Climate PROOFING Sorghum-based production systems

ACCRA Programme Round Table

Birchood Hotel, South Africa

5th March 2020

KHOTSO PULA NALA

PULA

REPUBLIC OF BOTSWANA

CCARDESA

Centre for Coordination of Agricultural Research & Development for Southern Africa

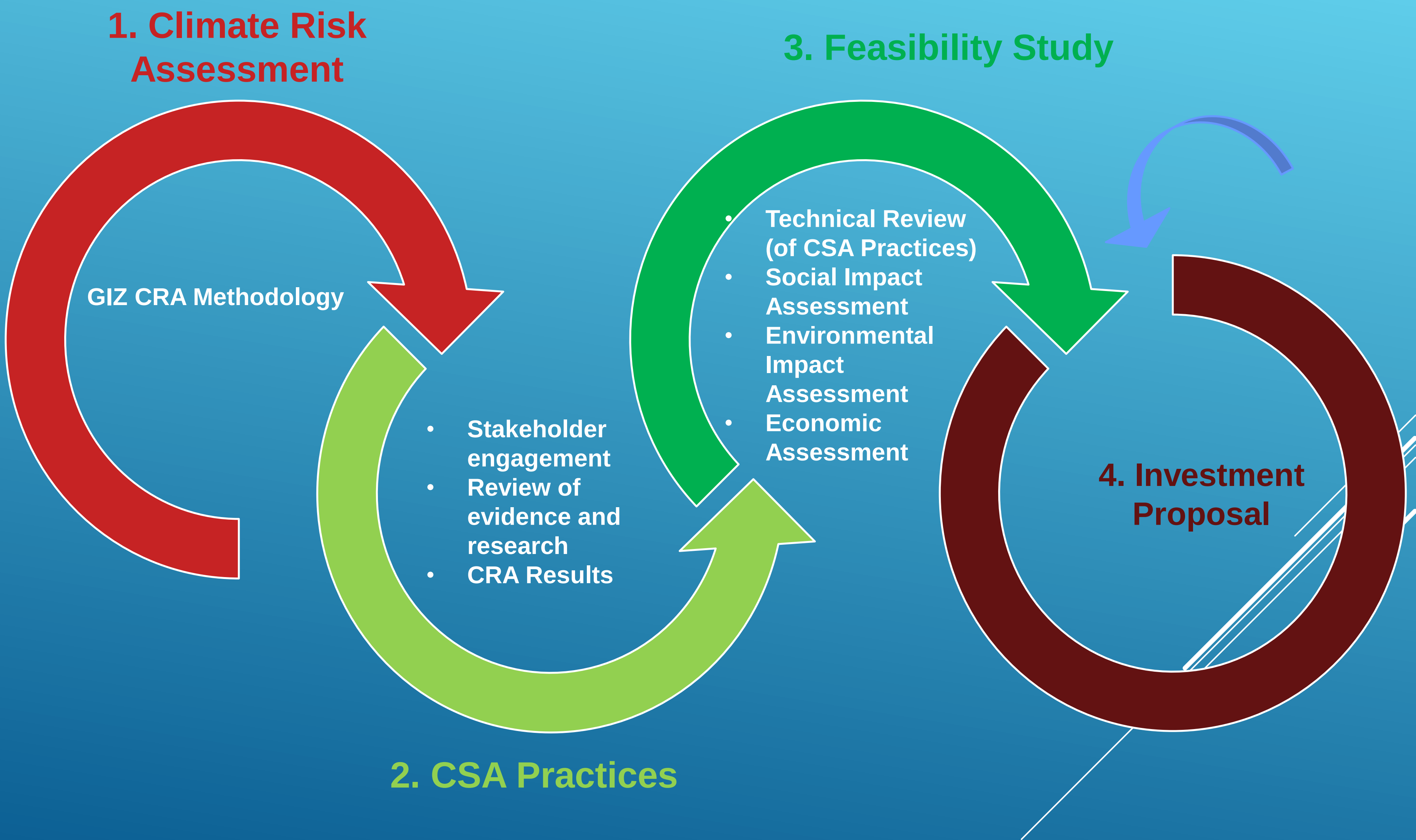
Centre De Coordination De La Recherche Et Du Développement Agricole De L'afrique Australe

Centro para a Coordenação da Investigação e Desenvolvimento Agrário na África Austral

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Rural Self-Help Development Association

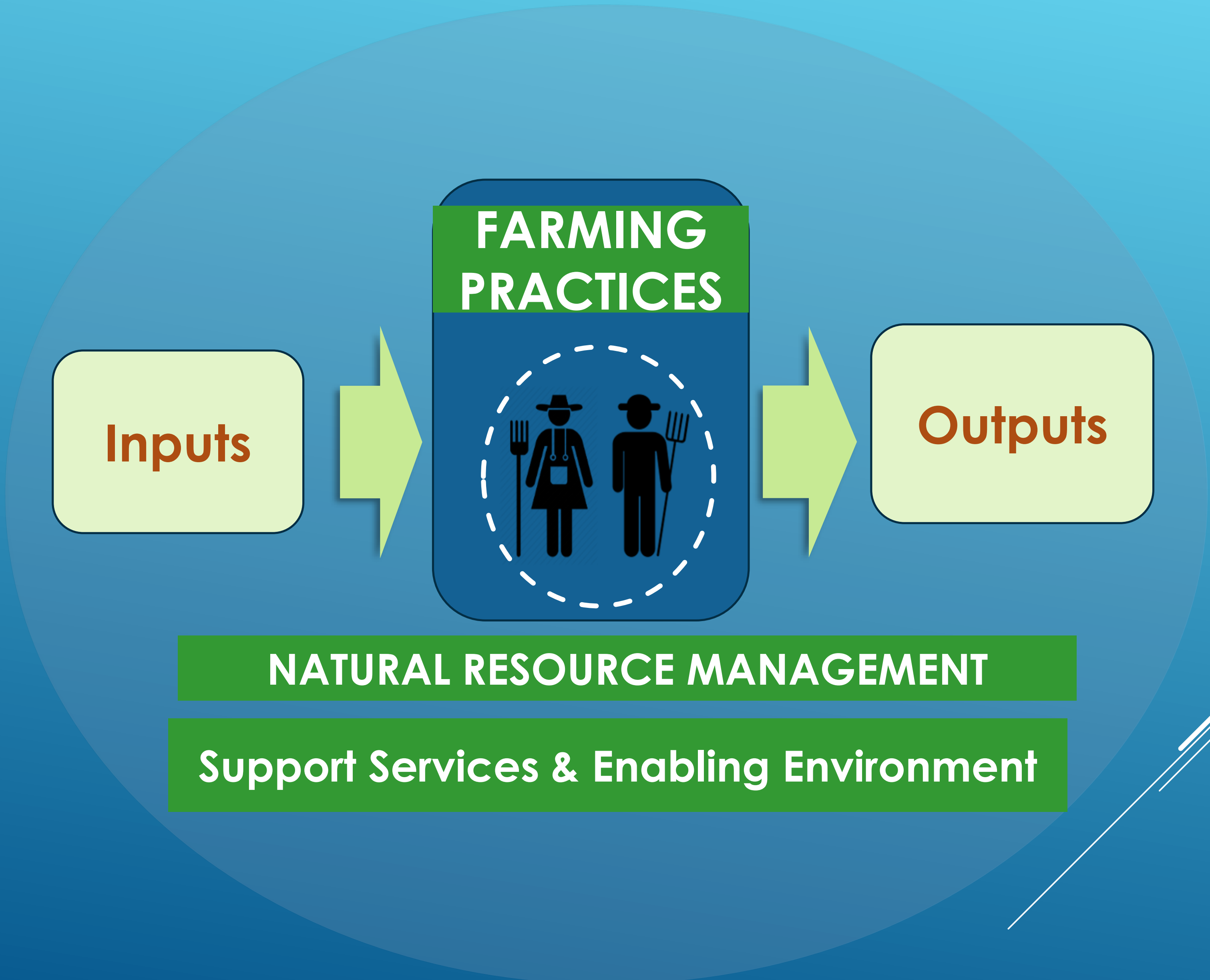
PROJECT COMPONENTS



OUTPUTS

- Climate Risk Assessment
- Sorghum Feasibility Study report
- CSA Practices
- Concept Note

FARMING SYSTEM FRAMEWORK



VALUE CHAIN APPROACH

Pre-production

Inputs – information, knowledge, seeds, fertilizer

Farm preparation

& Other

Production

Planting

Maintenance

Harvest

& Other

Post-production

Storage &preservation

Transport

Processing & packaging

& Other

Market

Purchaser/ wholesaler

Retailer

Consumer

& Other

VALUE CHAIN MODEL FOR FEASIBILITY STUDY

Farming Systems Framework

Climate Resilient Agriculture Practices

Priority Collaborative Practices

Pre-Production → Production → Post-Production → Market

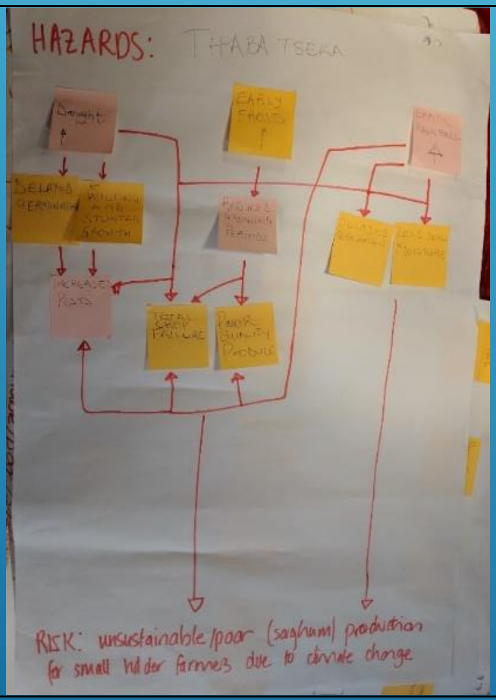
FEASIBILITY STUDY

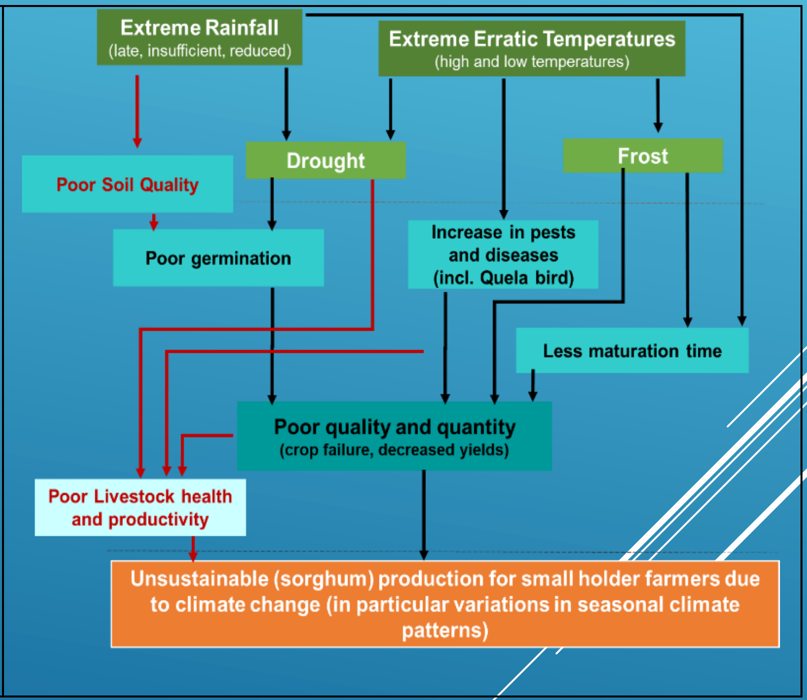
Technical Assessment

- Environmental and Social Assessment
- Economic Assessment
- Institutional and Coordination Analysis
- Delivery Mechanisms

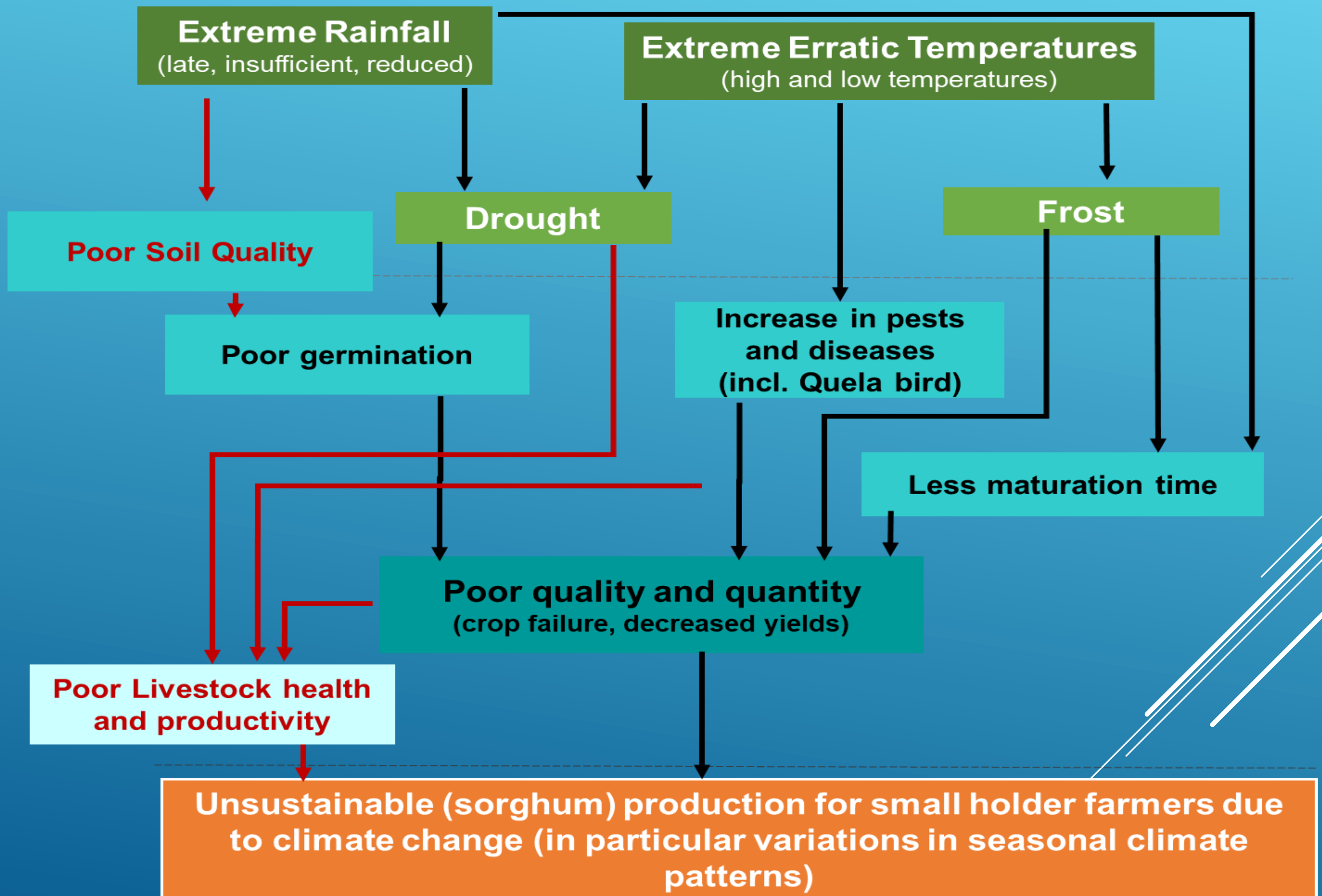
TECHNICAL ASSESSMENT CLIMATE RISK

Stakeholder engagement for mapping country-specific climate risk and impact chains





TECHNICAL ASSESSMENT CLIMATE RISK



INPUTS

- Ease of access to inputs (seeds, fertiliser)
- Improved seeds and breeds available
- Information services (weather, crop information etc)
- Financial services – eg credit, crop insurance, input insurance, etc
- Farm services – eg Ox-drawn / mechanised ripping
- Labour available and affordable
- Access to plant and livestock germplasm
- Access to land

FARMING PRACTICES

SHORT TERM

- Field preparation
- Use of drought-tolerant & early maturing varieties
- Use of local adaptive livestock breeds
- Precision use of inputs
- Crop rotation
- Soil protection – cover crops, crop residues
- Sustainable livestock grazing systems
- Nomadic livestock systems
- Fodder Production
- Feed Mixing
- Protected Farming (shading, tunnels)

MEDIUM TERM

- Improve soil quality & health
- Agroforestry
- Crop / livestock mixes
- Farming system change
- Drip irrigation,
- Rainwater Harvesting
- Plant Health

LONG TERM

- Crop diversification
- Reduced / minimum tillage
- Homestead gardens
- Micro-irrigation, with shared infrastructure
- Molapo Farming (Botswana)
- Organic Farming
- On-farm conservation of germplasm

OUTPUTS

- Post-harvest storage and management
- Information on markets and prices
- Links to wholesalers / food processors
- Links to higher value crops
- Value addition/ processing

NATURAL RESOURCE MANAGEMENT

- Landscape-level water
- Control stocking rates of livestock
- Landscape-level land management (erosion,etc.)
- Rangelands rehabilitation and management

ENABLING ENVIRONMENT

- National Policy and Strategy
- Legal and phytosanitary frameworks
- Group organisation and Umbrella Groups
- Subsidy policy
- Transport/Road Access
- Gene Bank – seed and breed

RISK ASSESSMENT RESULTS

G Biophysical	H Socioeconomic	Current Risk Lesotho	Projected Future Risk Lesotho	Current Risk Botswana	Projected Future Risk Botswana
Poor germination	*Increased Production Costs* *Increased Labour Requirements* *Low Farm Outputs* *Low market price* *Reduced Household Savings*	Medium	High	Medium	High
Increase in pests and diseases		Medium	High	Medium	Medium
Less maturation time		High	High	Medium	High
Poor quality and quantity (crop failure, decreased yields)		Medium High	High	Medium	High
Poor Soil Quality		Medium	Medium	High	High
Poor Livestock health and productivity		Medium	Medium	Medium	High

TECHNICAL ASSESSMENT
CLIMATE RISK

The CRA concluded that;

- The risk categorisation for all of these biophysical elements under the projected climate change will be high

- These risks are exacerbated by the sensitivities of the farming systems, namely the high reliance on rain fed agriculture and the use of crop types which are highly vulnerable to changes in water, pest and weather.

TECHNICAL ASSESSMENT
CLIMATE RISK

- The characteristics of the farming system limit the capacity of farmers to cope with the hazard impacts when they do occur;
  - there is low uptake of irrigation systems that manage moisture deficit, limited targeting of agriculture practices to seasonal climate challenges,
  - low utilisation of information services and lack of models to de-risk agriculture for small holder farmers.
- Adaptation measures that target these gaps and build these capacities will be those that best mitigate the risk from the climate hazards.

FEASIBILITY STUDY ON SORGHUM

TECHNICAL ASSESSMENT
SORGHUM PRODUCTION

Sorghum has characteristics making it a resilient crop:

- It's ability to withstand higher temps than most other cereal after germination
- often grown in regions with 350–700 mm precipitation annually
- ideal soil moisture during germination between 25% and 50% of field capacity and it can survive flooding as it is more tolerant of wet soils
- Sorghum has a short maturity period and the highest food production per unit of energy spent
- Post-harvest, its versatility allows the whole plant to be consumed/utilized for a variety of uses (broom-making, firewood, animal feed, fuel, food) and various cooking preparations

TECHNICAL ASSESSMENT
SORGHUM PRODUCTION

- Whilst Sorghum appears to have significant potential as an adaptation response to predicted climate changes there is insufficient data specific to Lesotho and Botswana.
- Results from regional research indicate that combining sorghum in mixed systems and careful selection of variety choice is the most realist approach.
- Interventions promoting Sorghum production should incorporate research and in particular action learning research approaches to ensure that resilience assumptions are upheld by production and livelihood outcomes.

TECHNICAL ASSESSMENT

SORGHUM PRODUCTION

Quelea Bird

- Chemical avicides and fire bombs have previously been used to control them but these both have negative outcomes for the environment and non-target organisms.
- In small (< 10 ha) areas, IMP approach is the most environmentally benign strategy however training in these principles would need to be incorporated into FFS.
- Whilst some Quelea tolerant varieties have been trialled there are still further opportunities to address this challenge that require additional exploration.
- Further pilot studies and action research projects can continue to address the challenge.

ENVIRONMENTAL AND SOCIAL

COMMUNITY ENGAGEMENT

- A series of community engagement workshops were held in Botswana (76 attendees) and Lesotho (58 attendees) to better understand the perspective of the farmers
- The purpose was to receive their opinions on Sorghum production and interest in opportunities for scale to validate the intervention basis.
- Also to give an opportunity for the real life situation to be fed into the assessment work of this Feasibility Study.

BOTSWANA

LESOTHO

ENVIRONMENTAL AND SOCIAL

Community Engagement

- Communities in both Lesotho and Botswana face a range of social and technical issues in their operations
- But all indicated that they currently produce Sorghum for personal use (both countries) and external sales (Botswana) and are interested to further increase their consumption.
- Whilst drought incidents sometimes limits production in both countries they still see Sorghum as a more drought tolerant option than other crops.
- In Botswana communities are concerned about the challenge the Quelea bird presents to their productivity.
- In Lesotho farmers are concerned about the lack of stable markets for selling produce.

ENVIRONMENTAL AND SOCIAL

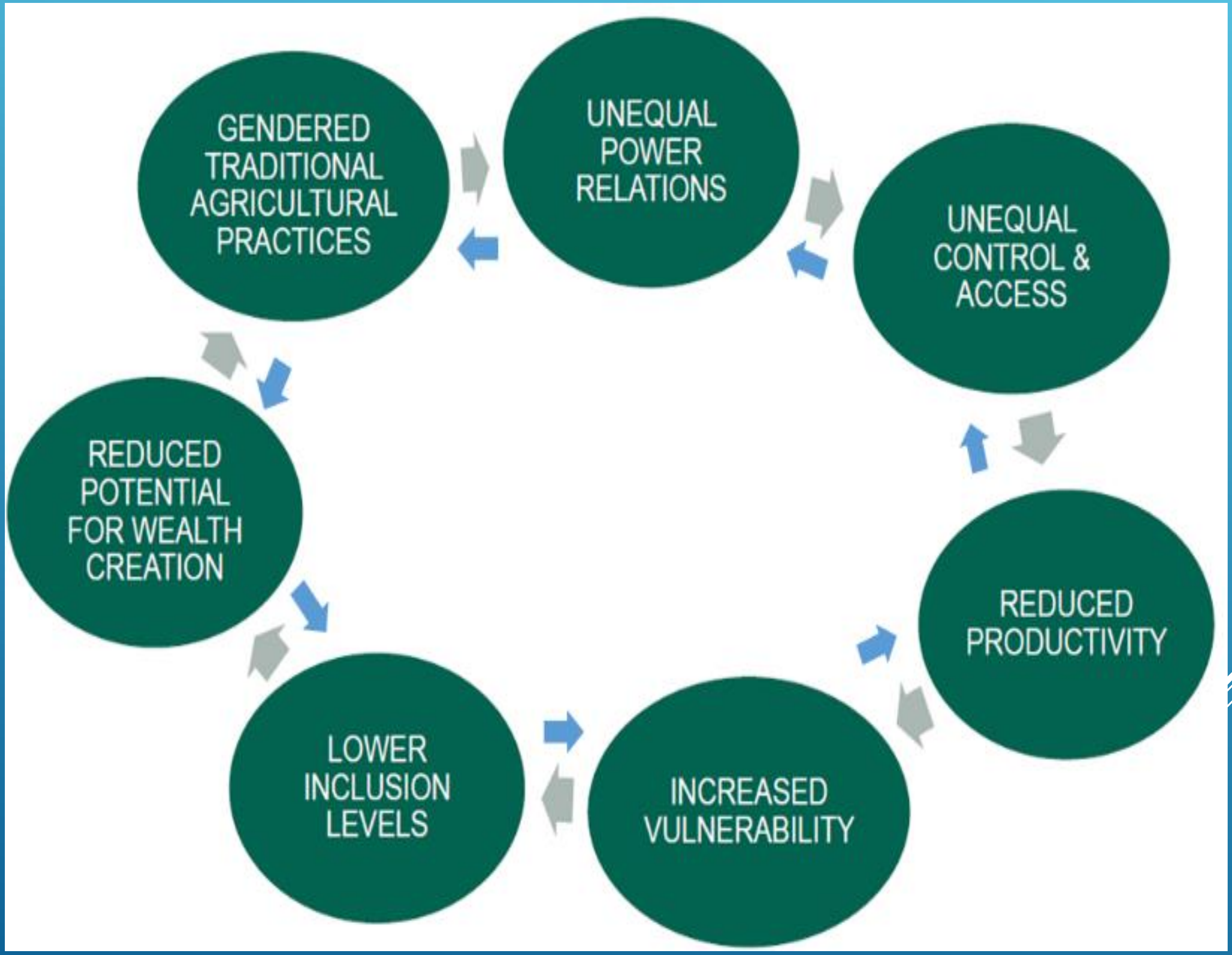
GENDER AND YOUTH

- Patriarchy and culture contribute to significant gender gaps in
  - power
  - control
  - choice
  - agency which is evident in decisions on land and income use,
  - household division of labour,
  - physical labour
  - market access.
- Whilst all farmers experience the impacts of climate variability, gender gaps in agriculture influence how women and men access, participate in, adopt and benefit from climate-smart agriculture practices for reduced vulnerability to climate variability.

ENVIRONMENTAL AND SOCIAL

GENDER AND YOUTH

Inequality Cycle in Agriculture



ENVIRONMENTAL AND SOCIAL

ENVIRONMENTAL & SOCIAL SCREENING

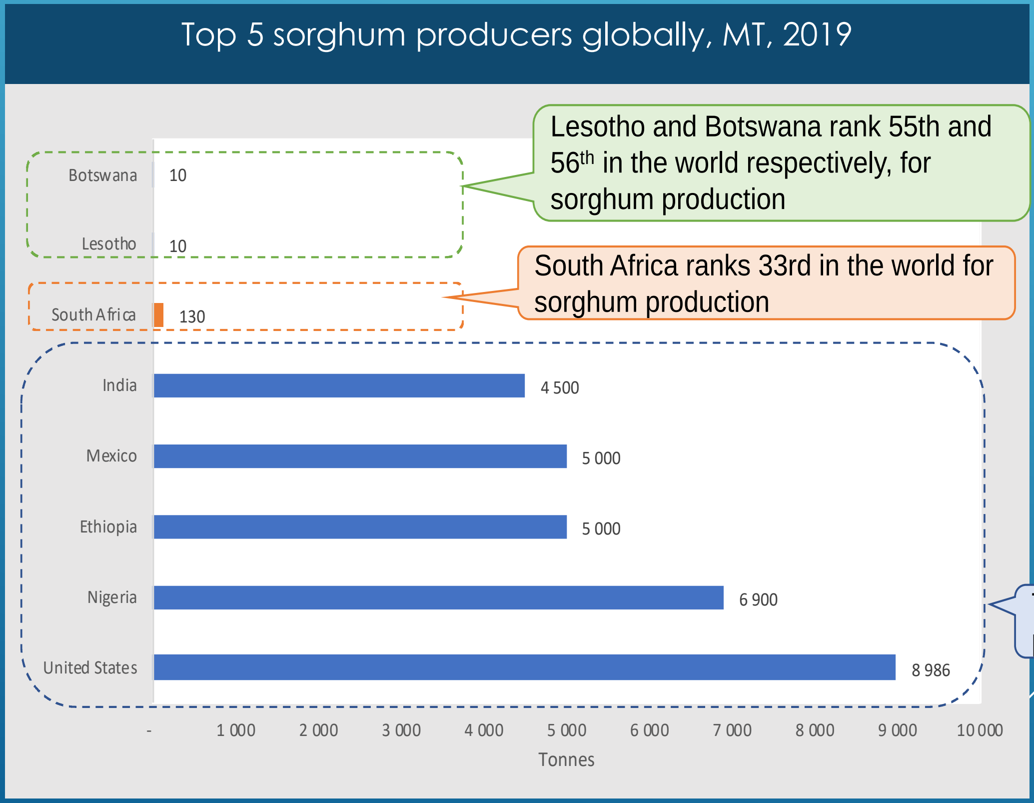
Although it is not possible to state precisely which exact activities will eventually be implemented Interventions developed from the results of this feasibility study; it is likely that such interventions will pose little threat to the environment and social systems.

FEASIBILITY STUDY

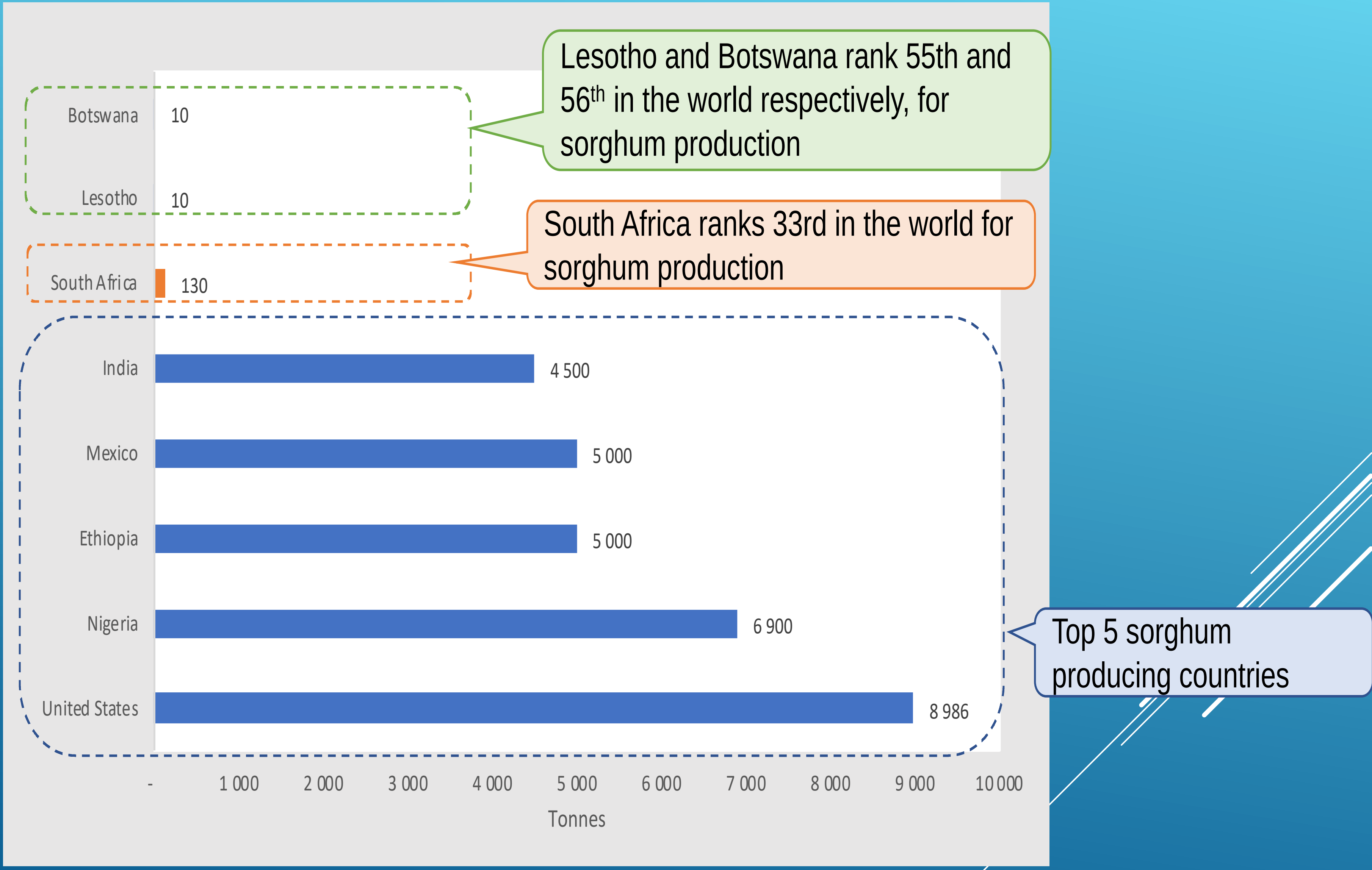
- Technical Assessment
- Environmental and Social Assessment
- Economic Assessment
- Institutional and Coordination Analysis
- Delivery Mechanisms

ECONOMIC ASSESSMENT

- **Purpose:** is to **assess the economic viability** of upscaling sorghum production in Lesotho and Botswana as a means to reduce the vulnerability of small-scale farmers.
- Sorghum is grown in over 60 countries globally with Lesotho and Botswana ranking 55th and 56th in terms of global production volumes.



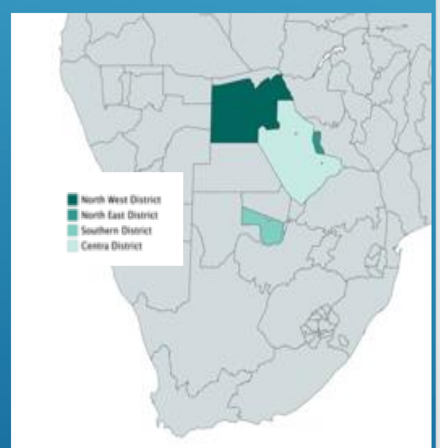
Top 5 sorghum producers globally, MT, 2019

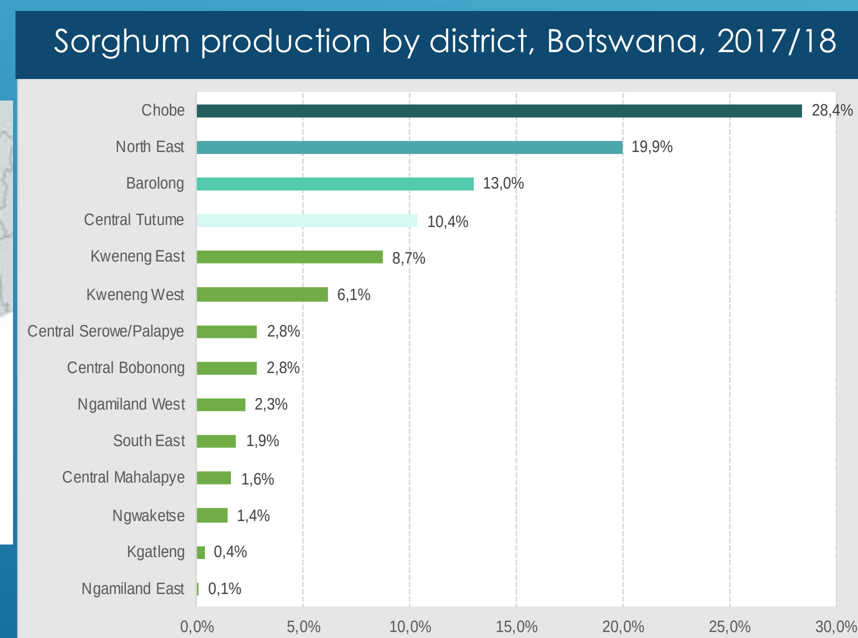


STATUS QUO FOR BOTSWANA

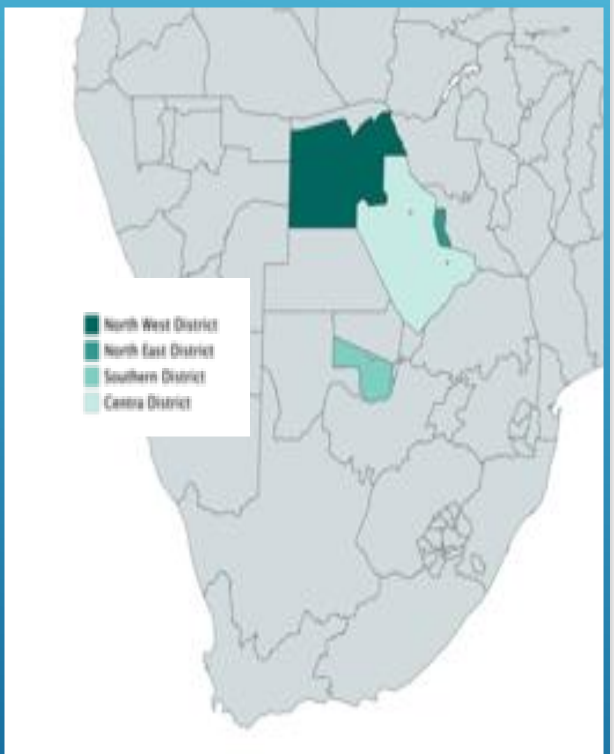
- Over the last decade, volumes of sorghum production in Botswana have shown a declining trend. Average annual production of 27,300 MT between 2010 and 2019.
- **BUT** sorghum remains the **second largest crop**, accounting for 25% of production of the 4 largest crops.
- In 2017, 36% of sorghum was sold/traded, generating revenue of over USD 500,000

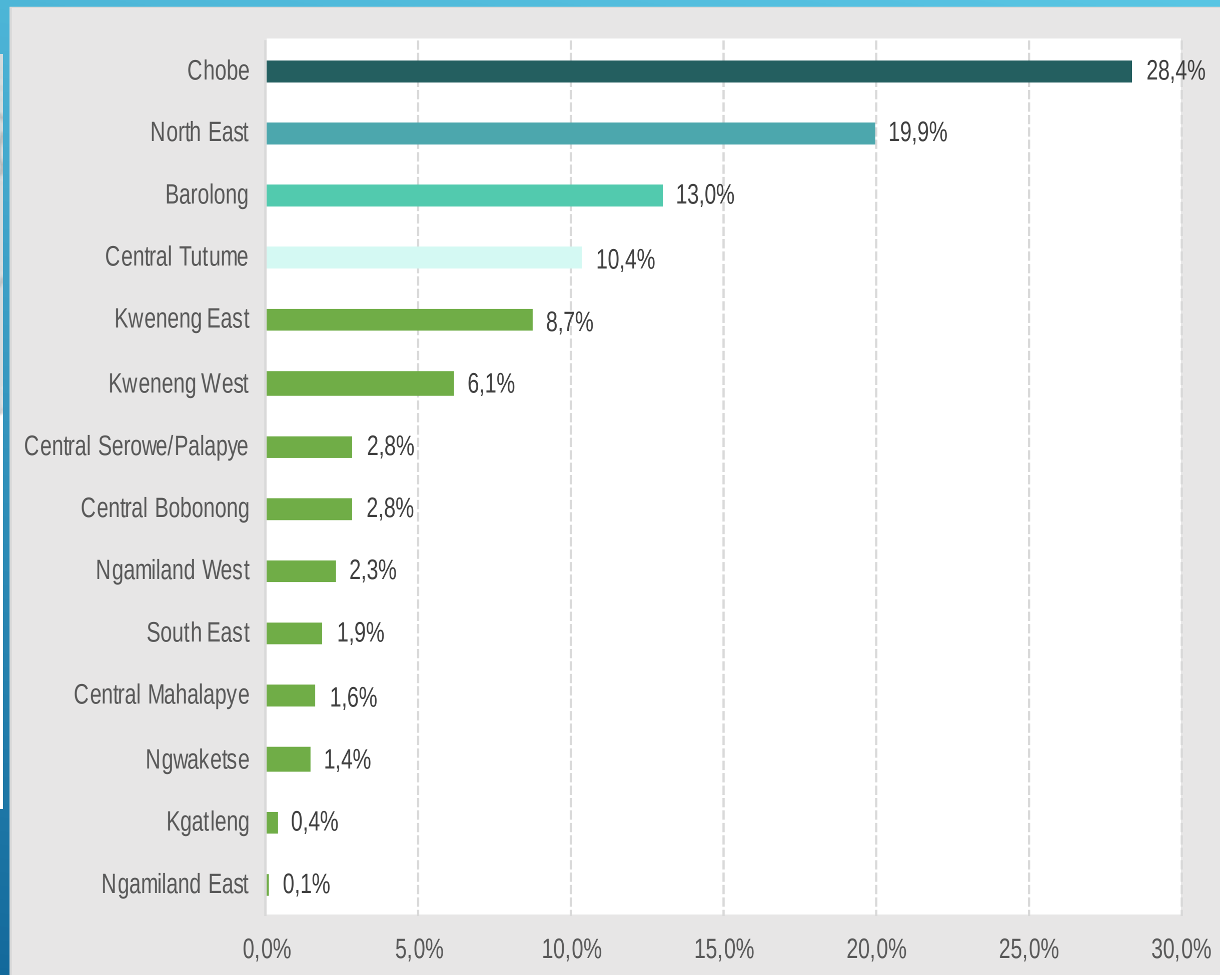
- Sorghum production is **concentrated in 4 districts** which account for over 70% of production.
- **Traded prices across districts vary widely** ranging between 16 and 54 US cents per kg.





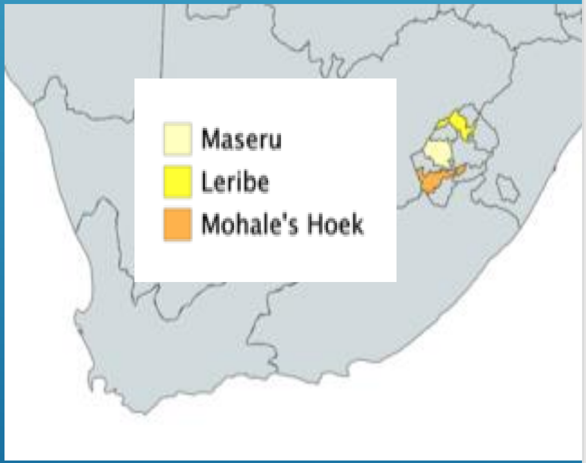
Sorghum production by district, Botswana, 2017/18

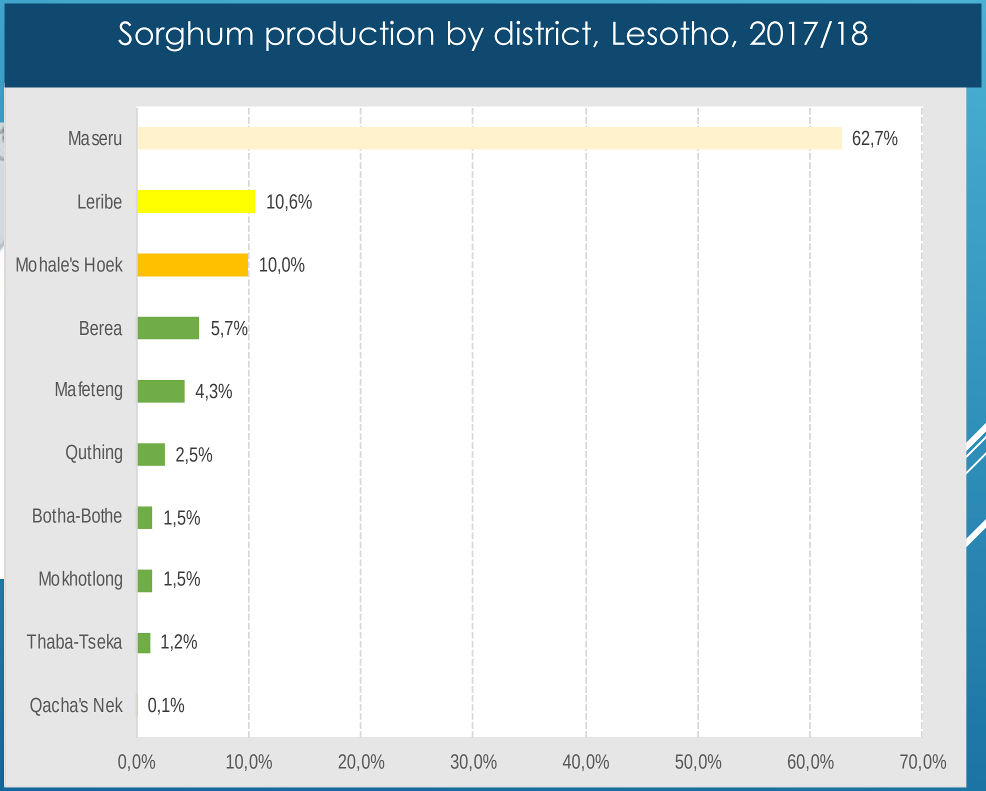




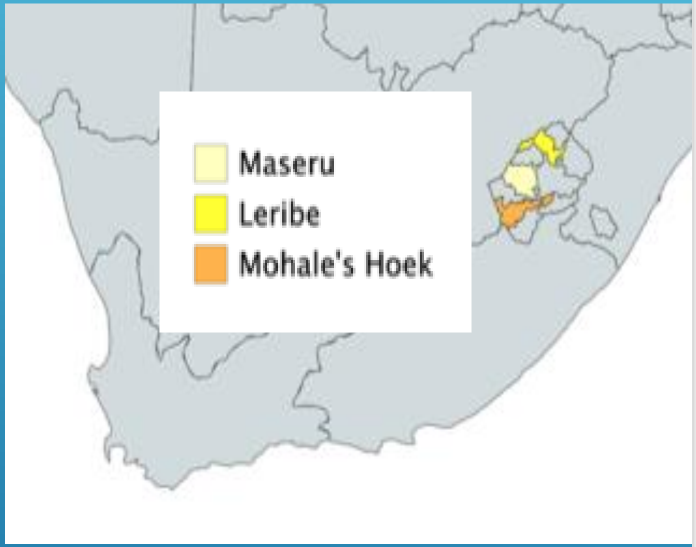
STATUS QUO FOR LESOTHO

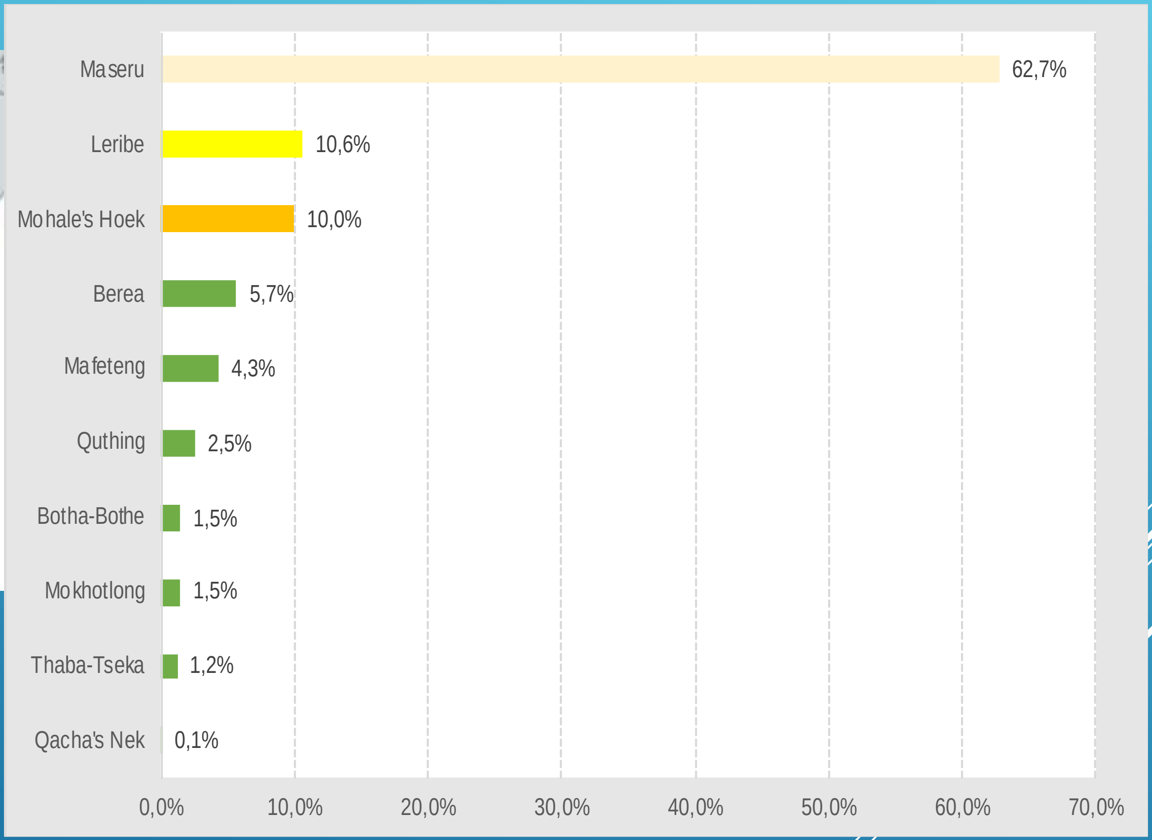
- Sorghum production volumes have remained stagnant over the last decade with an annual average of 11,300 MT between 2010 and 2019.
- **BUT** sorghum is also the **second largest crop**, accounting for 25% of production of the 5 largest crops.
- Although sorghum is produced in all districts across the country, production volumes are concentrated in 3 districts which account for over 60% production.





Sorghum production by district, Lesotho, 2017/18





ECONOMIC VIABILITY

Economic viability is determined by the following variables:

- Operating costs for production per hectare
- Yield per hectare
- Prices per kilogram at which sorghum can be traded
- The potential to enhance food security (this is a qualitative benefit that has not been quantified in this study)

FINDINGS & RECOMMENDATIONS

- **Cost of the programme and viable selling prices:** these need to be considered as both will impact the revenue-generating potential of the interventions in both countries.
- **Geographic concentration of production:** programme design should consider the market structures and pricing within each district as this will influence the probability of success of upscaling.
- **Gain information on off-takers:** currently very limited information on the sorghum off-takers and mills. Before detailed programme/intervention design can commence additional primary research would be required in order gauge their ability to increase their intake. This will be an important aspect for potential funders.
- **Funder requirements:** programme design, including capital and operating costs; institutional implementation arrangements within national and local governments; overall net economic benefits/costs of the programme over a predefined time period.

Items	Quantity	Unit price (USD)	Total Price (USD)
Ploughing (ha)	1	16.74	16.74
Harrowing (ha)	1	8.37	8.37
Ridging (ha)	1	8.37	8.37
Seed (kg's)	8	0.33	2.64
Planting (man days)	5	1.67	8.35
First weeding/thinning (man days)	20	1.67	33.4
Fertiliser (bags)	4	18.42	73.68
Fertiliser application (man days)	10	1.67	16.7
Harvesting (man days)	10	1.67	16.7
Threshing (man days)	20	1.34	26.8
Bags & labour for handling (bags)	20	0.27	5.4
Total cost per ha		**60.54**	**217.15**

ASSESSING THE BUSINESS CASE

- Economic viability can be assessed by assessing the operating costs relative to revenue-generating ability as demonstrated in the table below.
- Items to be verified before completion:
  - **Yield:** kg's per hectare for each country (the figures within the table are currently based on official statistics for kilograms produced relative to hectares planted)
  - **Selling prices:** there is large variability in prices per kg. Guidance is required on which prices per kg are most applicable for each country
  - **Cost per hectare:** Differs in each of the countries due to different subsidy programmes..

FEASIBILITY STUDY

- Technical Assessment
- Environmental and Social Assessment
- Economic Assessment
- Institutional and Coordination Analysis
- Delivery Mechanisms

INSTITUTIONAL AND COORDINATION

- Sustained coordination between government departments and disjointed approaches to programming which includes private sector are challenges in both countries.

INSTITUTIONAL AND COORDINATION
LESOTHO

Opportunities have been identified for;

- Institutional coordination between private and public agriculture and climate-related institutions at national, regional, and international levels to enable increased investment from diverse sources.
- Closely monitoring the impact and success of CSA projects in Lesotho to understand the potential of initiatives to contribute to agricultural transformation and livelihoods, and attract increased investment.
- Women who play a key role in the agriculture sector, need to be provided with knowledge and training opportunities and be actively involved in the planning and implementation of CSA

INSTITUTIONAL AND COORDINATION BOTSWANA

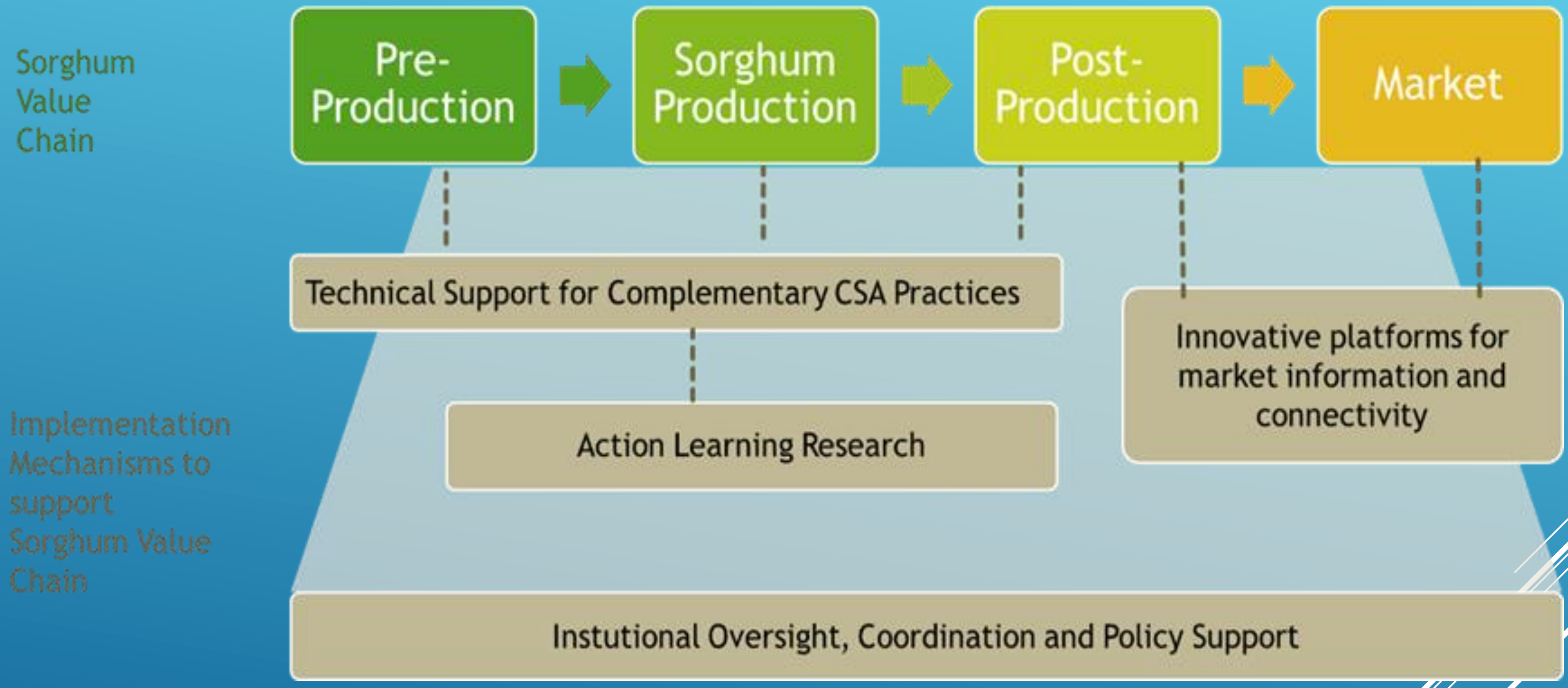
	Climate-smart agriculture Policy	Incentives for adoption
Botswana	CSA Framework Programme National Master Plan for Arable Agriculture and Dairy Development Integrated Support Programme for Arable Agriculture Development Livestock Management and Infrastructure Development programme	Capacity development and technology support Tax exemption for agricultural products and farming inputs A Young Farmers Fund issues loans at lower interest rates and longer repayment periods to encourage youth participation in agriculture.

- However, some perverse incentives have been identified that undermine a CSA approach, such as the Integrated Support Programme for Arable Agriculture Development which pays P500.00 per hectare for minimum tillage but P800.00 for conventional tillage.

FEASIBILITY STUDY

- Technical Assessment
- Environmental and Social Assessment
- Economic Assessment
- Institutional and Coordination Analysis
- Delivery Mechanisms

DELIVERY MECHANISM



Sustainable Sorghum Value Chains for Climate Resilience, Lesotho and Botswana

Project Concept Note for Financial Assistance

Developed by the Rural Self-Help Development Association, the Departments of Research (Lesotho and Botswana) and the Department of Crops (Botswana) with support from the Southern Africa Development Community (SADC) / German Development Cooperation (GIZ) Adaptation to Climate Change in Rural Areas in Southern Africa Programme (ACCRA), September 2019.

BOTSWANA

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INVESTMENT CONCEPT NOTE COMPONENTS

INTERVENTIONS

Component

- Technical Support for Complementary CSA Practices
- Action Learning Research
- Innovative platforms for market information and connectivity
- Instutional Oversight, Coordination and Policy Support

Impact

- Increased Incomes from Sorghum Production for small holder farmers
- Increased knowledge of application of CSA practices across farming system
- Increased engagement between Value Chain participants
- National Policies and Coordination that supports growth of Sustainable Agriculture (incl Sorghum) Production

Mixed farming (Crops and Livestock)

By combining crops and livestock, farmers diversify household diets, improve nutrition and mitigate risk of loss.

CHALLENGE

Climate change is expected to include erratic weather patterns, primarily: increasing temperatures and decreasing rainfall. These climatic changes impact on farming and can pose challenges to sustainable production, income and food security. If a farmer is entirely dependent on one value chain, their resilience is compromised, and they may have difficulty coping and adapting in cases of extreme weather events.

CSA PRACTICE

Mixed farming combines crop production with livestock rearing (it may also often include agroforestry, rice-fish, fish-livestock or food-energy combinations in farming) . It presents not only a means to diversify food production and improve nutrition at household level, but also a way for farmers to fortify their income and to mitigate risk of loss of either crops or livestock if the farmer is entirely dependent on one or the other.

Compromised crop production due to extreme weather (frost, droughts or flooding), can lead to reduced yields, stunted growth of crops or even crop failure.

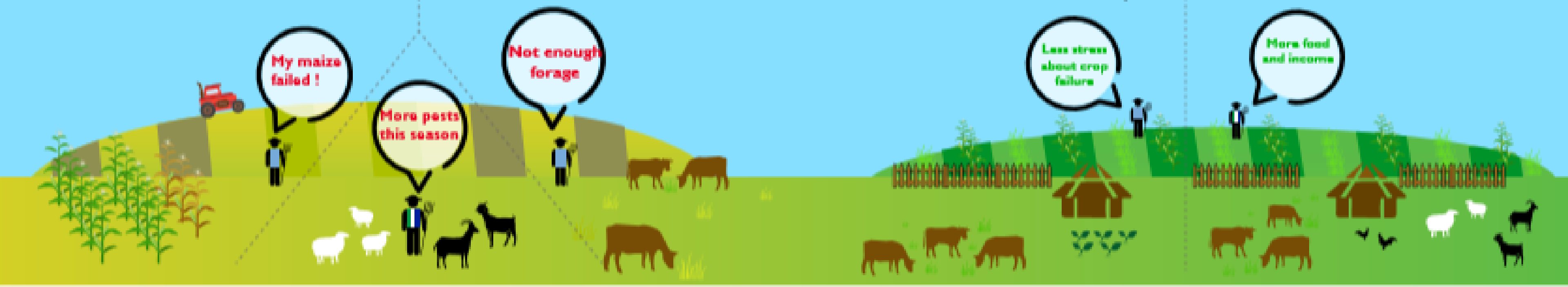
Compromised animal rearing, brought on by droughts, lack of grazing land and fodder and increase in pests and disease, can lead to animals becoming emaciated or dying and will threaten quality and quantity of livestock and by-products.

1 Integrating cattle farming with crop production

In Botswana and Lesotho, cattle farming accounts for a large percentage of the agriculture sub-sector. In mixed systems in these countries, livestock can consume crop residues and by-products and in turn their manure can be used to fertilise crops.

2 Integrating small ruminant farming with crop production

In Lesotho in particular, goats and sheep are reared on a large scale to produce wool and mohair. By integrating crops, farmers can also grow fodder for small ruminants and poultry.



In Lesotho and Botswana:

The Departments of Agricultural Research consider the adoption of mixed farming a key adaptation measure to climate change due to high performance against four key criteria; Effectiveness, Cost, Feasibility and Speed of results.

In Botswana and Lesotho, many lands have become eroded and degraded. By combining livestock and crop farming, farmers can better manage farmlands and reduce the stresses on grazing land.

Mixed farming approaches in Lesotho and Botswana contributes to adaptation to climate change, because the diversification of crops and livestock allows farmers to have a greater number of options to face uncertainty due to increased climate variability.

How does it help farming?

IMPROVES PRODUCTIVITY

This farming system incorporates principles of crop rotation, organic fertilizer, and integrated pest and disease management which improve efficiency and productivity.

ENHANCES ADAPTATION

Enhances resilience to climate variability by stabilising production across the crop varieties, and maintaining livestock sales as coping mechanism.

PROMOTES MITIGATION

Incorporating crop residue into the soil results in less carbon emissions than burning.

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Sustainable fodder production

allows farmers to meet the demand of forage for their livestock

CHALLENGE

Climate change threatens food and water supply globally, due to increase in temperatures, prolonged dry spells and changes in rainfall patterns. This, coupled with rangeland degradation and soil erosion compromise quality of pastures, making livestock grazing increasingly difficult.

CSA PRACTICE

By producing fodder, farmers are able to supplement livestock grazing and provide a more nutrient-rich addition to animal diets.

- Animals may be prone to disease, pests and less resilient to hazards
- Overgrazing & increased water shortages make pastures highly vulnerable
- Animals may be subject to reduced fertility affecting farmer's ability to breed animals
- Beef, wool & mohair, milk quality and quantity may be compromised
- Livestock population numbers reduce and as a result so too beef, wool and mohair production
- If underfed, animals may become emaciated, potentially unmarketable

1. Intercropping crops for consumption with forage can help farmers maximise limited land space, while concentrating the labour of planting.
2. Growing fodder by sprouting cereal grains in a controlled environment hydroponically: requires minimal labour, provides a high yield in a small area, year-round production of nutritious feed and control over feed quality.
3. Fodder crop production on land suitable for crop production provides control of soil erosion by protecting soil surface. Fodder crops provide effective ground cover.
4. After harvesting principal crops, farmers can plant crops that, when harvested, serve as forage. This supplements grazing, protects against soil erosion, inhibits weed growth and serves as mulch material.

In Lesotho and Botswana:

The Departments of Agricultural Research consider fodder production a key adaptation measure to climate change due to high performance against four key criteria; Effectiveness, Cost, Feasibility and Speed of results.

In Botswana, livestock production, especially cattle, contributes about 80% to the agricultural GDP and the major subsectors are meat and dairy. In Lesotho, livestock subsectors include primarily cattle, sheep, goat, pigs and poultry and it accounts for 62% of agricultural GDP.

Fodder production can ensure continuous and nutritious food supply to livestock, addressing feed shortages, contributing to healthy, resilient animals and in effect food security, livelihoods and the national economy.

How does it help farming?

IMPROVES PRODUCTIVITY

Increases productivity of livestock and reduces production costs, increasing livelihood.

ENHANCES ADAPTATION

Enhances resilience to dry spells by improving availability and quality of animal feed, and thereby ensuring healthy animals.

PROMOTES MITIGATION

Greater production per unit of feed results in reduced emissions per unit of output.

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Implementation of Rainwater Harvesting

enables farmers to collect and use rainwater in times of drought, or as an irrigation mechanism.

CHALLENGE

One of the biggest challenges which climate change poses, is the predicted decrease in rainfall. This, coupled with predicted higher temperatures and potential prolonged droughts, mean that relying on rainwater for farming will be impractical and a high risk for farmers. Overreliance on rain-fed agriculture is known to be one of the key challenges in Lesotho and Botswana. It poses a risk to farmers when the onset of rains is later in the season, or when the rains are inconsistent.

CSA PRACTICE

Rainwater harvesting allows farmers to hedge against the risk of low/late/no rainfall, providing water for crops and livestock in water shortage emergencies or an irrigation mechanism. The practice of rainwater harvesting generally refers to the installation (or identification) of a catchment area and the collection and storage of rainwater into natural reservoirs or tanks.

If reliant only on rains, crop farmers may face a delayed planting season if there is late onset of rains

Limited availability of rains may also threaten livestock production as drinking water is reduced as well as water required for growing feed.

1 Rooftop rainwater harvesting and storage in tanks

2 Runoff harvesting from open surfaces and paths and storage in pans and ponds

3 Earth dams

4 Farming practices that minimise water usage and promote soil moisture retention

In Lesotho and Botswana:

The Departments of Agricultural Research consider rainwater harvesting a key adaptation measure to climate change due to high performance against four key criteria; Effectiveness, Cost, Feasibility and Speed of results.

Global Circulation Models (GCM) used by the Intergovernmental Panel on Climate Change (IPCC) show that precipitation in the Southern African region is expected to decrease over the next 50 years, which means that farming systems that rely entirely on rains, are vulnerable.

Coupled with improved moisture retention practices, farmers can divert rainfall from surrounding catchment areas to the soil in which the crops or fodder for livestock are grown.

How does it help farming?

IMPROVES PRODUCTIVITY

Significantly increases resilience to fluctuations in rainfall patterns by ensuring continuous farming.

ENHANCES ADAPTATION

Helps farmers maintain livelihoods and food security in periods of drought, inconsistent or late rain.

PROMOTES MITIGATION

Allows more sustainable farming practices which maintain soil quality and improve productivity per unit of output.

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Improvements in post-harvest storage and management

help farmers to reduce losses after harvesting, increasing their food supply and income.

CHALLENGE

In sub-Saharan Africa, 30-50% of food produced for human consumption is lost or wasted along the value chain every year. These losses equally affect nutrition, food security and income. Post-harvest losses exacerbate food insecurity and threats to livelihoods globally when combined with the pressures on future food systems which climate change is expected to bring.

CSA PRACTICE

Post-harvest storage and management encompass a wide range of activities, influenced by a wide range of actors and factors along any value chain. In Lesotho and Botswana, cereal production (maize, sorghum and wheat) is critical and smallholder farmers account for a large percentage of farming activities. Introducing strategies for smallholder farmers in the post-harvest storage and management of cereals will be crucial.

Production & pre-harvest losses
Damage in the field before harvest, due to biological and biotic factors such as weeds, insect, pests and diseases

Harvest and handling
Poor harvest scheduling and timing and careless handling of produce contribute to food loss and waste along the chain

Storage
Lack of proper storage facilities is a major cause of losses. Highly perishable produce requires adequate storage facilities with suitable conditions: - temperature, humidity & gas composition

Transport
Transport introduces an element of longer time span between production and consumption, of particular importance for fresh products, as well as additional risks of mechanical and heat injury

Processing and Packaging
Food losses at the processing stage are mainly due to technical malfunctions and inefficiencies. Errors during processing often lead to defects in the end product and processed food can be discarded for not adhering to set standards

In Lesotho and Botswana:

The Departments of Agricultural Research consider post-harvest storage and management a key adaptation measure to climate change due to high performance against four key criteria; Effectiveness, Cost, Feasibility and Speed of results.

The effect of postharvest losses and losses as a result of degradation and soil erosion, reduces countries' capacity to be food secure. This, coupled with the effects of climate change (limited rainfall and higher temperatures) will further compound the food and livelihood security challenges which Botswana and Lesotho face.

How does it help farming?

IMPROVES PRODUCTIVITY
Increases amount of farm output that reaches market.

ENHANCES ADAPTATION
Increases farm gate output and therefore income (livelihoods).

PROMOTES MITIGATION
Achieves higher productivity per unit of land by minimising loss prior to farm gate.

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WAY FORWARD

- **Fund raising activities.**
- **CSA extension strategy**
- **Testing e-extension App in the field.**

Thank you

KHOTSO PULA NALA

PULA

REPUBLIC OF BOTSWANA

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Centre for Coordination of Agricultural Research & Development for Southern Africa
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