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Factsheet Resilience Solutions for the Maize Sector in South Africa

This Factsheet is a part of the Private Markets for Climate Resilience (PMCR) project to evaluate systematically the potential market for climate resilience solutions in the private sector. Focusing on agriculture and transportation, current practices and opportunities highlight products, services and finance in six emerging markets — Colombia, the Philippines, South Africa, Nicaragua, Kenya, and Vietnam.

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Maize sector in South Africa

Maize is the most important grain crop in South Africa, being both the major feed grain and the staple food for the majority of the population. Maize is the second largest crop (by tonnage) produced in South Africa after sugar cane. The sector is important to the economy both as an employer and earner of foreign currency. Maize also serves as a raw material for manufactured products such as paper, paint, textiles, medicine and food, and it is actively traded on the South African Future's Exchange.

Climate models suggest that by 2100, the maize growing region should expect a temperature increase of roughly 1.5°C at the coast and 2-3°C inland. Regional crop models suggest that maize yields will decrease by up to 25% compared with the 2009 baseline. However, regions with current temperatures marginally too low for maize's ripening stage, may experience increased yields in the mid-term subject to temperature increases of up to 1°C. While small pockets of South Africa in the east of the country may experience more favourable conditions under climate change, production in the western and central regions is likely to become more difficult.

Climate change affects the entire maize value chain either directly, through the amount, quality and location of production, or indirectly through price. As maize production and storage are vulnerable to climate change, producers are already reporting an increase in extremely hot days (above 36°C) and shifts in seasonal rainfall patterns. Climate change could expose the maize value chain to pre-existing social and economic fault-lines in the industry related to the bifurcation between commercial and subsistence farmers. Enhancing resilience in the maize value chain will require a combination of technological, behavioural and institutional changes.

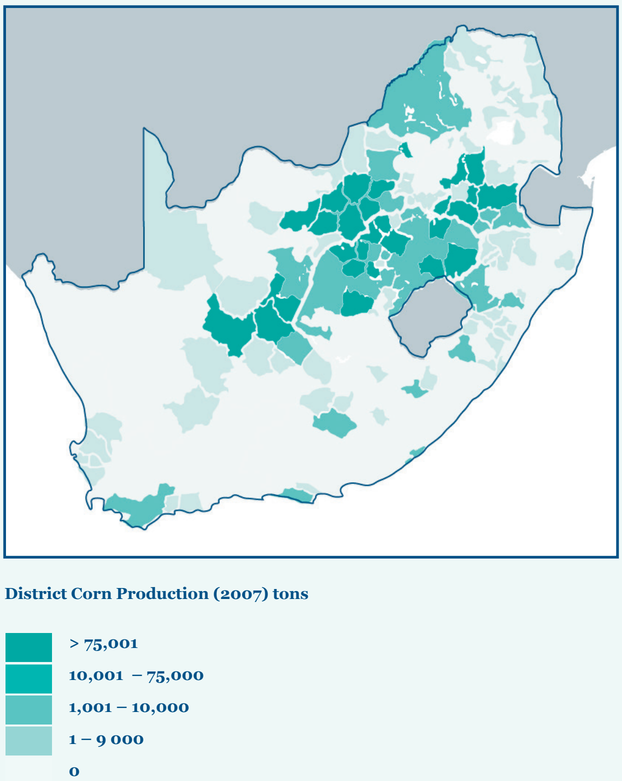
Sector facts

Total production: annual crop typically varies between 7-12 million tonnes, of which approximately 500,000 tonnes is produced by small-scale farmers.
Total area of production: varies between 3.8-4.8 million hectares (ha), roughly 25% of the country's arable land.

Number, size and types of producers: ~9,000 commercial and ~1 million small-scale farmers, accounting respectively for 98% and 2% of total production.
Average yield: : 2-6 tonnes per ha for dryland maize and 8-16 tonnes per ha for the small areas of irrigated maize.
Type of production: ~52% of production is white maize, used primarily for human consumption as maize meal, and the balance of 48% is yellow maize, used for animal feed and food supplements. An estimated 86% of maize production is from genetically modified seed and selected for local climate and soil conditions.

Sector association level: Grain SA is the sector association. Some functions previously undertaken by the Maize Board have been absorbed into companies that are jointly owned by maize growers. These include the South African Grain Information System and the South African Grain Laboratory.

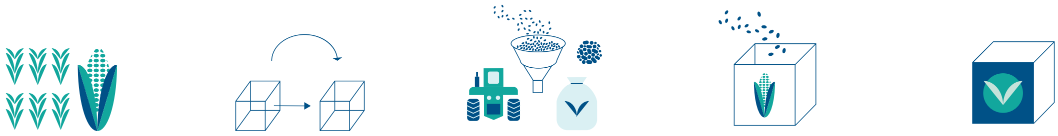
South Africa Maize Production (2011-2015)



For a list of references, see the References Section of the PMCR Report.

The maize value chain

The value chain builds on five main processes from production to retail. Each process involves specific activities, which are conducted by direct actors and engage identified indirect actors.



	Production	Transport	Milling	Product manufacturing	Retail
Activities	• Planting • Harvesting	• Loading & transport • Storage • Silo sorting • Drying	• Milling • Sorting • Grading • Transport	• Processing • Packaging • Marketing	• Transport • Re-packaging • Value-adding • processing
Direct actors	**Agriculture & economic advisors**	**Transport companies**			
	Input suppliers	**Owners of storage facilities**		**• Manufacturers • Product designers • Marketers & Packagers**	**Post-processors Retailers Customers**
	Farmers & producers		**Millers**		
Indirect actors	**Financial institutions, Investors, Speculators, Buyers, Traders, Export agents, Advertisers**				

Normal environmental conditions for production

• Production is largely dependent on the timing and extent of rainfall with limited scope for irrigation. The price paid to farmers varies greatly from year to year based on rainfall and production. This complicates planning of production and investment.

• Maize can be grown in regions that receive annually more than 350 mm of rain and ideally between 450 and 600 mm.

• By the time it reaches maturity, a maize crop will have consumed 250 litres of water.

Changes in the weather that could affect production

• In the short and medium term, maize growers in existing production areas will be exposed to increasingly *variable weather* with more intense *dry* and *wet spells*, stronger *winds*, *high temperatures*, and more intense *rainfall, flooding, drought* conditions and *hail* events. These weather events are already damaging crops and making them more vulnerable to diseases.

• *Higher temperatures* combined with longer *dry* periods are expected to affect production by reducing yields. Maintaining yields will become increasingly difficult and the risks will be most acute in marginal areas.

• Due to seasonal disruptions, the timing of soil preparation and planting will become more difficult to anticipate. The uncertainty as to whether to plant maize at all will increase.

• *Pests and diseases* are expected to increase with climate variability. For example, the fall armyworm already threatens crops throughout the region, and the effects of climate change to the distribution and life-cycle of the armyworm are still unknown.

Main climate-related impacts affecting the value chain

• *Shifts in maize producing regions* will require an adjustment of the storage, transport and processing infrastructure that supports the industry. These shifts will lead to a *dislocation* between storage facilities and production areas, and to higher transport and operational costs.

• The impact of climate change will be felt across the entire maize value chain as *all actors*, both direct and indirect, face climate risks impacting negatively on their activities.

• Extreme events associated with climate change and variability may result in a higher post-harvest *risk of disease* and *losses* in maize storage and post-harvest handling.

• While *drought* is the major serious climate risk relating to production, *flooding* has serious impacts especially on transport and storage infrastructure.

• Increased *input costs* borne by farmers and by silo-owners will drive *prices* higher and possibly increase the risk of *competition* from imports.

• *Price increases* are not always directly borne by *consumers* of maize products, as *intermediate processors* and *manufacturers* using maize as raw material in their production can also be significantly affected.

• Any *risks* carried through to retailers will be reflected in the *price* and *supply* of maize meal. Since this is a staple food for many, any increases in price pose a serious threat to *food security*.

Resilience solutions

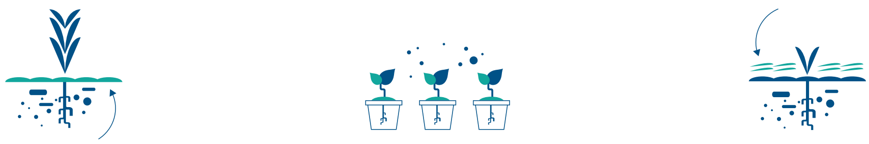
Identified resilience solutions in the maize sector in South Africa included cover crops, conservation agriculture, crop diversification and rotation, and on-farm grain silos and storage infrastructure.

Leading resilience solutions: *conservation agriculture and on-farm storage.*

Conservation agriculture

Conservation agriculture involves farming in line with the principles of minimum soil disturbance, reduced or no-till practices, establishing or maintaining organic soil cover, and implementing crop diversity or rotations, as opposed to monocultures. Conservation agriculture presents various *immediate benefits* and *co-benefits* in terms of improved soil fertility, lower use of chemicals, efficient water management and employment creation. In addition to reducing fixed costs (e.g. labour, machinery, fertilisers), conservation agriculture typically reduces or reverses soil degradation, reduces chemical pollution of water resources and soil, and sequesters CO_2 in the process. Other key benefits involve improved biodiversity, better weed control and the breaking of the disease and pest cycles.

The resilience solution was assessed using the ***B*Resilient Process Model (BRPM)***. The three processes involved in the application of conservation agriculture analysed included i) reduced till, ii) soil management, and iii) residue cover. Based on the BRPM analysis, conservation agriculture strengthens climate resilience by reducing the impacts of increased temperatures and crop stress due to climate change.



Resilience outcome	**Climate resilient agriculture production**		
Process Crop management	**Phase I Reduced till**	**Phase II Soil management**	**Phase III Residue cover**
Risks	Increased cost of equipment Unsuitable soil Lack of knowledge	Increased exposure to pests and diseases Reduced crop yields	Balance between livestock requirement and crop residue available
Actors	Farmers, Advisors	Farmers, Advisors	Farmers, Advisors
	Input providers	Input providers	
Options & Tools	Partial or full conversion Buy new or adapt existing equipment Training and guidance on the process and equipment required	Experimentation with various levels of intervention and pesticide/herbicide application Results from trial plots and extension advice	Trials and experimentation Results from trial plots and extension advice

Resilience contribution: Conservation agriculture can increase soil fertility by reducing fertiliser requirements. Conserved soils present less moisture loss and loss of carbon rich top-soils. In time, the farming system becomes less vulnerable to disease and drought. Ultimately, conservation agriculture can enable sustainable maize production in marginal production areas, sustained and more resilient yields in spite of adverse climate conditions.

> *"Farmers are seeing the value of crop rotation, but few understand the value of nitrogen fixing by planting non-traditional crops such as beans or other legumes."* ***Farmer, BRPM Workshop with Farmers***

Market opportunities: The uptake of conservation agriculture in South Africa remains low, at an estimated ~40% of the agriculture sector, and varies greatly across all agricultural crops. While there are no specific figures for the maize industry, the approach is mainly applied in the wheat industry. The uptake of conservation agriculture optimally results in higher profitability due to reduced input costs and higher production yields. A potential implication is that conservation agriculture can be useful in retaining viable maize production when other conditions become unsuitable. Moreover, the roll-out of conservation agriculture provides new business opportunities for various actors, such as providers of equipment and other services.

On-farm maize storage

Climate change, and particularly increased temperatures, will affect production and on-farm storage across the country. Low-cost on-farm maize storage can be used as an alternative to conventional silos to give farmers more flexibility over where they grow maize and the timing of delivery to processing plants. As investments in storage infrastructure are prohibitively expensive for most farmers, low-cost on-farm maize storage options offer maize farmers less exposure to price volatility and more flexibility to sell their production opportunistically at a time when prices are high.

The resilience solution was assessed using the ***B*Resilient Process Model*** (BRPM). The three processes involved in the application of on-farm storage in the form of silo bags and bunkers analysed included i) installation, ii) storage procedures, and iii) discharge and sales. Based on the BRPM analysis, the resilience outcome targeted of on-farm silo bags and bunkers is to provide improved storage options.

Resilience outcome	**Improved storage options**		
Process **Silo bags/bunkers**	**Phase I** **Installation of bags/bunkers**	**Phase II** **Storage procedures**	**Phase III** **Discharge and sales**
Risks	Increased cost of equipment Lack of knowledge of moisture requirements	Increased exposure to pests and diseases, especially with relation to moisture Reduced crop yields	Quality deterioration and timing of sales
Actors	Farmers Advisors	Farmers Advisors	Farmers Advisors
	Input providers	Input providers	
Options & Tools	Partial or full conversion Buy new or adapt existing equipment Training and guidance on the process and equipment required	Experimentation with various levels of intervention and pesticide/herbicide application Results from trial plots and extension advice	Trials and experimentation Results from trial plots and extension advice

Resilience contribution: As climate change is expected to create dislocations and disruption in the sector, on-farm storage options introduce new flexibility to the sector between where maize is grown, stored and processed.

Main challenges related to identified resilience solutions

- *Lack of knowledge*, skills and experience: Theoretical knowledge alone is not enough – farmers learn from years and years of experience. Developing farmers are mostly new entrants to a complex environment. With the profit margins being under extreme pressure, there is no margin for error.
- *Lack of production credit*: Developing farmers are finding it increasingly difficult to access production loans, as the profit margin is small and the risks are high.
- *Lack of adequate equipment*: Years of small profits have resulted in a decline in the condition of the fleet of tractors and implements. Continued mechanisation requires profitable operations.
- *Constraints of land and land access*: Crops have to be produced on land with adequate conditions that enable sufficient yields to cover production costs. Some farmers have access to lower production land where good yields are not possible. Many farmers are making use of communal land – often this is not adequately fenced, and livestock damage the crops, while theft of mature crops and equipment is an increasing problem. The small size of communal land poses challenges to efficient mechanisation.
- *Low resilience to climate variability and change*: New farmers do not often have the institutional memory or resources to cope with the inter-season variability and a setback in any specific year may require many years of recovery. Many do not have access to climate data and forecasts, and very few have any knowledge of the expected impacts of climate change, and possible responses.

> *"We are at the mercy of the traders. They know if we are lacking our own storage facilities, we have to sell, and they take advantage of that by offering us lower prices for grain and (where applicable) livestock."* ***Farmer, BRPM Workshop with Farmers***

Climate resilient business

BKB Grain Storage provides a wide range of storage-related services, including on-farm grain storage. BKB has depots throughout South Africa's grain producing areas and it stores and manages more than 500,000 tonnes of grain annually. BKB provides collateral management storage services for all types of agricultural products. Grain stocks are managed to ensure traceability and safeguard the quality of the product. BKB covers 50% of total non-silo grain storage and approximately 12% of total storage market, and it is a subsidiary of GrainCo, a company with an annual turnover of more than USD 144 million, servicing the grain market.

According to BKB, the main risks faced by traditional grain storage facilities relate to the significant uncertainty regarding the future of the sector, especially in terms of investments, pressure to reduce input costs, the shifting of crop suitability regions, aging infrastructure, and lack of capacity. In the context of climate change, changing and variable rainfall patterns threaten the business, as it affects supply of maize and often reduces yields. Some regions are experiencing a shorter harvest period, causing backlogs at storage facilities. Under very high temperatures, silo bags split while being emptied, causing wastage and extra cost. In some regions, there is an increasing amount of wet maize being delivered due to late rainfall.

Silo bags and bunkers, such as those offered by BKB, provide a solution in the form of cheaper capital outlay for suppliers and farmers, through lower capital investment and transportation costs. On-farm storage solutions provide flexibility that allows farmers to expand or contract sales as required by demand or fluctuating production levels due to weather-related events.

Carmen Lacambra

"Storage solutions are a solution for farmers because of cheaper capital outlay for suppliers and farmers, their flexibility, which allows farmers (and our company) to expand or contract our maize business as required by demand and by the weather related production. Silo-bags can be easily moved as maize producing areas shift, they require fewer skills to operate storage, lower transport costs, much lower capital investment and can be located at any suitable site in a short time."
Resilience Dialogue with BKB GrainCo