundaries.

A great advantage of NDVI is that this remote sensing data is available from several public sources. It is also a great asset to assess trends in land-use systems and vegetation. In the insurance space, it is used as a proxy on the conditions of pasturelands. Due to its acceptance among international reinsurers, livestock insurance is often based on NDVI data. The drawback for NDVI is the risk of cloud cover interfering with the observation and the difficulty in separating tree canopies from green pasturelands.

As in this study, many drought and pasture drought index insurance schemes are based on MODIS NDVI data. As MODIS satellite platforms approach mission end, a replacement for the NDVI data is needed in the future. To fill the gap, various options for datasets are worthy to consider, such as:

- **NOAA Climate Data Record (CDR) of AVHRR NDVI, Version 5**
  The AVHRR NDVI is provided by the US National Oceanic and Atmospheric Administration. It entails daily NDVI data on a 0.05° spatial resolution and is updated roughly 1 day after measurement. The data set spans a historical length from 1981 to present. Therefore, it has the longest historical data length in this sub selection of three options. Reinsurers have confirmed the suitability of this dataset and expressed their willingness to work with it.

- **Sentinel 3 NDVI data from the Sentinel/ Copernicus program**
  The Sentinel 3 satellite was launched in 2020 and is jointly operated by ESA and EUMETSAT. It is reporting daily NDVI data since July 2020 on a 300m resolution. The latency of the data, which depicts the time that data takes from measurement to availability to the public, is 3 days. Of all considered datasets, Sentinel 3 has the most sophisticated system and is seen as the future of satellite data.

- **Suomi NPP VIIRS NDVI Data**
  The Suomi NPP VIIRS NDVI data has a spatial resolution of 4km and has been recording NDVI since 2014 on a weekly basis. The latency of this dataset is 6 hours. To date, the suitability of this dataset as a way forward for index NDVI products has not been confirmed by reinsurers.

The meta data for each considered dataset is summarized in Table 6.

Table 6: Properties of the considered alternative satellite data to follow-up on MODIS NDVI.

Data Name	Source	Historical Record	Spatial Resolution	Temporal Resolution	Latency	Confirmation from Reinsurers
NOAA CDR of AVHRR NDVI	NOAA Climate Prediction Center	1981 to present	0.05°	Daily	1 day	Yes
Sentinel 3 NDVI	Copernicus Sentinel	2020 to present	300m	Daily	3 days	Yes
Suomi NPP VIIRS	NOAA	2014 to present	4km	Weekly	6 hours	No

For the index insurance product design, it is important to consider that there are two separate process steps. Firstly, the product pricing process depicts the methodology for the calculation of a premium. The pricing of an index insurance product is always based on a relevant dataset with a sufficiently long historical track record (or a probabilistic model). Secondly, the calculation and settlement process focuses on monitoring a relevant dataset during the policy period, triggering a payout if the attachment threshold is met. Usually, the product pricing and settlement processes rely on the same dataset. However, in case of old satellites being discontinued and/or new data providers coming to market, the dataset used for the two processes can be different.

To safeguard the integrity of this study's baseline analysis and product design, it is important to note that the follow-up dataset needs to be very similar and minimize discrepancies. Therefore, product design data and data used for settlement or alternative data used for both processes need to show sufficiently high correlation. At this stage, the literature does not provide any indication on the correlation between the considered NDVIs. Therefore, CP recommends conducting a detailed analysis between MODIS NDVI and Sentinel 3 NDVI data, the preferred successor dataset for vegetation density due to its sophisticated standard and high resolution. Given the current overlap period between both datasets, a bias correction could be attempted by conducting quantile matching.

Such analysis would allow for a homogenous extended dataset to be generated, enabling the product pricing process to be based on historical, bias-corrected MODIS NDVI data providing a sufficient track record of past vegetation growth cycles. The NDVI data starting from July 2020 as well as the settlement process, can then be based on Sentinel 3 data. Certain deviation between the bias-corrected extended NDVI dataset and the current MODIS-only NDVI data can be expected, which might also result in adjustments in the technical premium. However, the changes are expected to remain minor.

For further refinement of the insurance product, the project team suggests to further process the NDVI data. The data can minimize bias and consequent basis risk by removing areas from the dataset which are not suitable for cattle grazing such as waterbodies, hillsides and urban infrastructures. The removable can have an impact on the aggregated NDVI.

SAR Data – Case Study – 2019 Namibia Drought

Synthetic Aperture Radar (SAR) images represent physical vegetation and soil measurements through the backscattering of objects. For this case study, the SAR data is provided by SARmap SA and comprises processed satellite data in high spatial and time resolution. For drought, the processed multi-sensor SAR spatially categorizes spatial areas into medium to strong vegetation, weak vegetation, stable vegetation, and bare soil. The following chapter contrasts NDVI and SAR data in a section of the Otjozondjupa region in the vicinity of the Grootfontein, Tsumkwe, and Okakarara constituencies (see the black square in Figure 16). The investigated period stretches from September 2018 to June 2019, covering one of driest wet seasons in Namibia's history, resulting in the severe 2019 drought. According to the reliefweb press release, an estimated 60'000 cattle starved due to inadequate grazing. [31]

In the 2019 drought, both temperature and rainfall as well as soil moisture were significantly influenced by the ENSO. In January 2019, the monthly sea surface temperature was roughly 1° C above the average, which led to an El Niño impact of 0.5° C above the anticipated El Niño threshold.[32] Figure 15 shows the anomalies of rainfall and soil moisture from December 2018 to January 2019 over large parts of the southern region of Africa. Namibia is strongly affected, especially by the negative soil moisture anomaly. The figures highlight that large parts of Namibia showed strong negative anomalies in soil moisture and precipitation, which would be expected to be reflected in both NDVI and SAR data.

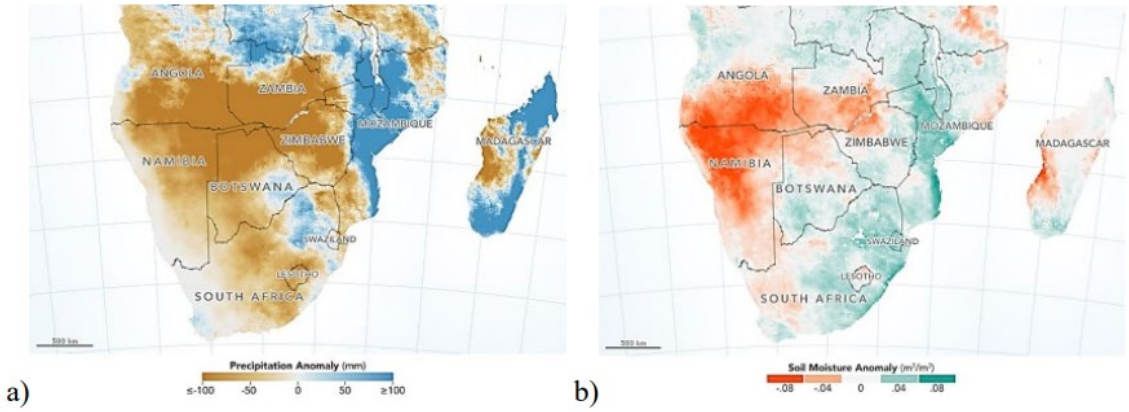

Figure 15: Anomalies in a) Rainfall (mm) and b) Soil moisture (m3) taken from NASA in southern Africa from December 2018 to January 2019. Source: Rosemary N. Shikangalah, "The 2019 drought in Namibia: An overview" in Journal of Namibian Studies : History Politics Culture. 30 June 2020.

[31] NewEra, "Namibia's devastating drought: Our strategy so far". 7 June 2019. https://neweralive.na/posts/namibias-devastating-drought-our-strategy-so-far

[32] Nat Johnson, "August 2019 El Niño Update: Stick a fork in it". Climate.gov. 8 August 2019. https://www.climate.gov/news-features/blogs/enso/august-2019-el-ni%C3%B1o-update-stick-fork-it

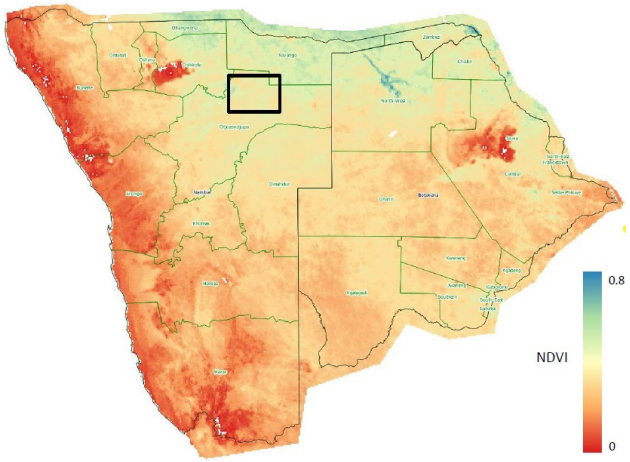

Figure 16: Maximum NDVI values from Sept 2018 to June 2019 of Namibia and Botswana. Source: SARmap SA.

The intensity of the 2019 drought can be detected when comparing it to September 2019 and June 2020, a period with less severe drought conditions. Figure 17 shows the maximum NDVI values during both years in the left panels and the intra-season variations across the observed period. In the 2019 wet season, the variation was very small, indicating little to no vegetation growth during the wet season. When compared to the 2020 difference, it becomes visible that many areas did not show any vegetation in the study area as well as an extremely low variation to the corresponding dry season.

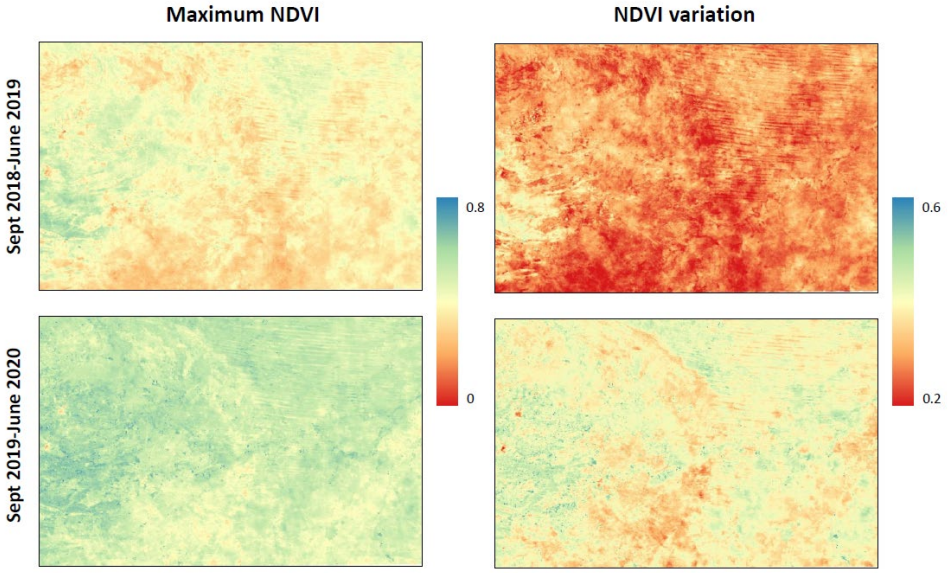

Figure 17: Maximum NDVI and NDVI variation between Sept 2018 to June 2019 in the top panels and from Sept 2019 to June 2020 in the bottom panels. Source: SARmap SA.

Figure 18 shows the SAR vegetation status data and seasonal variations thereof. The data is provided by algorithms processing Sentinel-1 satellite data and are therefore on a 20m resolution. The SAR data features very detailed spatial information on vegetation status and seasonal variations in this example. Because of its categorization of spatial patterns and its very high resolution, it enables very precise interpretation of the vegetational status. SAR data is able to differentiate areas with no changes in vegetation, such as tree canopies, and those with no greenery at all. As done for NDVI, the SAR data also shows low seasonal variations across a large scale of the study area in 2019.

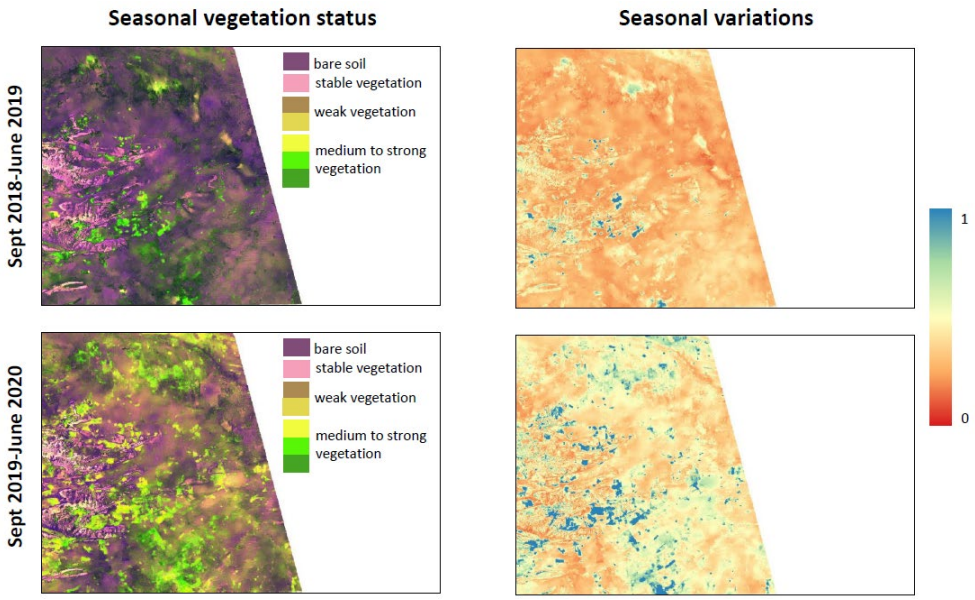

Figure 18: SAR vegetation data as well as the seasonal variations between Sept 2018 to June 2019 in the top panels and from Sept 2019 to June 2020 in the bottom panels. Source: SARmap SA.

Figure 19 demonstrates the difference between SAR and NDVI data. In principle, NDVI picks up similar similar vegetation signals, with the maximum NDVI values highlighting areas which experienced little to no growth during the wet season. The major difference remains the stable vegetation, which includes tree canopies and other vegetation which are not subject to large growth fluctuations between the wet and dry seasons. In the NDVI data, the trees highlighted in Figure 19 black rectangle are flagged strongly green vegetation. This situation increases the average NDVI value recorded for the study area, distorting the impact of the drought on the nearby pasturelands. Therefore, an observed area with a high share of stable vegetation would consistently record higher NDVI values than a comparable area dominated by pasturelands.

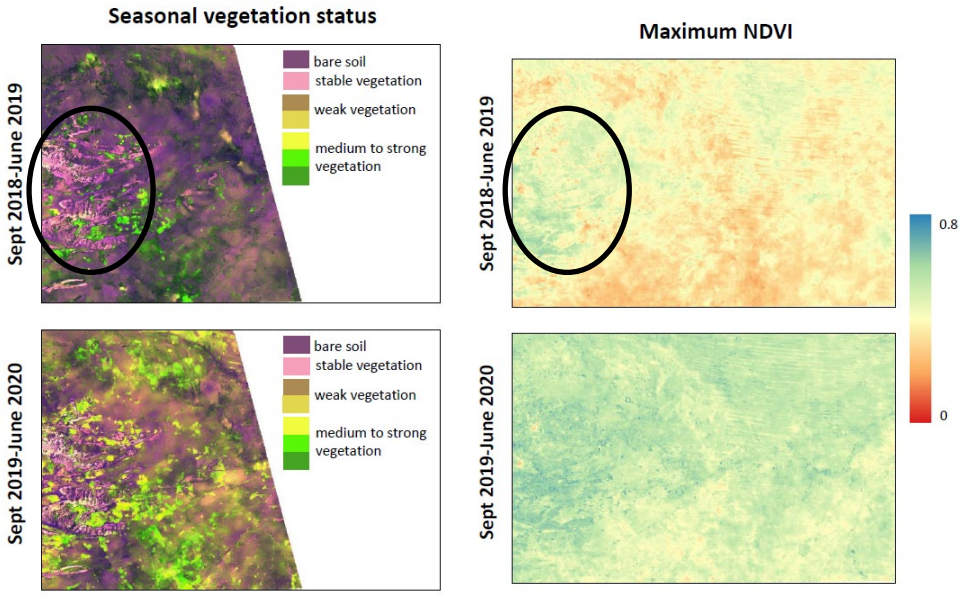

Figure 19: Comparison between the SAR vegetation and NDVI data for the same two periods, highlighting SAR's ability to detect stable vegetation such as tree canopies. Source: SARmap SA.

Increased data precision enables index insurance to be increasingly precisely structured. The better an index structure can reflect the on-the-ground disaster faced by the policyholder, the lower the product's basis risk will be. Therefore, the additional precision provided by SAR data enhances the ability to precisely monitor drought conditions. However, the extra layer of data processing required for raw SAR data, even for public remote sensing data such as Sentinel-1, increases the index insurance product cost. This holds especially true when larger regions must be continuously monitored. If applied selectively, SAR data alleviate basis risk concerns by cross-checking the observed NDVI values after a wet season with below average growth. For areas close to the NDVI trigger threshold defined in the product structure, SAR data could act as an additional verification or an adjustment factor, if this can be agreed upon with the risk capacity provider.

While NDVI data does face some drawbacks and lower precision, the inability to identify stable vegetation is not a disqualifying factor. The impact on a tree canopy on the NDVI value of an area can be expected to be similar across several years. Since an NDVI-based insurance product looks at the difference between a drought year and the average NDVI, the tree canopy would conceptually results in a higher base-average and a higher trigger threshold.

Product Options

A core component of this study is to develop an index insurance product tailored to the needs of the local farmers. As previously described NDVI acts as a good proxy to detect drought events and their impact on pasturelands and livestock. Therefore, NDVI is used as the data set to price the insurance product options in the following chapter.

Insurance Policy Period

A typical indemnity-based insurance policy lasts for one year. For index insurance, it is possible to set the inception date and expiry date more freely. The NDVI development over the year is similar in all three countries over the year, with an increase starting in October, the peak around February, and the beginning of a decline in March (see Figure 20). The pattern may be different for several local constituencies, but the overall pattern matches across the three countries. Therefore, the timeframe of the policy is recommended to cover the six months from October 1st to March 31st. The insurance policy period ends before the most severe impacts of a drought on livestock, which are expected towards the middle of the dry season in August. Since the product provides a payout after the policy expiration, the cattle health can still be maintained thanks to the additional liquidity provided.

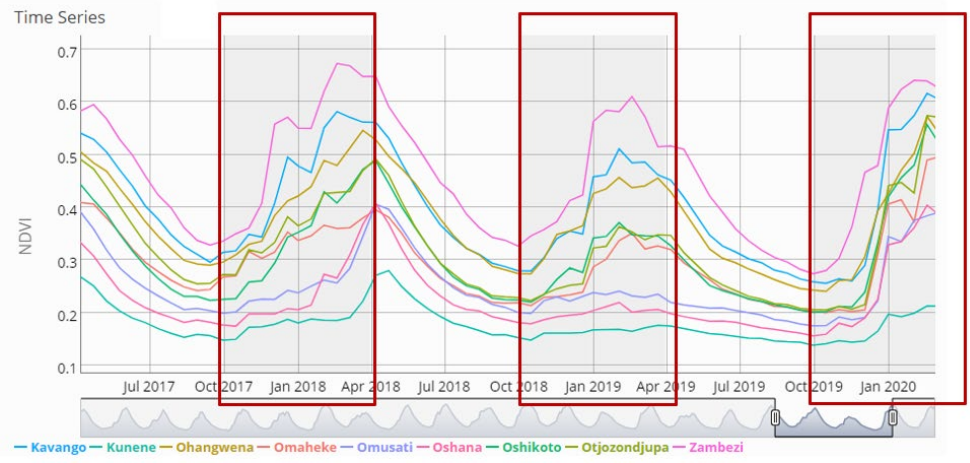

Figure 20: NDVI development over three years for some Namibian provinces. Source: CelsiusPro AG

Alternative payout structure and policy period are considered as part of this study. The months with the lowest vegetation are typically at the end of the dry season. With the payout at the beginning of the dry season, the funds might be used up before this critical phase. To avoid this, the payout could be split with the first payout tranche at the beginning of the dry season and the second payout towards the end of the dry season (see Figure 21). The disadvantage of this option is two-fold, with considerably more erratic NDVI variations during the dry season, leading to less consistent average NDVI values across the years. The second disadvantage is that the size of the payout per batch is lower, while the administrative and transaction costs are higher. The reasons result in a preference for a single payout at the beginning of the dry season.

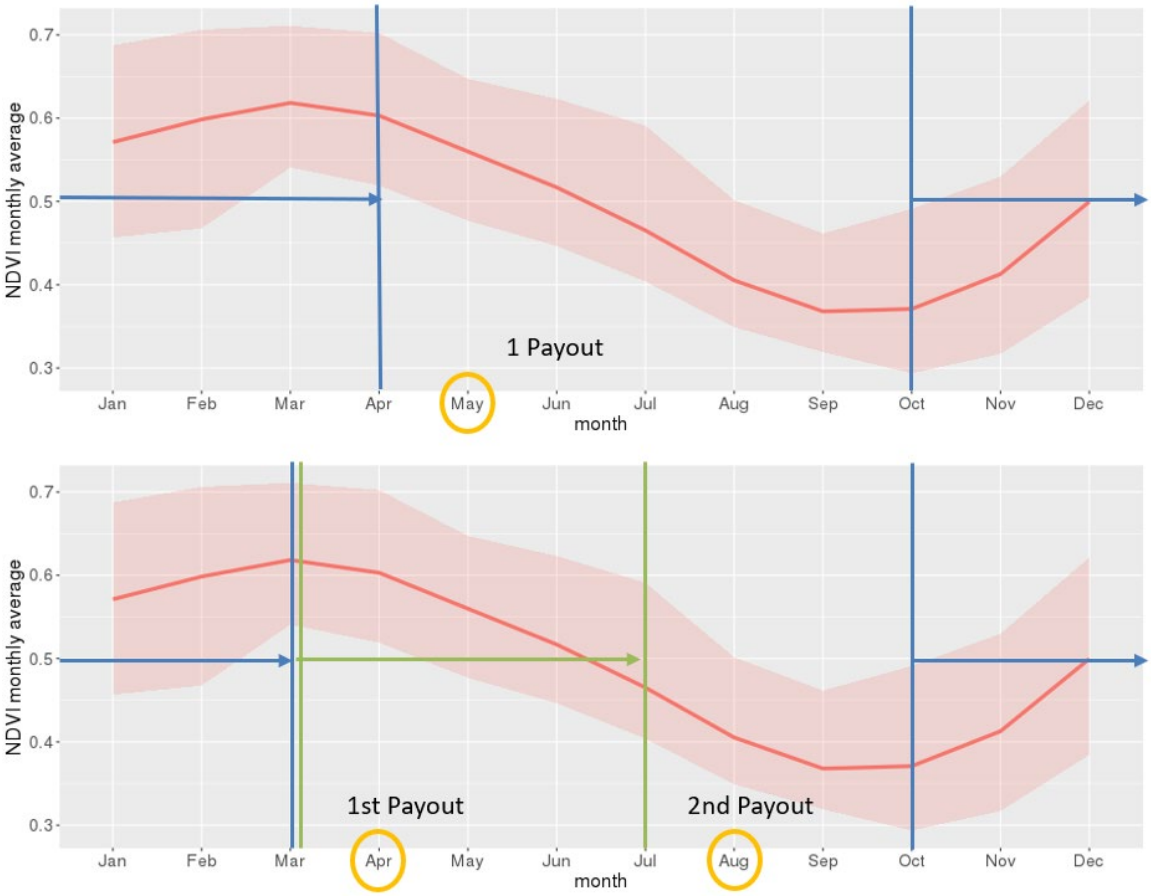

Figure 21: Options of payout patterns with a one-off payment (top) and two payments (bottom). Source: CelsiusPro AG

Insured Area

For index-based livestock insurance, the region that is covered by the product is crucial as it will decide the applicable NDVI value and payout thresholds. The vegetation conditions within the insured area should act as a proxy for the drought conditions experienced by the policyholder. The project team considers two relevant aspects insured area (see Figure 22):

- **Marketing Focused**
  Here, the insured area is the administrative boundary of the admin-level II (constituency in Namibia, sub-district in Botswana, district in Mozambique). Every farmer within this administrative unit will have the same conditions regarding pricing and payout which makes the marketing easier and limits the risk of neighboring towns having different payout experiences.

As herds may graze across admin boundaries, the grazing region is not perfectly represented with this approach. This leads to a higher basis risk as the NDVI that triggers the payout is focused only on the admin region where the farm is located and focused on the grazing area.

- **Risk Focused**
  This approach defines the insured area based on the grid cells that surround the farm location. This can be defined through a radius of e.g. 12.5 km or 27.5 km. This approach is an more accurate reflection of the vegetation that is available for grazing and thus reduces the immanent basis risk. Disadvantages of this approach are that the pricing and trigger calculation has to be set individually for every policyholder. It is also challenging to scale up the product to a (loan) portfolio level due to the individual pricing. As the insured area is smaller with this approach, there is less spatial diversification, thus the NDVI is more volatile and there is a higher risk of distorting NDVI signals for example due to rocks or water bodies.

Depending on the distribution strategy, the final product, and the country in question, the advantages of the risk focused approach may overweigh. But for the study at hand, the project team bases the technical premium calculations on marketing focused approach.

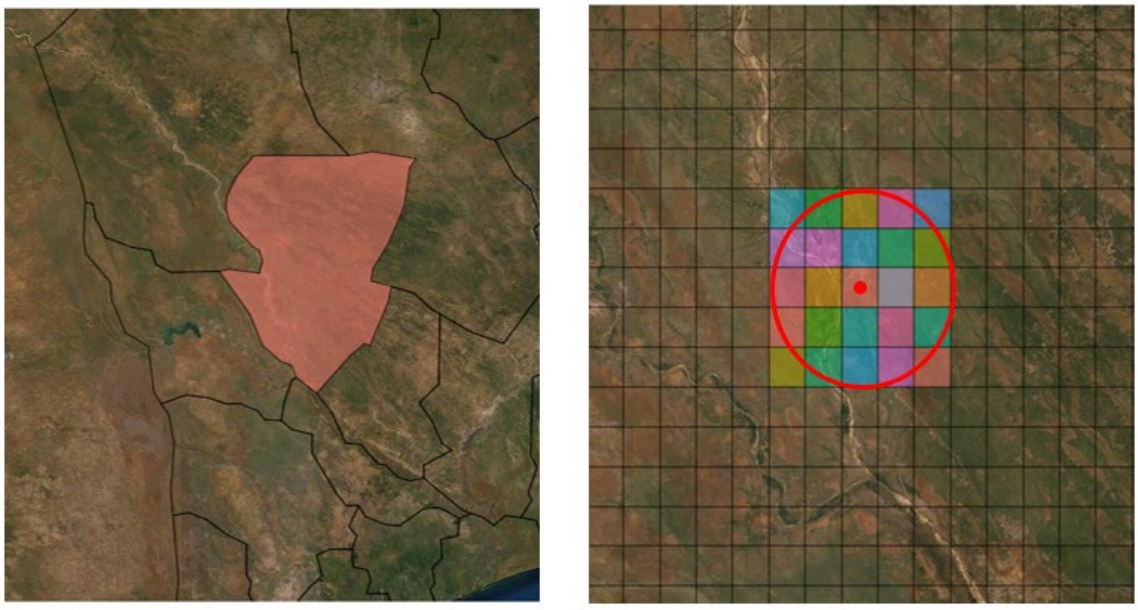

Figure 22: Options to define the insured area as admin boundary / "marketing focused" (left) and using grid cells (5km x 5km) within a radius surrounding the farm location / "risk focused" (right). Source: CelsiusPro AG

Indicative data on common grazing radiuses, collected during the study's survey, point towards a radius of 20km being sufficient for the average smallholder farmers in Mozambique (see Figure 23). By expanding the radius to 30km, the more extensive grazing patters could be accounted for. However, these figures are certainly not fully representative, since only eight farmers provided detailed answers. Similarly, for Namibia only anecdotal evidence can be provided, with grazing patterns ranging certainly exceeding 10km, reaching up to 250km during droughts. The most extensive insight can be derived for Botswana, where almost all respondents provided a grazing distance estimate, averaging 14km. The most extensive distance in Botswana seems to be around 25km, concluding that a radius of 30km would cover most farmers, similar to Mozambique.

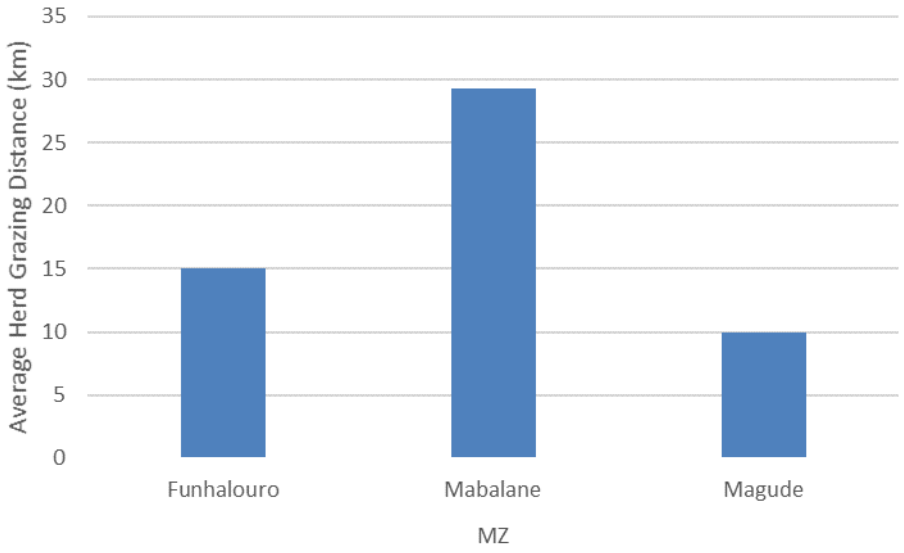

Figure 23: Survey respondents' estimation of usual grazing distances (southern region of Mozambique)

Insurance Policy Structure

After agreeing on the policy period, several structuring options are considered and modelled regarding their attachment threshold or trigger value and the exit point/value to derive the technical premium. The project team uses the return period of droughts (measured as a shortfall in vegetation density) to determine the trigger threshold and exit point. Return periods are the inverse of a probability and a widely used measure in the insurance industry. For example, a 20-year return period event refers to an event that occurs on average once in 20 year and thus has a probability of happening of 1/20 (5%) in any given year.

Depending on the selection of the attachment threshold and exit point, the technical premium varies significantly (see Figure 24). Several considerations are crucial to the selection of the proposed structure:

- **Price sensitivity**
  Affordability is the most important focus of the pricing as this is the deciding factor when it comes to market acceptance. The target technical premium across the country is set below 10% to ensure attractiveness of the product in all regions.

- **Reasonable deductible of the policy**
  The attachment threshold needs to be set in a way that the insured can cope with events that are below the value and the policy is only triggered when needed. Setting the attachment threshold too low, would lead to considerably higher prices and limit the affordability of the product. A attachment threshold that is set too high can lead to unbearable losses for the farmers and significant loss of livestock without a payout.

- **Reasonable exit of the policy**
  Similar to the attachment threshold, the exit point is also crucial for the effectiveness of the policy. As the payout value is linear between events that trigger the policy and the ones that exceed the policy, the exit point is of high importance for index insurance products. Setting an unrealistically high exit point decreases the product's payout for events which just exceed the attachment threshold, since the linear payout stretches across a longer coverage (see Figure 25).

- **Management of basis risk**
  Basis risk is defined as the discrepancy between the loss to the insured and the payout by the insurance in case of an event. This entails the loss to the insured is higher than the payout that they receive, or vice versa, the payment exceeds the actual loss.

- **Cover of historic events**
  The suggested structures are aimed to provide protection against severe droughts, with the project team ensuring the most severe droughts of the past 21 years would have provided large payouts.

Keeping the above considerations in mind, several policy structures are tested for their performance and price. The attachment threshold varies between return periods of 5 and 10 years and the exit point between return periods of 12 and 25 years as indicated in Figure 24. The red dots represent the technical premium in the same graph.

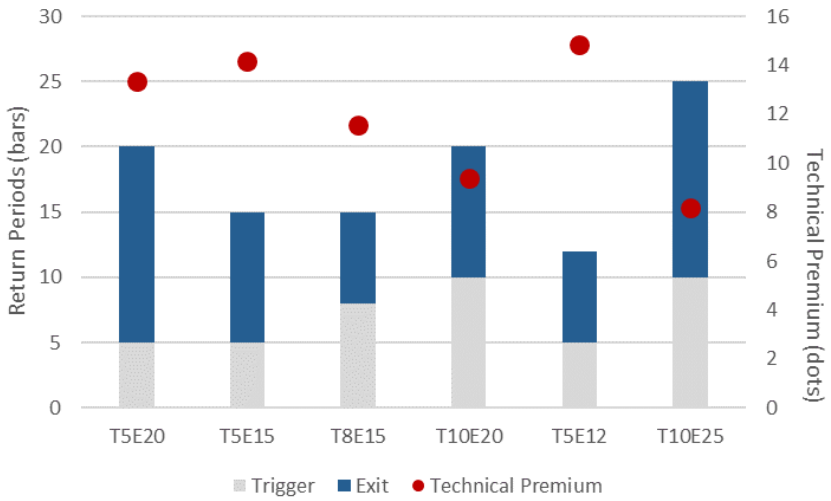

Figure 24: Product structure options for an NDVI-based insurance coverage. Using the example of Namibia.

Finally, all structures include a minimum payout of 5% of the sum insured to avoid marginal payouts where the transaction and administrative costs may exceed the amount of the actual payout (see Figure 25).

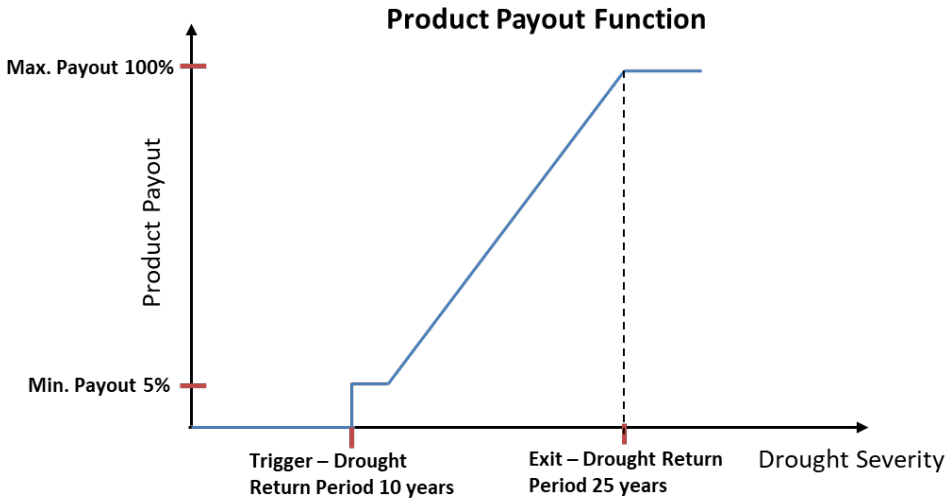

Figure 25: Proposed product structure, with an attachment threshold at a 10-year return period and an exit at a 25-year return period.

Recommended Policy Structure

Among the various structures, the project team recommends a product with an attachment threshold at a 10-year return period and with an exit at 25-year return period (T10E25) with a minimum payout of 5% (see Figure 25). This structure results in a country wide average technical premium of 8.2% for Namibia, 7.5% for Botswana and 8.1% for Mozambique, as highlighted in Table 7. The price per admin level II can be found in Appendix 4 – Technical Premium per constituency / sub-district / district. The technical premium is naturally not distributed uniformly across the three countries as there are regions that are more susceptible to droughts. For the selected policy structure, the technical premium of the different admin level II areas are displayed in Figure 25. The high-level variations of technical premium values among the constituencies is displayed in Table 1. In the appendix, you can find the full list of the constituencies and their technical premium values.

Table 7: Technical premium range for each admin level II (constituency in Namibia, sub-district in Botswana, district level in Mozambique).

	Namibia	Botswana	Southern Regions of Mozambique
Average	8.2%	7.5%	7.0%
Maximum	10.1%	10.0%	9.7%
Minimum	5.0%	5.4%	5.1%

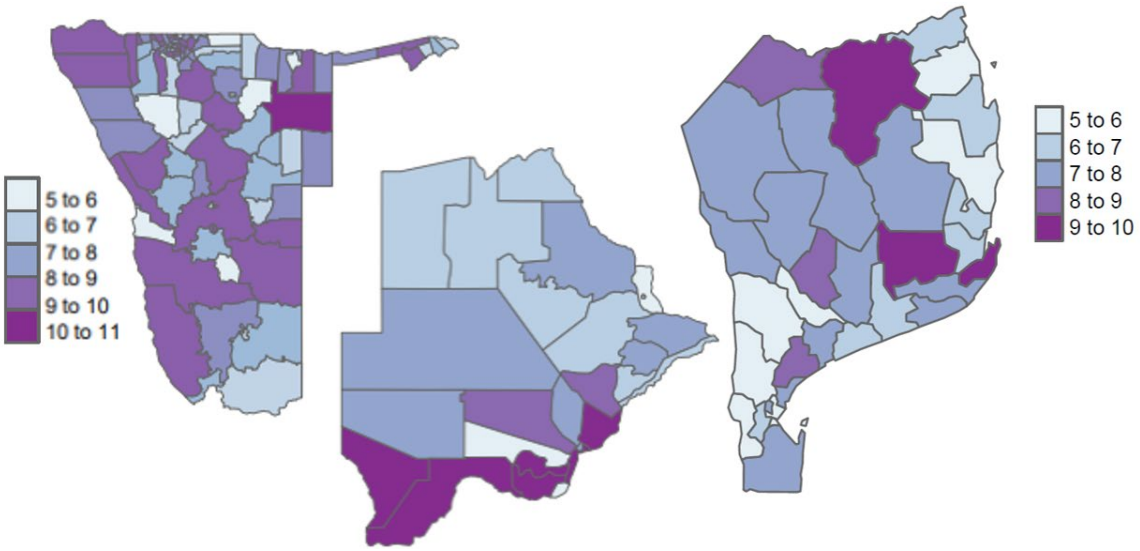

Figure 25: Technical premium by admin level II (constituency in Namibia, sub-district in Botswana, three most southern provinces on district level in Mozambique). Source: CelsiusPro AG

No recommendation on the sum insured per policy is provided at this stage, since this depends strongly on local circumstances and the distribution strategy selected. When marketing the product directly to smallholder livestock farmers, the sum insured should represent the approximate cost of maintain one cow's health during the dry season. Comparable products recommend using roughly 30% of the price of one mature cow.[33]

[33] Francesco Fava et al. "Building financial resilience in pastoral communities in Africa". World Bank. February 2021.

Performance during historical events

Finally, the selected structure is compared to severe droughts since 2001 to stress-test its performance. For Namibia, the 2019 drought led to substantial loss of livestock and for Mozambique and Botswana, the drought in 2016 was especially intense. The three events caused significant damage to the exposed farmers and state of emergency was declared in the affected provinces. When comparing these events that attracted widespread media coverage with the NDVI data, similar provinces can be identified that suffered losses under the drought and had low NDVI values during the bespoke year. Figure 26 (top) shows deviations from average NDVI values (ZCum) for the three countries throughout the last 20 years. Here, the above-mentioned drought years show NDVI values that are significantly below the average.

The bottom of Figure 26 displays the corresponding payout that the T10E25 structure would disburse. For the southern regions of Mozambique, the 2016 drought year would have triggered 75% of the maximum payout for the southern three provinces, while Botswana would have recorded a 65% payout in 2003 across all districts. For the Namibian 2019 drought, 70% payout across all constituencies would have been recorded. The frequency of events triggering the payout in Figure 26 is substantially higher than the expected 10 year return period would suggest. This due to the payout is on the admin II level, with different constituencies/sub-districts triggers payouts in different years. The flip side of this perspective is that a full payout across the entire country is very unlikely, as all parts of a country are rarely all affected with a similar drought severity.

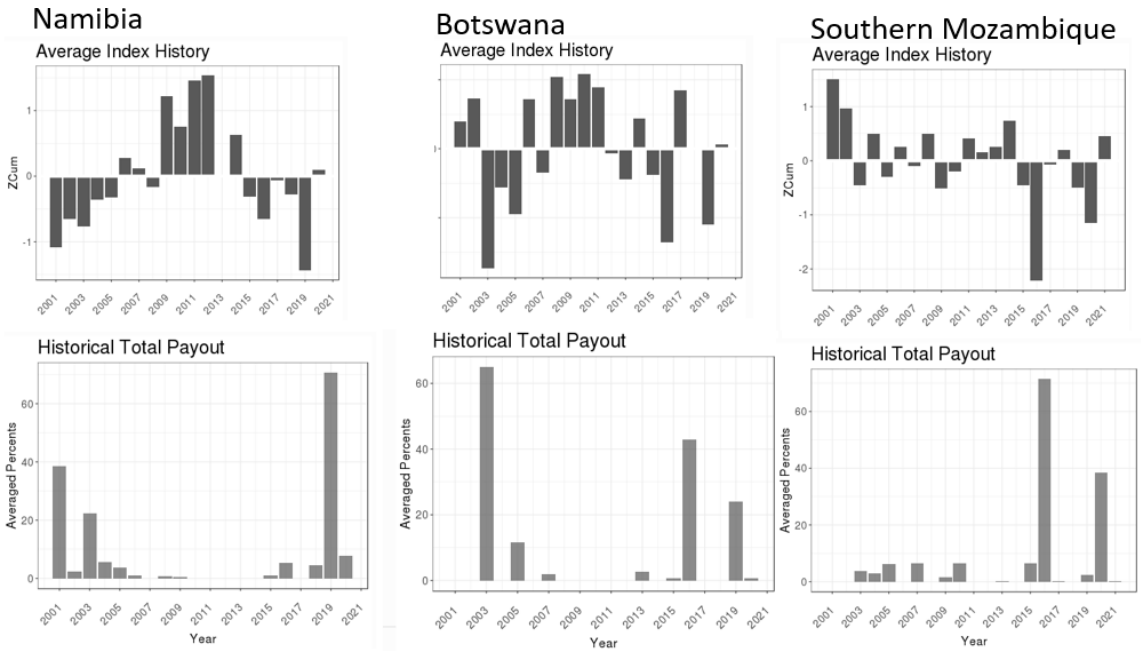

Figure 26: Countrywide distribution of the deviation from the historical average (ZCum) of the NDVI (top) and averaged percentages of payout (bottom) for the last 20 years. Source: CelsiusPro AG

Conclusion

Lessons Learned

Product Concept

Severe droughts in recent times have had a widespread impact across the agriculture and livestock sectors in Namibia, Botswana and the southern region of Mozambique. The conversations with various stakeholders on index insurance have clearly highlighted a high level of drought risk awareness within these regions. It is perceived as the most pressing climate risk. Index insurance is seen as a possible innovative approach to address an acute protection gap in the local insurance markets, where drought risks are largely excluded from existing product offerings.

The use of remote sensing vegetation density data (NDVI) is largely seen as an acceptable drought proxy, with limited follow-up inquiries on this approach. The insured area selected for the insurance coverage focuses on admin II level (i.e. constituency in Namibia, sub-district in Botswana, district in Mozambique) for this study and remains the primary discussion point. There is a slight preference among stakeholders for a more “risk-focused” insured area by using the vegetation density within a radius drawn around the farmer's location (see section Product Options). The benefits and drawbacks of applying either of these approaches will need to be evaluated in more detail in close collaboration with a distribution partner.

The primary concern related to use of vegetation density data is the focus on the short-term impact of drought, with the multi-seasonal effects of a severe drought not being directly addressed. The slow recovery of pasturelands in the years following a severe drought could be reflected in below-average vegetation density during the subsequent wet seasons. However, the product concept cannot cater to the possible multi-year drought impact on cattle health that the farmers might suffer after the most immediate dry season.

The product's affordability remains high on the agenda of most stakeholders and the project team expects upcoming discussions on implementing index insurance to be strongly focused on price sensitivity. The study indicates that severe droughts across Namibia, Botswana, and the southern region of Mozambique can be covered if the technical premium rates are kept below 10%. This must be clearly communicated to all stakeholders and prospective clients.

Utilizing vegetation density data for a livestock insurance product is generally accepted by stakeholders. Agriculture lenders, in particular, are especially interested in identifying a drought insurance solution that can cover both crop and livestock farming activities. Ultimately, the most viable product to bundle with agri loans to farmers would be based on a well-correlated drought index. This could be based on vegetation density, other drought indices or a combination of underlying datasets. Alternative options would need to be explored in detail based on the loan portfolio of the agri lender.

The project team remains confident that an NDVI-based livestock insurance product will be acceptable to international reinsurers, given its similarities to KLIP’s tried and tested product concept. Prior to launching any pilot product, an extensive technical dialog with potential reinsurers about the product concept would need to be held. In addition to national reinsurers such as NamibRe, international reinsurers with a focus on the agriculture sector in Africa include, among others, Swiss Re, Allianz Re, and AXA XL. Due to time limitations, Detailed technical feedback from reinsurers has not yet been collected as a part of this study. However, due to the considerable accumulation risk posed by droughts, the involvement of international reinsurers is imperative to protect the balance sheets of primary insurers. In addition to their ability to diversify risks, their experience in providing risk capacity to cover droughts enables global best practices to be incorporated into the product structure.

Project Management

This study provides a few key project management lessons:

- **Timelines & Deadlines**
  The core project team should ensure that dedicated capacity is continuously provided to the project to avoid large fluctuations in workload. If this cannot be guaranteed, then the project timeline should include buffers to account for weeks with limited progress.

- **Stakeholder Management**
  At the onset of such a multi-country study, key stakeholders should be notified beforehand, allowing them to be smoothly onboarded during the project. In addition, the project plan should spread out discussions across the study's project period and not only focus them on a few dedicated weeks. The time-intensity of preparing and following up on calls across three different jurisdictions should not be underestimated and could potentially be streamlined by splitting discussions into specific country or topic groups (e.g. conduct discussions with regulators around the same time).

- **Survey with Smallholder Farmers**
  Drafting a well-structured questionnaire is certainly a worthwhile investment for any survey. However, sufficient financial and organizational investment needs to be dedicated to recording the survey results. The importance of using a survey tool with on- and offline functionalities is a key necessity. If questions are not asked and replies not recorded in a standardized manner, a well-structured survey questionnaire cannot be fully leveraged.

Feasibility Assessment & Next Steps

Mozambique

Among the three countries included in this study, Mozambique is the only market where index insurance products are being sold to retail clients. The groundwork laid by HM's weather index insurance product is a promising example of how index insurance can be bundled with agri inputs. The regulatory exception provided for the existing index product can be replicated for the NDVI-based livestock insurance solutions, increasing the chances of being able to move towards a pilot project in the country. Local risk capacity for the implementation of any follow-up project will not be a challenge.

Among the areas reviewed, the three Southern provinces of Gaza, Maputo, and Inhambane have the highest density of smallholder livestock farmers, a factor that should benefit any scaling up of the product. Unfortunately, certain detractors complicate the implementation of index-based livestock insurance in Mozambique. The localized livestock market and the limited commercial interest of farmers in their cattle, restricts the level of investment in the sector. Since smallholder farmers do not currently incur high expenses for their cattle and have relatively low insurance awareness[34], a limited willingness to invest in financial resilience can be expected.

Reducing the premium cost incurred by farmers will be critical to facilitate wider distribution of the product. Only by subsidizing part of the cost or tying the product to development projects can any index insurance solution be substantially scaled up. Given the high interest of the development sector in Mozambique, the possibility of accessing premium subsidies can be pursued.

[34] The study's survey indicates that 2 out 3 smallholder farmers in the southern regions of Mozambique are not aware of insurance.

A carefully designed marketing strategy and extensive awareness-raising programs would be required as part of any product roll-out in the market. The successful implementation of such an education campaign could have widespread benefits, bringing climate risk concepts, financial education, and the topic of resilience closer to smallholder farmers in the southern region of Mozambique. Increasing knowledge in these areas can be expected to have a positive spillover effect on the farmers' financial inclusion and agriculture risk management practices.

In the short-term, the lack of input supplies required by farmers for their livestock limits the ability to replicate the bundling approach used for Hollard's existing weather index insurance product.

The product could be sold on a stand-alone basis via an agri-service provider, which the farmers engage with for their general farming needs, subject to previously mentioned marketing and affordability considerations. In Mozambique, Casa do Agricultor is the only sizeable provider with the commercial reach and educational set-up required to distribute index insurance products.

Next Steps

- **Product Concept**
  No major adjustments to the proposed product concept are anticipated for the Mozambique market. Selling index insurance as a stand-alone product via an agri-service provider requires pre-agreed and standardized prices for each district in the country. The smallholder farmers would need to be provided with simple and plainly described options for different sums insured/product options. The proposed sum insured options require further investigation and could be based on different common herd sizes and the associated cost of maintaining the cattle's health during the dry season. The affordability concerns for smallholder farmers in Mozambique cannot primarily be addressed via the product structure.

- **Stakeholder Engagement**
  The project team aims to continue engaging with the development sector and entities advising the Government of Mozambique (e.g. IFC, Sustenta/WB, FSD Moc). The objectives of this engagement will be to verify the possibility of accessing premium subsidies as well as promoting the concept of index insurance in the country. Hopefully, this will result in the direct involvement of the development and/or public sector in strengthening the financial resilience of smallholder farmers in the southern region of Mozambique against drought in the mid-term.

- **Pilot Project & Upscaling**
  The project team seeks to collaborate with Casa do Agricultor to pilot the index-based livestock insurance product in Mozambique. If grant funding can be secured (e.g. from SCBF), a novel distribution partnership between HM and Casa do Agricultor can be established, allowing for the product to be upscaled. No farmer in the country is currently being offered an insurance product via their agri-service providers. The pilot and subsequent product upscaling would include both the existing weather index insurance for rain-fed crops and the proposed NDVI-based livestock insurance for livestock. Casa do Agricultor's Farmer School would be utilized to conduct trainings directly with farmers. A high level of financial education and climate risk awareness would be conveyed to smallholder farmers, which is expected to positively affect the farmers' financial inclusion and agriculture risk management practices.

Namibia

This study coincides with a strong momentum in Namibia for index-insurance, which bodes well for the possibility of launching an NDVI-based product in the market. Namfisa, the regulator, has implemented a working group dedicated to the issue, which includes various private and public sector entities. Moreover, the state-owned special risk insurer, Nasria, has also initiated a feasibility study on index insurance. Subject to the buy-in of a Namibian primary insurer and the state-owned reinsurer, NamibRe, an index insurance product could be tested within a sandbox regulatory framework. Namfisa's timeline for the development of index-based insurance solutions targets a product roll-out by April 2022. The project team sees the chances to launching a product before this date as limited.

Namibia's livestock market is split between largely domestic smallholder farmers and export oriented commercial farmers. Both groups of farmers benefit from a well-developed agriculture value-chain, providing inputs for both crop and livestock farming as well as enabling the sale of cattle. Livestock plays a crucial role within Namibia's agriculture sector and both the smallholder and commercial farmers are attractive target groups for drought insurance solutions.

Identifying and collaborating with suitable distribution partners will play a key role in advancing index insurance in Namibia. The project team sees a mid-term potential to contribute to a public sector (or state-owned entities) led drought resilience scheme. The Government of Namibia has identified drought risk as a pressing need and is actively seeking solutions by engaging with a range of sectors on the topic. The option of bundling index insurance with products or services used by livestock farmers is also seen as a viable mid-term option, subject to finding a mutually beneficial arrangement with a distribution partner.

The project team sees considerable potential in bundling index insurance with agri loans to farmers, with major private and public lenders indicating conceptual interest in including drought insurance within their product offerings. Depending on the objectives of the bank, the insurance coverage would act as an additional security when lending to smallholder farmers and SMEs or be offered as a drought resilience instrument to commercial farmers. The structure of any index insurance solution would need to be more closely aligned to the bank's portfolio and loan issuance, requiring a close engagement with the institution in question. The product would most likely not only need to cover livestock related risks but also address the impact of droughts on crops.

Next Steps

- **Product Concept**
  A strong interest in an NDVI-based insurance solution is noted in Namibia. However, further work on the product structure will be required to ensure a close alignment with the objectives of the distribution partner in question, especially when bundling it with an existing product/service or loan. The question of affordability, insured area, sum insured and possibly even the policy period will need to be re-assessed in detail, with the proposed livestock insurance product acting as a good basis for further discussions.

- **Stakeholder Engagement**
  Continuing the dialog with Namfisa as well as public and private sector members of the dedicated index insurance working group is a priority for the project team. Keeping the current momentum on index insurance high increases the chances of bringing a drought insurance solution to the market. A further priority area includes ensuring that local risk capacity providers gain a certain level of comfort in covering droughts and managing the associated accumulation risk, possibly by including international reinsurers in the discussion. The project team is looking to continue the dialog with the state-owned Agribank of Namibia and the private commercial bank, FNB Namibia. Finally, livestock service providers will be approached to evaluate the potential of bundling index insurance with their products/services.

- **Pilot Project & Upscaling**
  Subject to finding an agreement with Agribank and/or FNB Namibia, the proposed index insurance solution will be tailored to the loan and client profile of the bank. Once a detailed understanding of the drought-induced default risk of loans is gained, a bundled product can be structured and tested in the market. This process is anticipated to require multiple months and a high level of engagement, however, once the concept of a bundled product has been proven, scaling up the bundled product is expected to be less of a challenge. The timeline for launching a pilot project in Namibia is expected to follow Namfisa's target date in April 2022.

Botswana

Index insurance targeting retail clients is not a prominent feature within Botswana's insurance landscape. However, strengthening financial resilience against droughts has been on the Government of Botswana's agenda for at least 35 years now. The state-provided ACGS, securing agri loans issued by the NDB to dry-land farmers against droughts, can be seen as a form of (expert-based) index insurance. The high engagement by the public sector, also observed more generally within the wider agriculture sector, limits the need for private sector initiatives. While regulatory approval from NBFIRA could be sought for a NDVI-based livestock insurance product, due considerations would need to be paid to the impact of accumulated drought risk on the financial sustainability of the local risk capacity provider.

Botswana's agriculture and livestock sector strongly focus on smallholder farmers. Despite their wide geographic spread and relatively low numbers, the smallholder livestock farmers play an important role in the export of live animals and beef abroad.

However, the number of smallholder farmers engaged in livestock farming and their total cattle population have seen a considerable decline over the past decade. The country's commercial farmers have an outsized impact on the overall output of the sector, but their numbers are only in the low hundreds. The combination of low geographical density, a limited number of smallholder livestock farmers, and a systemic decline in the sector limit the attractiveness of the market for index-based livestock insurance.

Potential distribution partners in the agriculture sector are largely limited to two state-owned entities which enjoy monopoly positions in certain areas. BAMB not only provides farmers with the farming inputs needed but acts as the purchaser of their crop outputs. Both smallholder and commercial farmers sell their cattle directly to BMC, which runs Botswana's abattoirs and exports the country's livestock products abroad. Bundling index insurance with the services and products offered by these two organizations is conceptually possible. However, since both organizations are not profit-oriented, aligning the incentives for the product distribution is expected to require extensive discussions.

The high involvement of the Government of Botswana in drought risk management opens the door for a more comprehensive public sector-led financial resilience initiative, especially if government policy shifts away from assuming most of the losses itself. Alternatively, the ACGS could be expanded to include livestock-related loans and shift towards remote sensing triggers. However, these are only mid-term prospects, and there are currently no indications thereof.

Next Steps

- **Product Concept**
  No specific adjustments of the product concept are required in the short-term. Any potential regulatory approval is expected to require detailed illustrations on the accumulation risk of drought scenarios. The likelihood of successfully introducing index-based livestock insurance is expected to be considerably higher once the product has successfully been tested in a different SADC country.

- **Stakeholder Engagement**
  FNB Botswana has hinted at a conceptual interest in drought insurance solutions for the commercial farming sector. Agri lenders, BAMB and BMC can be approached once a pilot project has been launched in a comparable market. In the short term, the project team will seek a dialog with the NDB to learn more about the ACGS scheme.
- **Pilot Project & Upscaling**
  Launching a pilot project in Botswana is not seen as feasible in the short-term. The country could be a possible market for expansion once the product concept has been successfully implemented in a different SADC country.

Appendix

Appendix 1 – Climatology

Regional Climatology

The study area (Namibia, Botswana, and Mozambique) has a very diverse climatological footprint. The large-scale climate in the region is mostly dominated by the humidity that is brought by the trade winds from the South Indian ocean basin, based on the Intertropical Convergence Zone. These are dominated by the Indian Ocean Dipole (IOD), which is a pattern of Sea-Surface Temperature (SST) variability. Additionally, more remote teleconnections such as the El Niño Southern Oscillation can have a major influence on the climate through a chain of interactions. Additionally, tropical cyclones and depressions over the Southern Indian Ocean Basin can influence the SST variability and air humidity.[35]

Mozambique

Mozambique lies largely within humid subtropical climate. This is due to the fact that the coastline is subject to the regular seasonal influence of the Indian ocean monsoon rains. Its influence is the strongest in the north east. Large parts of the southern region of Mozambique lie in a warm semi-arid climate. This is due to the modification of monsoon interactions by the Comoros and Madagascar. The semi arid regions of interest are Gaza, Inhambane and Maputo. These regions are highly susceptible to drought. This is because of their very considerable inter-annual variability. However, also the high rainfall seasonality is also common to the north and exposes it to severe droughts too. A major driver of inter-annual variability is the ENSO phase. Rainfall reductions due to El Niño are most pronounced in the period between January to March. La Niña have a positive influence on rainfall, more pronounced in the south and center during January and February.

For the growing season suitable humidity conditions need be given. This can be monitored by NDVI data, which shows the variation in greenery measured from satellites. The length of the growing season in Gaza is from September to April. The vegetation period shows a lag compared to rainfall. As the wet season is key for the occurrence of drought, the quantity of rainfalland its distribution are highly important. Figure 27 shows the monthly average NDVI. It confirms that potential dry spells in November, December, January and February potentially could have a significant impact on the vegetation levels.

[35] Joseph Daron et al. “Climate process chains: Examples from southern Africa” in International Journal of Climatology. 17 April 2019

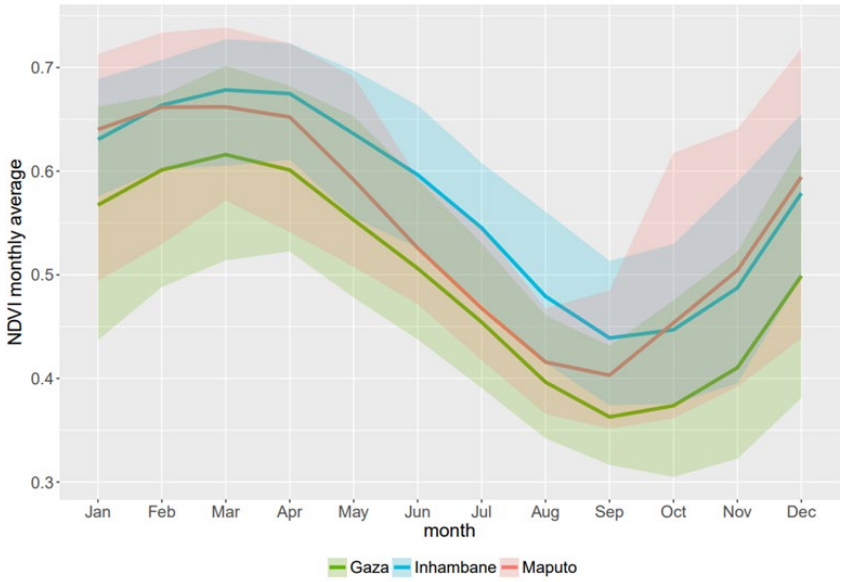

Figure 27: Average monthly NDVI of Gaza, Inhambane and Maputo province. Source: CelsiusPro AG

Namibia

Namibia has a very diverse subtropical desert and semi-arid climate. Climatologically, Namibia can be separated in the coastal region divided by the "Great Escarpment" from the central plateau. The central plateau declines from the rise in the west, towards the Kalahari desert in the east. The semi-arid conditions in Namibia leads to a high spatial and temporal variability of rainfall. Commonly this can lead to multi year drought conditions. Namibia is known as the driest country in Southern Africa. The Caprivi Strip (Zambezi Region) in the North East of Namibia has a unique tropical climate which often leads to flooding between December and March. Figure 28 shows the seasonal rainfall of the Zambezi, Khomas, Karas region as references for the north to south disparities. The rain months in the Zambezi region show higher rainfall compared to other regions. Rivers and swamps are plentiful and dominate in the Zambezi landscape. The intensity of rainfall patterns during the rainfall season decrease in southern and westward direction from the Zambezi Region (Britannica). In the central highlands around Windhoek (Khomas) moderate temperatures and average rainfalls are measured. During winter overnight frost can occur. Usually, no rainfall occurs between June and September in Namibia. This can also be seen in Figure 29, which shows very low rainfall in the dry season. In the Namib and Kalahari Desert little rainfall can be expected. Furthermore, due to the cold Benguela Current along the Atlantic coast the temperatures drop significantly. Thus the coastal regions shows the least amount of rainfall.[36]

On a larger climatical scale both El Niño Southern Oscillation (ENSO) pattern in the pacific as well as tropical cyclones that occur in the South Indian Basin can have an impact on the humidity that is transported to Namibia (Britannica). Warm phases of ENSO typically invoke positive rainfall anomalies in equatorial eastern Africa, however it also invokes negative rainfall anomalies across Southern Africa including Namibia. Hence, a positive ENSO season has the potential to trigger drought conditions across Namibia.

[36] Britannica, "Climate of Namibia". https://www.britannica.com/place/Namibia/Climate

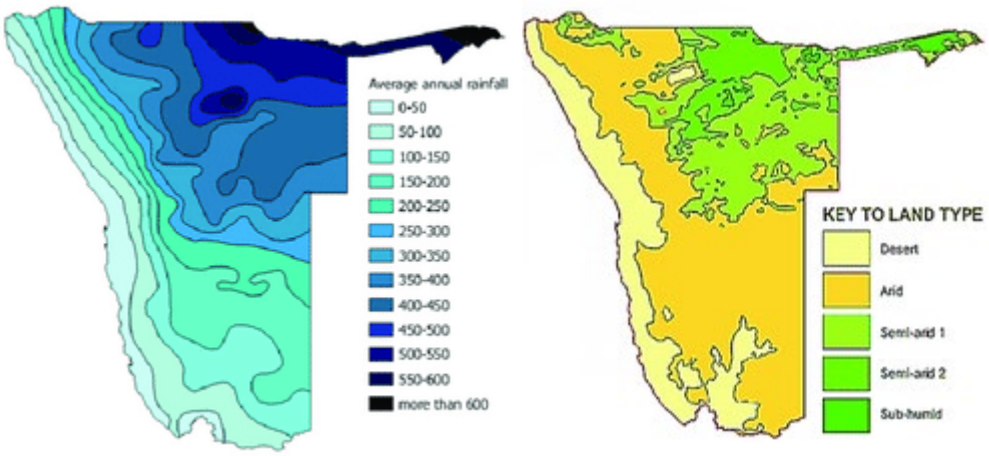

Figure 28: Rainfall Land type regions in Namibia. Source: R N Shikangalah, "Dendrochronology in Namibia: A Review" in International Journal of Environmental Sciences & Natural Resources. 16 April 2020.

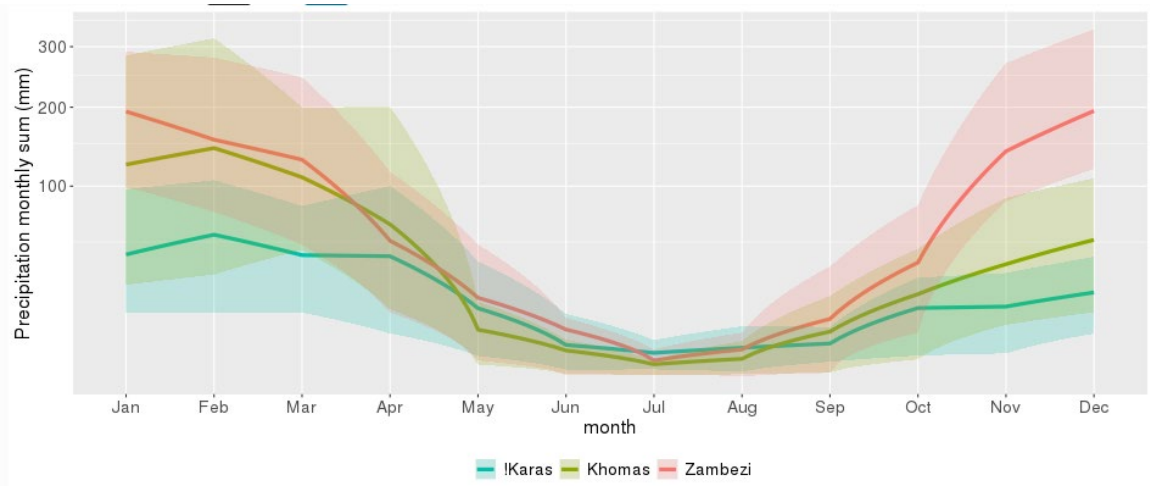

Figure 29: The seasonality of the sum of monthly precipitation in mm in, Zambezi (red), Kohmas (olive green) and Karas (blue-green) based on imerg precipitation data. Source: CelsiusPro AG

The vegetation period and planting season overlap with the wet season, which ranges from October to May. However, it is important to state that NDVI is contaminated by non-vegetation-related factors. It provides indirect indications of vegetation extent and health. Furthermore, it is very important to recognize the lag between rainfall and vegetation activity, which is also detected by the NDVI data. Figure 6 shows the NDVI monthly average of the provinces Zambezi, Khomas and Karas. The maximum NDVI decreases from North to South. Furthermore, the length of lower NDVI values increases from North to South. This shows that the central as well as particularly the southern provinces are subject to drought and sparse vegetation. The susceptibility to drought conditions is additionally investigated in the chapter covering past drought events.

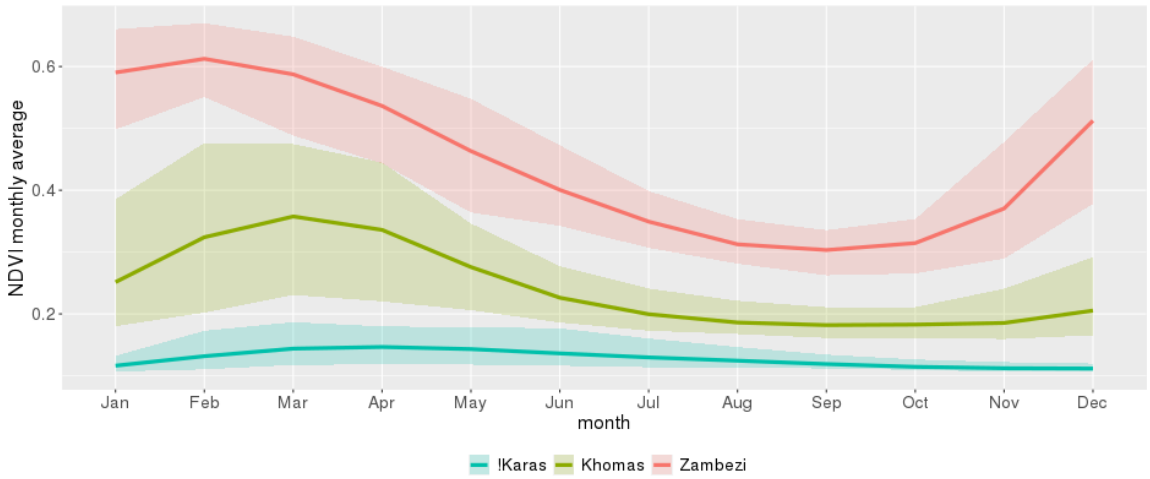

Figure 30: NDVI monthly average of the province of Zambezi, Khomas and Karas Namibia. Source: CelsiusPro AG

Botswana

Botswana's climate is subtropical and semi-arid depending on the area. Rainfall is highly variable, spatially, inter- and intra-annual. Droughts and floods have been common in the past. It is hot and dry for much of the year. In summer from November to April it is hot and moderately rainy, depending on local thunderstorm systems that break out in the afternoon. For this reason, rainfall tends to be erratic, unpredictable, and highly regional. Winter ranges from May to October and is very dry and relatively cool.

The country is divided into three main environmental regions. Eastern Botswana is covered by rocky hill ranges and shallow sand cover. In this area the Okavango delta drains the rainfall from the Angola highlands in summer and comprises an important permanent and seasonal home for wildlife. However, it is important to note that the floods in the Okavango Delta are not triggered by heavy rainfall, which usually evaporates very quickly, but from the water drainage from the Angola highlands. Droughts, in terms of rainfall deficits, are most common in northern Botswana, while extreme droughts based on soil conditions are most common in south western Botswana in the Kalahari desert. The Kalahari desert stretches across large areas in western Botswana. Figure 31 shows the sum of monthly precipitation per month with standard deviation for the three regions Central, South-East and Kgalagadi in the South-West. Central and South-East are the most populated areas of Botswana. Both show less than 10mm rainfall in the winter months. The Kgalagadi region shows maximum values at 100 mm of rainfall in the summer months. Numerous studies have shown that droughts in Botswana coincide in association with most Pacific ENSO episodes.[37]

[37] Sharon E. Nicholson et al. "The Relationship between El Niño and Drought over Botswana" in Journal of Climate. 1 February 2001.

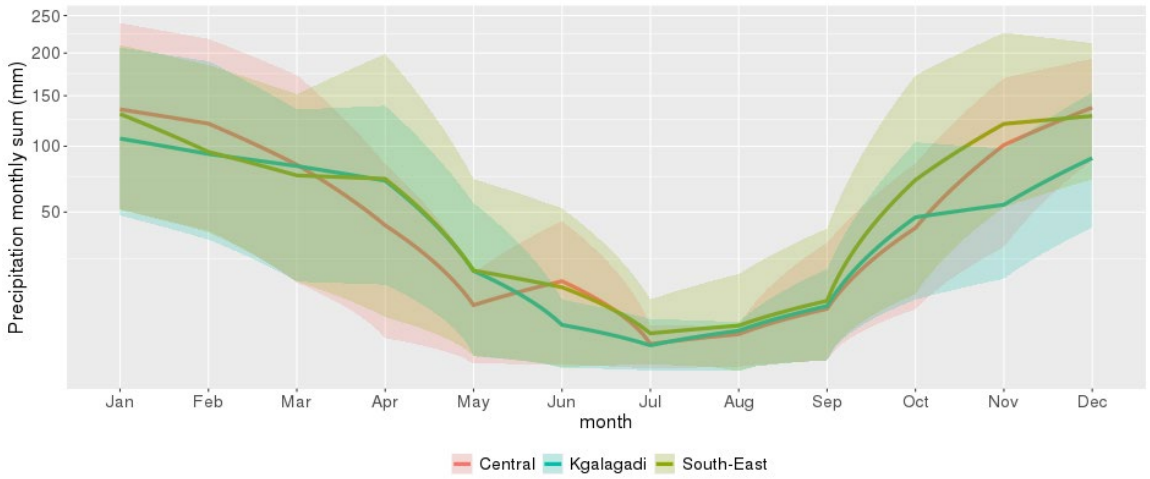

Figure 31: Monthly precipitation sums (mm) for three reference areas (top panel). The reference areas are Central (red), South-East(green) and Kgalagadi(blue) in the South-West. Source: CelsiusPro AG

The growing season for Botswana coincides with the rainfall months in summer. Hence, it ranges from October to March. This refers to the growing and not the green season, which is seen in the NDVI data (see Figure 32). Particularly the Kgalgadi region does not show a high variability of NDVI throughout the year. Kgalgadi is the Kalahari desert, where high evapotranspiration, temperatures and soil conditions impede vegetation growth. NDVI values in Central and South-Eastern regions show NDVI values up to 0.5 in the summer months. Scientific literature shows that the growing season has shortened with increasing climate change.[38]

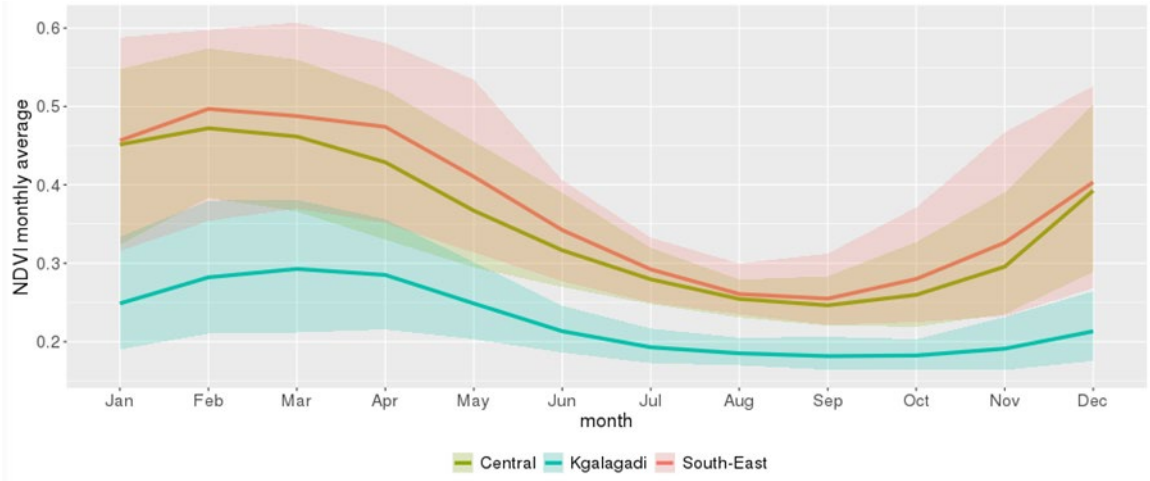

Figure 32: NDVI monthly average of Central, South-Eastern and Kgalagadi regions derived from MODIS data. Source: CelsiusPro AG

[38] Sam Adewale Adelabu et al. "Assessing Growing Season Changes In Southern Botswana" in The African Journal of Plant Science and Biotechnology. 3 March 2011.

Appendix 2 – Mozambique Smallholder Farmer and Livestock Markets

Demographics

Smallholder farmers hailing from Mozambique's three southern provinces of Gaza, Inhambane and Maputo are well known for their affinity for holding cattle, rooted in both local customs and climatological circumstances. The differences to the central and northern part of the country is visible in demographic figures; out of the approximately 4 million smallholder farmers in Mozambique, 30% are located in the three southern provinces. An estimated 250'000 smallholder farmers breed cattle, with 44% residing in the south. While only about 6% of all smallholders in Mozambique manage cattle, 9% of all southern smallholders hold them. This is especially pronounced in Inhambane and Gaza, where between 19-26% of all smallholders breed them.[39]

More than 750'000 cattle are owned by smallholder farmers[40] in the south, accounting for 45% of the total population in the country. Gaza province alone handles 52% of the cattle in the south, with an above average herd size. The study's survey finds higher average herd sizes than indicates in literature, which hints at an average of just above 7. The survey's average for Mozambique lies at approx. 13 cattle per household, with Mabalane (Gaza) reaching almost 16, Magude (Maputo) indicating an average of 13, and Funhalouro (Inhambane) resulting in approx. 11. It can be concluded that Gaza and Maputo generally have larger herd sizes, which might also be influenced by these two provinces accounting for a high share (60-70%) of the large breeders in the country, having a knock-on effect on the herd sizes of smallholder farmers.

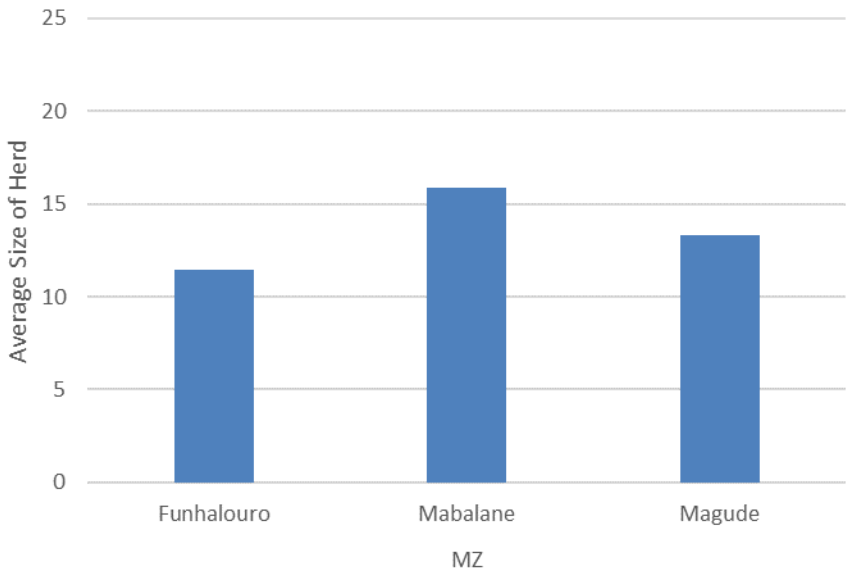

Figure 33: Survey respondents' average herd size for the three districts of Funhalouro (Inhambane), Mabalane (Gaza), Magude (Maputo).

Generally, smallholder farmers account for approximately 88% of the country's total cattle population. The total number of cattle has been increased over the past few years, with growth rates between 2017 – 2020 averaging approximately 4%. The three southern provinces have tended to keep pace, even though the growth rates were usually slightly below the national benchmark. Despite this recent success, Mozambique has a relatively low cattle population considering its landmass and total

[39] Minister of Agriculture and Rural Development, "Integrated Agricultural Statistics Survey (IAI)". 2015.

[40] Includes small breeders with up to 10 cattle and medium breeder with between 11-100 cattle

population of approximately 30 million. The situation is partially explained by the civil war between 1977-1992, which decreased the cattle population and stunted agricultural development. Since 2001 the cattle population has steadily increased, doubling in the two decades since.

Table 8: Overview of smallholder livestock farmers in the southern region of Mozambique. Source: Minister of Agriculture and Rural Development, "Integrated Agricultural Statistics Survey (IAI)". 2015.

	Inhambane	Gaza	Maputo	Total for South	Total for Country
Smallholder Cattle breeders (in % of all smallholders)	40.351 (19.0%)	52,223 (25.5%)	13,595 (1.7%)	106,169 (43.8% of country total)	242.473 (6.0% of all smallholders)
No of cattle owned by smallholders	235,131	392,886	133,619	761,636 (45.3% of country total)	1,682,017
Average herd size	5.8	7.5	9.8	7.2	6.9
Used cattle for ploughing	54.0% (of all smallholders)	44.1% (of all smallholders)	3.4% (of all smallholders)		9.2% (of all smallholders)

Within the three southern provinces, certain districts play a stronger role in livestock farming. The following districts combined account for more than 50% of the respective provinces' cattle population:

- **Inhambane:** Inharrime (13%), Funhalouro (11%), Massinga (11%), Panda (10%), and Zavala (10%)
- **Gaza:** Chibuto (18%), Mabalane (13%), Chokwe (9%), Guija (9%), Chicualacuala (8%)
- **Maputo:** Magude (27%), Moamba (20%), Matutuine (19%)

There are various reasons for raising cattle, with animal traction resp. their use for ploughing fields being one key aspect. This is especially pronounced in Inhambane and Gaza. Other reasons for cattle breeding include generating income via the sale of animals and their milk, use in ceremonies, milk and meat consumption and last but not least, as a medium to long term financial reserve. Smallholder farmers in the southern region of Mozambique usually do not consider cattle breeding as a business and therefore do not actively invest in their improvement, health, and feeding. They also do not plan their marketing of cattle, only realizing their financial reserves in the form of cattle when responding to pressing needs.

The study's survey generally supports these findings, with smallholder farmer's in the southern region of Mozambique primarily keeping cattle for ploughing and other farm work. Their role as emergency reserve, a source of meat & milk, and selling or breeding is not consistently mentioned as their primary purpose across the three districts. However, many farmers indicated that cattle have a secondary purpose as an emergency reserve, food source, or source of sales income.

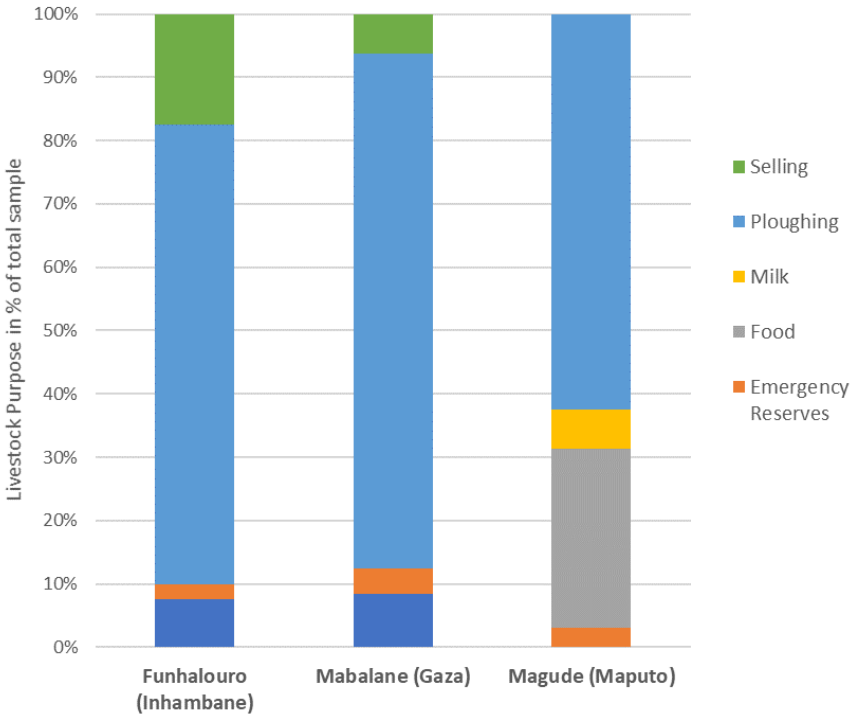

Figure 34: Survey respondents' primary purpose for holding cattle.

Typical smallholder livestock farmers apply a free-range production system, depending solely on natural pasture to feed their cattle, with no supplementary feed provided. The animals are left to graze freely on communal land within the vicinity of the village, at times herded by the children or designated members of the community, and returning back to the farm in the evening. Only about 10% of the arable land is used in Mozambique, leaving enough communal pastureland available for grazing. Following harvest, leftover plant material is often grazed on by the cattle. This additional food source is less prevalent in the semi-arid areas of the South, where soil conditions only allow for marginal crop production while still providing pastureland suitable for livestock rearing. There is no rangeland management frequently resulting in limited pasture in the dry season especially in August, September and October. The lack of supplementary feed and fodder remains a major constraint to systematic livestock production.

Appendix 3 – Survey Questionnaire

Introduction & Personal Details

Topic	Question	Question Format	Action Item
Introduction	1. Survey introduction by interviewer	Standard text on the background (see * text after the survey)– Adjusted according to local language/dialect	➢ Reconfirm the farmers has some connection to cattle (ownership, herding, trading), if not don't continue with the interview
	2. Oral consent enquiry on the use of the survey outcomes	Text on consent (see ** text after the survey). **Closed binary question** – Yes/No	➢ Yes = Proceed with interview ➢ No = Enquire why, address concern, ask again. ➢ Second No = Stop survey with the individual
Personal Details	3. **Various details** – Name, gender, age, mobile number, number of cattle held/size of herd.	To be noted within Hollard's GIS app	➢ Pot. use aid to count / demonstrate herd size such as pebbles or stones ➢ Should include all animals (inc. calves & bulls) and ensure the same understanding if needed e.g. one head of cattle = 1 cattle, not 10
	4. Mobile phone – Does the mobile number you provided belong to you personally or to a family member? What type of mobile phone is it?	**2x Closed binary question** – 1. Belong to me or 2. belongs to other household member + 1. Basic phone (sms/calling) or 2. Smart phone (with internet/apps)	➢ Ask Q4 after registering the mobile phone number via the Hollard GIS app
	5. **Farm location** - lat/long of house/farm + where ever else the cattle are kept	To be logged into Hollard's GIS app	➢ Ensure the farm location is where the cattle are usually kept. Log additional lat/long coordinates if cattle are kept in different locations
	6. Family size – How many family	**Open question -** Number	➢ Ensure extended relatives are not included and the

	members live within your house?		answer is only related to one household
	7. **Membership of association/cooperative** – Are you a member of any farming/livestock cooperative, association or savings group? If yes, which one?	**Open question** – Name of cooperative, association or informal savings group	➢ If yes, enquire about the name of the cooperative/association (can also be more than one)

Economic Activity & Financial Inclusion

Topic	Question	Question Format	Action Item
Economic Activity	**8. Purpose of livestock –** How do you derive income from cattle? What other functions do cattle have within your farm?	**Open Question –** Purpose of livestock for the farmer (e.g. sale of milk, draught power, investment/saving etc.)	➢ Allow interviewee to freelist the purpose of livestock for the farm
	9. **Main economic activities** – Which of activities/sources provide your household with income?	**Open Question** – Income sources (e.g. livestock farming, crop farming, shop ownership, relatives, aid/NGO etc.)	➢ Allow interviewee to freelist a number of income sources which come to mind
Financial Inclusion	10. **Use of payment channels** – How do you pay for your recurring mobile costs and regular school fees for the children? (adapt to local circumstances if needed)	**Ranking question limited to Top 3** – 1. Cash, 2. mobile money/wallets, 3. digital payments, 4. banks/MFI, 5. remittance providers, 6. trader/shop, 7. via family member/friend, 8. others	➢ Ranking by most frequently used ➢ Ask for details if "others" is selected
	11. **Details on payment channels** – What is the name of X,Y,Z payment provider?	**Open question** – Name of payment provider (2. mobile money/wallets, 3. Digital payments, 4. Banks/MFI, 5. remittance providers, 6. trader/shop)	➢ Follow up on the name of the three most frequently used payment channels from Q10 ➢ Only follow up for the payment channels listed on the left
	12. **Awareness of insurance** – Have you heard of insurance before?	**2x Closed binary question** – Yes/No	➢ If yes, then follow up with a second question ➢ If yes for the second question then can ask

	If yes, have you ever purchased an insurance policy before?		for type of insurance or name of insurance company

Livestock & Service Providers

Topic	Question	Question Format	Action Item
Herd Movement	13. **Cattle production system** – How do you manage your cattle?	**Multiple choice** – 1. Cattle fed both at farm and grazing at regular places (semi-intensive), 2. Cattle kept at designated areas only and fed there (intensive/ zero grazing), 3. Cattle grazing in many different places and followed by herder (extensive system), 4. Cattle range freely around village (free range), 5. others	➢ If more than one selected, push to clarify which method dominates in the growing/wet season ➢ Ask for details if "others" is selected
	14. **Cattle production system 2** – How does your cattle management change during the dry season?	**Open Question** – Changes to cattle production system	➢ Note down the main changes during the dry season in bullet points.
	15. **Cattle mobility** – During the growing season, how far from your farm do the cattle usually graze?	**Open ended question** – Distance Use a map or examples such as half way to the next village, past the river nearby, other tangible measurements of distance	➢ Use example for visual aid to simply the distance estimation (e.g. maps). ➢ Check if answer makes sense compared to answer from Q13
Service providers	16. **Livestock trade** - Who do you sell your livestock, livestock produce, milk to? Where do you generate the most income?	**Ranking question limited to Top 3** – 1. Butchery, 2. meat cooperation/state organization, 3. traders, 4. individuals in the community, 5. at a market, 6. feedlots, 7. independent abattoirs, 8. others	➢ Ask to rank the top 3 by highest income source (alternatively the most frequently used) ➢ Ask for details if "others" is selected
	17. **Other service providers** - Are there any other organization, veterinary services,	**Closed binary question** – Yes/No	➢ Ask for more extensive details such as name, reason for interaction, frequently if the

	government entities, which you interact with to manage your herd size or cattle health?	If yes, **open ended question** on the name of the entity, the purpose, the frequency of the interaction	binary question is answered with yes

Drought Risk

Topic	Question	Question Format	Action Item
Historical Droughts	18. **Risk to animals** – What is the most dangerous for the cattle's health?	**Ranking question limited to top 3** – 1. Floods/too much rainfall, 2. lack of rainfall/too little water, 3. lack of pasture growth/feed shortage, 4. too high temperatures, 5. disease/sickness, 6. predators, 7. theft/conflict, 8. others	➢ Ask to select three main risks, starting with largest. ➢ Ask for details if "others" is selected
	19. Drought impact – When there is too little water/feed and it is very hot, what is the biggest problem with the cattle?	**Ranking question limited to top 3** – 1. reduction of milk, 2. no calves produced, 3. lower meat quality, 4. forced slaughter of cattle, 5. starvation of cattle, 6. others	➢ Ask to rank by biggest problem. ➢ Exclude those not used. ➢ Ask for details if "others" is selected
	20. Local droughts – Can you remember which years your cattle suffered from too little water/feed and it was very hot?	**Open ended question** - Years	➢ Pot. use timeline exercise (see example after survey) to help make past drought events relatable ➢ Ask them to name specific years or how many years back from today. ➢ No limit to the number, as many as they can remember
Drought Mitigation	21. **Risk Management Strategies** – When faced with cattle suffering from too little water/feed with hot temperature, what do you do?	**Open Question**– Actions to deal with drougths (e.g. increase feed for cattle, slauther cattle, ask government/NGO for help)	➢ Note down the actions taken by the farmers during a drought in bullet points (focus on top 3)

	22. **Drought support** – During times of little/water feed and high temperature, what would help your cattle the most?	**Open Question** – Most beneficial support measures for farmers (e.g. Cash payment, access to designated large feedlot, veterinary services etc.)	➢ Note down the most valuable support measures for cattle health in bullet points (focus on top 3)

Appendix 4 – Technical Premium per constituency / sub-district / district

Technical premium by Constituency in Namibia

Region	Constituency	Technical premium
!Karas	Berseba	8.8
!Karas	Karas	6.5
!Karas	Keetmanshoop Rural	7.8
!Karas	Keetmanshoop Urban	6.5
!Karas	Luderitz	9.9
!Karas	Oranjemund	7.8
Erongo	Arandis	9.0
Erongo	Daures	9.5
Erongo	Karibib	7.3
Erongo	Omaruru	7.5
Erongo	Swakopmund	7.9
Erongo	Walvisbay Rural	5.2
Hardap	Gibeon	9.1
Hardap	Mariental Rural	9.9
Hardap	Mariental Urban	5
Hardap	Rehoboth East	9.5
Hardap	Rehoboth Rural	7.4
Hardap	Rehoboth West	9.4
Kavango	Kahenge	8.9
Kavango	Kapako	8.8
Kavango	Mashare	9.3
Kavango	Mpungu	6.8
Kavango	Mukwe	8.7
Kavango	Ndiyona	8.1
Kavango	Rundu Rural East	8.4
Kavango	Rundu Rural West	5.6
Kavango	Rundu Urban	7.7
Khomas	Katutura Central	7.7
Khomas	Katutura East	7.7
Khomas	Khomasdal North	7.2
Khomas	Moses Garoeb	5.3
Khomas	Soweto	7.2
Khomas	Tobias Hainyeko	7.7
Khomas	Wanaheda	7.2
Khomas	Windhoek East	9.0
Khomas	Windhoek Rural	9.3
Khomas	Windhoek West	5.7
Kunene	Epupa	9.2
Kunene	Kamanjab	5.2
Kunene	Khorixas	8.5

Kunene	Opuwo	9.2
Kunene	Outjo	6.9
Kunene	Sesfontein	8.2
Ohangwena	Eenhana	9.2
Ohangwena	Endola	8.6
Ohangwena	Engela	8.0
Ohangwena	Epembe	8.6
Ohangwena	Ohangwena	9.9
Ohangwena	Okongo	5.2
Ohangwena	Omulonga	9.0
Ohangwena	Omundaungilo	7.4
Ohangwena	Ondobe	8.6
Ohangwena	Ongenga	9.9
Ohangwena	Oshikango	6.2
Omaheke	Aminius	9.5
Omaheke	Epukiro	6.9
Omaheke	Gobabis	6.9
Omaheke	Kalahari	8.8
Omaheke	Otjinene	7.9
Omaheke	Otjombinde	8.5
Omaheke	Steinhausen	7.6
Omusati	Anamulenge	9.2
Omusati	Elim	8.6
Omusati	Etayi	8.4
Omusati	Ogongo	8.4
Omusati	Okahao	7.8
Omusati	Okalongo	9.8
Omusati	Onesi	9.2
Omusati	Oshikuku	9.8
Omusati	Otamanzi	9.5
Omusati	Outapi	8.5
Omusati	Ruacana	9.7
Omusati	Tsandi	7.2
Oshana	Okaku	9.6
Oshana	Okatana	8.4
Oshana	Okatyali	7.7
Oshana	Ompundja	9.8
Oshana	Ondangwa	9.2
Oshana	Ongwediva	8.8
Oshana	Oshakati East	6.8
Oshana	Oshakati West	8.1
Oshana	Uukwiyu	9.9
Oshana	Uuvudhiya	6.9
Oshikoto	Engodi	7.3
Oshikoto	Guinas	8.8

Oshikoto	Okankolo	6.3
Oshikoto	Olukonda	8.1
Oshikoto	Omuntele	8.0
Oshikoto	Omuthiyagwipundi	9.5
Oshikoto	Onayena	8.9
Oshikoto	Oniipa	9.4
Oshikoto	Onyaanya	8.9
Oshikoto	Tsumeb	7.8
Otjozondjupa	Grootfontein	5.3
Otjozondjupa	Okahandja	8.7
Otjozondjupa	Okakarara	7.5
Otjozondjupa	Omatako	9.5
Otjozondjupa	Otavi	9.6
Otjozondjupa	Otjiwarongo	6.9
Otjozondjupa	Tsumkwe	10.
Zambezi	Kabe	6.6
Zambezi	Katima Muliro Rural	7.1
Zambezi	Kongola	9.4
Zambezi	Linyandi	9.5
Zambezi	Sibinda	6.8

Technical premium by Sub-District in Botswana

District	Sub-District	Technical premium
Central	Bobonong	7.2
Central	Lethlakane	6
Central	Machaneng	6.0
Central	Mahalapye	8.6
Central	Palapye	7.0
Central	Serowe	6.9
Central	Tuli	6.5
Central	Tutume	7.4
Chobe	Chobe	6.8
Francistown	Francistown	5.8
Gaborone	Gaborone	7.6
Ghanzi	Ghanzi	7.8
Kgalagadi	Gemsbok	10
Kgalagadi	Hukunsti	7.3
Kgalagadi	Tshabong	9.2
Kgatleng	Kgatleng	9.0
Kweneng	Kweneng North	7.8
Kweneng	Kweneng South	8.0
North-East	Masungu	5.4
North-West	Ngamiland East	6.1
North-West	Ngamiland West	6.8

South-East	South East	9.1
Southern	Barolong	5.7
Southern	Ngwaketse Central	9.54
Southern	Ngwaketse North	5.9
Southern	Ngwaketse South	9.8

Technical premium by District in the southern region of Mozambique

Province	District	Technical premium
Gaza	Bilene	7.6
Gaza	Chokwe	5.2
Gaza	Chibuto	7.6
Gaza	Chicualacuala	7.2
Gaza	Chigubo	7.1
Gaza	Guija	7.8
Gaza	Mabalane	7.8
Gaza	Mandlakazi	6.6
Gaza	Massangena	9.2
Gaza	Massingir	8.0
Gaza	Xai-Xai	6.0
Inhambane	Funhalouro	8.0
Inhambane	Govuro	6.1
Inhambane	Homoine	6.1
Inhambane	Inharrime	7.3
Inhambane	Inhassoro	5.9
Inhambane	Jangamo	9.4
Inhambane	Mabote	9.9
Inhambane	Massinga	5.6
Inhambane	Morrumbene	6.1
Inhambane	Panda	9.6
Inhambane	Vilanculos	6.0
Inhambane	Zavala	8.0
Maputo	Boane	6.3
Maputo	Magude	5.3
Maputo	Manhia	8.2
Maputo	Marracuene	6.8
Maputo	Matutune	6.9
Maputo	Moamba	5.3
Maputo	Namaacha	5.2