A Status Quo Review of Climate Change and the Agricultural Sector of the Western Cape Province

Brief for the Livestock Farming: Central Karoo
The SmartAgri project

Smart Agriculture for Climate Resilience (SmartAgri), a two-year project by the Western Cape Department of Agriculture and the Western Cape Department of Environmental Affairs & Development Planning, was launched in August 2014. SmartAgri responds to the need for a practical and relevant climate change response plan specifically for the agricultural sector of the Western Cape Province. By March 2016, the University of Cape Town’s African Climate and Development Initiative (ACDI) and a consortium will deliver a Framework and Implementation Plan which will guide and support the creation of greater resilience to climate change for farmers and agri-businesses across the province. The project will provide real and practical information and support, and inspire farmers in a manner which optimizes their decision making and ensures sustainability at a local level.

This brief was prepared for the livestock farming sector in the Central Karoo region. It summarises the findings of the Status Quo Review of Climate Change and Agriculture in the Western Cape Province. This study covers current climate risks and impacts across the sector and how risks and potential benefits are expected to shift under a changing climate. It also considers how climate risks and impacts can be reduced and managed. This is approached in the context of provincial economic and social development goals, and careful use of scarce and valuable natural resources.
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Climate change in the Central Karoo

As a result of global climatic changes, the Western Cape faces a warmer future. This poses serious threats to agricultural commodities in the province, including sheep, goats and beef cattle. Changes in annual rainfall as well as changes to the spatial distribution, seasonal cycles and extremes in rainfall are also likely, even if the extent and direction of these changes are still uncertain. The SmartAgri project is focusing on the planning and preparation needed in the agricultural sector in order to deal with this threat over the next 10–40 years.

Agricultural production is closely linked to climate and weather. These linkages are sometimes straightforward, for example seasonal total rainfall influencing rangeland productivity. More commonly they involve far more specific influences such as dry spell duration during spring or early summer. Higher temperatures are often tolerated as long as rainfall is sufficient. However, temperature sensitivities can be much more complex, for example the reduction in animal fertility and milk production brought about by a heat wave. Thus, a discussion of the impacts of climate change on agricultural production requires focused attention to specific threats to specific animals and at specific times in the seasonal cycle. In addition, local conditions such as production potential and microclimate influence the extent of the threat.

The Central Karoo is characterised by summer rainfall and a dry winter. Annual rainfall is very low across the region, although slightly higher in the Nelspoort area to the north-east. Summers are hot, particularly in the Koup area around Laingsburg, and winter nights are cold. This distinct climate, the soils and mountains gives rise to a particular agricultural production potential. The area is primarily suited to extensive production of sheep, goats and beef cattle, as well as some game, ostrich and rabbits.

The SmartAgri project is assessing three agro-climatic zones in the region, based on Relatively Homogeneous Farming Areas: Tankwa-van Wyksdorp (this brief focuses on the central and northern parts), Koup and Nelspoort (Figure 1).
How will the climate of these zones change into the future? Climate modelling studies show with a high degree of certainty (i.e. almost all the models agree) that the region will experience continued warming. Summer rainfall processes are also likely to change under a warmer climate. It is expected that higher temperatures and humidity will drive more intense summer convective (thunderstorm) rainfall events in the future. However, it is not yet clear whether the large scale circulation patterns that are also required for thunderstorm activity will become more or less frequent over the Western Cape in the future. Hence there remains uncertainty around changes in mean annual rainfall in the summer rainfall areas. Since the science is not yet able to provide absolute certainty, both increased and decreased rainfall should be considered by farming communities.
Already, the weather data shows that warming has occurred (on average approximately 1.0 °C over the last 50 years), primarily in mid- to late summer. In the Central Karoo, rainfall has increased in October and the summer months (December to February) in the period 1960-2012, and the number of rain days in these months has also increased. As yet there are no detectable trends in total annual rainfall in the Central Karoo.

Future increased temperatures are almost a certainty. The greatest increases over the province are likely to be inland. Expected increases in mean annual temperature across the province for mid-century are in the range of 1.5 °C to 3 °C, with the Central Karoo likely tending towards the upper part of this range. Both maximum and minimum temperatures will increase.

The Western Cape experiences regular flooding events, droughts and heat waves. These events have had significant impacts on farmers. Floods are the most common problem, causing most damage and costs for response and recovery. Many of the worst floods are caused by cut-off low weather systems. An increase in extreme rainfall events is likely which could increase the risk of flooding. This could have an impact on erosion, sedimentation of dams and flood damage, which are already threats in the area.

Figure 2. Observed (grey) and projected additional (lines and red) number of hot days (> 32°C) per month for Touwsrivier. Projections are for the 2040 – 2060 period and based on 11 different climate models.
Heat waves are expected to become more frequent. Figure 2 shows the monthly count of days exceeding 32 °C for Touwsrivier, as well as projected changes in the same statistic for mid-century. This shows that under current climate, very hot days are frequent in the summer and shoulder season months and that under climate change such occurrences will increase significantly.

During the serious drought of January 2009 - January 2011 the region’s farmers and workers suffered large losses. The sector remains vulnerable to disasters such as this, since drought relief funding for farmers is limited and there is a shortage of skilled expertise available for agricultural risk management.

The Central Karoo, with its erratic and low rainfall and low runoff, has only a moderate water storage capacity, and there is a high reliance on groundwater. This region is expected to be more responsive to either drying (negative) or wetting (positive) and shifting rainfall patterns (seasonality) than many other parts of the province. The low water storage capacity and heat stress renders it vulnerable to periods of low rainfall.
Climate change risks and impacts on extensive livestock production

The likely climate-related risk factors in the area include higher temperatures and more intense heat waves, more frequent and longer dry spells and droughts, more frequent and intense convective summer rainfall (thunderstorms), and higher frequency of heavy rainfall and flooding. Rising CO₂ levels in the atmosphere can counteract some of the negative impacts through stronger veld plant growth.

Extensive livestock production (cattle, sheep, goats and ostriches) will be primarily impacted by rangeland vegetation changes, changes in the distribution of pests and diseases and water availability. Climate change is expected to worsen the condition of already degraded and marginal rangelands through further loss of vegetation and erosion. Soil degradation affects some commercial grazing areas in the Central Karoo, particularly the Tankwa. Range management can either increase or decrease the negative impacts of climate change on rangelands. Subsistence, emerging and smallholder farming systems are expected to be at high risk due to the high dependency on rainfed natural pastures, and fewer capital resources and management technologies available to farmers.

Livestock, especially the *Bos taurus* cattle breeds, are sensitive to heat stress which will become more frequent in future. Sheep and beef cattle could be at risk of reduced growth and reproduction performance, reduced meat yield and quality, reduced wool production and quality, and increased deaths and illnesses, due to heat and nutrition stress. These impacts are likely to be lower in sheep compared to cattle, and lowest in goats.

Owing to their low feed and water requirements, ability to utilise low quality forage, ability to browse and disease resistance, goats are likely to cope with, and adapt to, hot and dry conditions expected in the Western Cape compared to sheep. However, mohair goats such as the Angora breed may be susceptible to thermal and nutritional stress due to their high nutritional requirements for fibre production. In support of this prediction, a study conducted in the areas of Eastern Cape Province with similar conditions with those found in Koup and Tankwa-Van Wyksdorp showed that Angora goats inhabiting a desertified landscape were more water dependent and more susceptible to thermal stresses imposed by shearing in their environment than were those inhabiting a pre-desertified landscape.

Climate change is likely to have implications for the wool industry in the Western Cape, principally through its effects on growth performance, animal health, forage and water resources. The combination of these effects is likely to have an impact on wool production and quality. A reduced productivity in marginal areas (Koup, Tankwa- Van Wyksdorp) is likely. Changes in climate could increase plant and dust contamination and induce changes in mean fibre diameter and staple strength.
One of the expected potential benefits of climate change in the Western Cape is a decrease in the statistical probability of small ruminant losses due to cold, wet weather after shearing. However, if fleeced animals are not acclimated or acclimatized to cold, they may actually become more susceptible to cold stress after shearing in a warmer future. For example, in March 2007 an estimated 20,000 Angora goats died in the Eastern Cape during a cold, wet spell following shearing in late summer.

Extensive ostrich production requires significant hectarage of land. This is mainly marginal (semi-arid) land where the environment is very sensitive to disruptions of any form. It is in these areas where the impact of climate change is likely to be felt. Where stocking rates are inappropriately high, ostriches can lead to rapid rangeland deterioration, often exacerbated by poor management of water resources.

The ostrich is one of the most heat tolerant farmed animals but excessively high temperatures will likely affect productivity particularly in the growth of younger birds. Fertility is also adversely affected by high ambient temperatures. The ability to provide affordable forage and feed to the ostrich industry will remain one of the biggest challenges of the industry.

The impacts on rural communities need to be considered. Adverse impacts on the sector and the employment it offers could heighten levels of poverty, drive urbanisation, and increase food insecurity. The well-being of agricultural workers is likely to be affected by increasing heat stress, diseases associated with floods and poor water quality, and physical danger associated with storms, floods and fires. Poor nutritional status and other health threats (stunting, obesity, HIV/AIDS) prevalent in the region render rural workers less resilient to the demands of labour under stressful conditions.

There is a clear relationship between workplace heat conditions and economic performance. Beyond a certain heat exposure level (temperature beyond 30-40 °C, depending on humidity level) the hourly work capacity goes down. Outdoor work is particularly affected by hot climate conditions due to the extra heat load from solar radiation. The north-western areas of the province and parts of the Central Karoo are at highest risk.

The following table summarises key sensitivities for each agro-climatic zone:
Table 1. Summary table of climate change sensitivities for each agro-climatic zone in the Central Karoo.

<table>
<thead>
<tr>
<th>Name</th>
<th>Main water resource features</th>
<th>Main climatic features</th>
<th>Climate change temperature projections¹</th>
<th>Main commodities</th>
<th>Future agricultural potential²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koup</td>
<td>Few episodic rivers, medium storage capacity, use of groundwater</td>
<td>Very dry, very hot, cold winter minimum temperature</td>
<td>High range warming</td>
<td>Olives, vegetables and vegetable seed</td>
<td>Slowly declining productivity, constrained by heat</td>
</tr>
<tr>
<td>Nelspoort</td>
<td>Few episodic rivers, low storage capacity, use of groundwater</td>
<td>Hot summers, cold winter minimum temperatures, low rainfall in summer</td>
<td>High range warming</td>
<td>Cattle, sheep, goats, ostrich</td>
<td>Depends on rangeland changes, constrained by heat and water</td>
</tr>
<tr>
<td>Tankwa-Van Wyksdorp</td>
<td>Medium storage capacity, use of groundwater</td>
<td>Very hot and very dry; cold winter minimum temperature</td>
<td>Medium to high range warming</td>
<td>Wheat, stone fruit, wine grapes</td>
<td>Slowly declining productivity, constrained by heat and water</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sheep, goats, pigs, cattle, game, ostrich,</td>
<td></td>
</tr>
</tbody>
</table>

¹ Due to model uncertainties both decreasing and increasing rainfall scenarios should be considered
² For the medium term future 2040-2060
Natural resource use and management

Many of the impacts of climate change on agriculture show strong linkages with the ecological system and the natural resources which provide the means for farming. In the Central Karoo, the most important factors and threats to consider are water supply, fundamental shifts in biomes and thus grazing potential, predators, and biodiversity loss. All are expected to become worse under climate change.

Water resources

Water resources are already stressed due to the low rainfall and reliance on storage capacity and groundwater. Climate change is likely to increase this stress through increasing evapotranspiration, more variable rainfall and increasing demand by livestock. Studies on the groundwater resource and its usage show that the groundwater stress index is very high in the Koup area between Beaufort West, Merweville and Laingsburg. This indicates unsustainable rates of extraction.

Options to increase water supply, such as water conservation and demand management and possible re-use, will also need to be developed.

Compared to the highly developed and integrated water supply system for the greater Cape Town area which provides a reasonable degree of resilience to potential climate change impacts for this main demand centre, the less well integrated water supply systems of the Central Karoo will likely be more vulnerable to climate change impacts.

Biodiversity and ecosystems

Healthy ecosystems connected to working landscapes are the foundation for clean air and water, fertile soil and food production. They provide an immensely valuable role in buffering agriculture from the worst effects of climate variability and climate change, provide opportunities for adaptation, and provide sinks for the absorption of carbon dioxide.

Research suggests that the south-eastern parts of the Nama Karoo Biome could become replaced in the future by Albany Thicket (under the low-risk scenario) and the south-western parts in the dry Koup area could become replaced by Desert (under the high-risk scenario). However, there remains substantial uncertainty in these projections due to poorly understood effects of seasonal changes in rainfall and the effects of rising atmospheric CO₂.

The region contains ecosystems which are well adapted to the high climate variability, but which are also used for productive purposes, so that farming practices have a great impact on the long-term resilience of the landscape. A number of species such as the Cape Vulture, some Bustards and Korhaans, and the Riverine Rabbit are threatened or vulnerable, in part through contact with agro-chemicals and habitat loss.
The dynamics between wild animals and agriculture become heightened during times of climatic stress such as extended drought. Poor availability of prey and water drive wild animals to closer proximity to farmlands in search of food and water. Farmers then take harsh measures and population declines can take many years to recover following such events, causing predator-prey imbalances and further impacts on ecosystems.

Predators such as black-backed jackal, caracal, leopard and chacma baboons are a major challenge to farmers in the Central Karoo. The Predation Management Forum (PMF) provides guidelines and advice to producers to manage predation in the most humane and environmentally sustainable manner, i.e. guide producers to integrated management. It serves as a platform for liaison and coordination of activities of commodity organisations in the livestock and game ranching sectors, aimed at reducing losses incurred as a result of predation. The predator problem is highly significant in parts of the Western Cape but no research is available on possible linkages to climate variability and climate change.

A climate resilient sector in the Central Karoo

Responding to climate-related risks involves decision-making in a changing but uncertain world. The agricultural sector of the Western Cape is adapting by responding to the demands posed by current climate variability and extremes in the context of other equally challenging socio-economic drivers and pressures. Irrespective of production system, location or resource status, if producers and their value chain have access to a wider choice of appropriate options, they are able to innovate and improve their practices tailored to their own situation and needs.

In the agricultural sector, technology plays an important part in productive potential and ability to adapt. It includes physical infrastructure, machinery and equipment (hardware), knowledge and skills (software), the capacity to organise and use all of these (orgware), as well as the biological technology with which farmers produce.

For farmers in the Central Karoo, flexible adaptation options are available for all farming systems and commodities which, combined with the fertilising effects of rising atmospheric CO₂, could provide some resilience to warming of up to ~+2 °C. Additionally, planning for droughts and floods is essential.

The critical element in this region is security of water for agricultural use and an increase in water sources to account for rising demand in future. Farming practices will focus increasingly on conserving soil moisture and maintaining soil cover.
For livestock farmers, choice of species and breed is the primary adaptation already being used. A range of breeds are available which are more heat and drought tolerant, and more resistant to diseases and parasites. Provision of alternative supplements can reduce the effects of heat stress. In low rainfall areas or during periods of low rainfall, farmers are making use of bought-in commercial dietary supplements (e.g., poultry litter, urea blocks/licks), cultivated pastures (rain-fed or irrigated) and conserved forages (silage, hay, foggage, crop residues). There are also prospects for using novel feeds from various sources such as horticultural crop residues, winery by-products, insects and worms to provide alternative sources of energy and protein for livestock. Other farmers are reducing livestock numbers (destocking), changing livestock composition, diversifying, altering the timing of operations, modifying stock routings and distances, adjusting stocking densities/rates, practicing rotational grazing and multi-species grazing, reseeding rangelands with improved grasses and legumes to cope with drought and long dry spells, and improving water management. In addition, animal health monitoring and management can be stepped up. Reductions in heat stress can be achieved through the provision of shade for animals, especially those which are more vulnerable such as the young and ill.

In all cases marketing and processing options should be re-evaluated on a continuous basis in order to optimise the opportunities presented by local shifts in production and shifting global markets.
Energy use and reducing greenhouse gas emissions from agriculture

The generation of electricity and the use of liquid fossil fuels such as diesel leads to greenhouse gas emissions which cause climate change, but energy is an essential input in agricultural production and processing. In the Western Cape the sector is responsible for 2% of energy use and 5% of greenhouse gas emissions. Estimates suggest that the livestock sub-sector is accountable for approximately 16% of provincial agricultural emissions (highest contribution from cattle), grains and field crops for 28% (highest contribution from wheat), fruit and wine for 55% (highest contributions from pome fruit and wine grapes) and other commodities for 1%.

The economic competitiveness of the agricultural sector must be maintained and increased. One component of this is to ensure local and international acceptability of agricultural products from the province by minimising the environmental impact of their production and complying with agreed standards for energy use and emissions. Some farmers are already measuring their ‘carbon footprint’ and implementing measures to reduce it. This can be done either by reducing energy consumption and switching to renewable (non-fossil) energy sources such as wind or solar, or by absorbing carbon through land-based farming methods.

There are six principal options in the Western Cape:

- Restoration of grasslands,
- reducing land degradation,
- conservation agriculture,
- improving energy efficiency at a farm and packhouse level,
- production of bioethanol,
- production of electricity through anaerobic biogas digestion using organic waste such as cattle manure.

Apart from conservation agriculture which is already widely adopted in the Western Cape, the other options are still in their infancy. Both the implementation of anaerobic biogas digestion and bioethanol provide a means of processing waste streams from the agricultural sector in a way that generates energy, leads to a net reduction in greenhouse gas emissions, and reduces potential water and soil pollution. A number of the other options also provide combined benefits for emissions reductions and adaptation.
Key actions which farmers can implement

What are key actions farmers in the Central Karoo can take to be able to respond effectively to existing climate risks and projected climatic changes? The following priorities were highlighted by the status quo assessment and by regional farmers attending the stakeholder workshop:

1. **Implement best practice grazing management and protection of soil resources.** The overgrazing in some parts of the Central Karoo by sheep and goats must be halted and the land rehabilitated in order to restore its productive potential. All farmers should implement soil erosion measures and sustainable grazing management practices. Land use decisions for marginal lands should be made carefully. The importance of biological diversity and organic carbon within soils needs to be better understood, and farming practices implemented which increase the water holding capacity of the soils.

2. **Improved management of water resources and maintenance of on-farm water infrastructure** to optimise water use efficiency, reduce water losses in the system, and preserve and restore good water quality. Water infrastructure must be well maintained to prevent losses and crises in times of drought. Catchments require conservation and good management – maintain the necessary buffer of unfarmed and undisturbed land between riverbanks and the cultivated lands, and do whatever is possible to clear alien invasive plants along river courses. Do not overextract groundwater. Regular monitoring of surface and groundwater resources should inform maximum extraction rates.

3. **Become well informed on best practices for predator prevention and control in your farming area** and play an active role within the wider community and in partnership with conservation agencies in order to find sustainable solutions to this problem.

4. **Identify and use crop and livestock species/cultivars and breeds which exhibit resilience to drought, heat and saline water.** Develop production methods to optimise production and income on low levels of external inputs and natural resources by using suitable genetic material.

5. **Natural hazards and pest and disease outbreaks pose a high risk in some parts of the region and pro-active risk management should be practiced by farmers.** These should include learning from established long-term experience of dealing with droughts, better holistic flood and drought planning by all role players (farmers and government in partnership), and excellent monitoring and rapid response to disease outbreaks. In the future, the development of early warning systems relating to pests and diseases will be critical.
Further information on all these responses and opportunities, and others, can be found on the GreenAgri information portal: http://www.greenagri.org.za
Conclusion and way forward

The Western Cape agriculture sector is faced with numerous difficulties and climate change will exert its influence in the context of multiple interacting drivers and pressure points. It can thus be regarded as a stress multiplier. Agriculture is highly dependent on effective risk management covering economic, environmental and social sustainability.

All farms in the Central Karoo region can experience exposure to variable and extreme weather, but some are able to draw on resources and skills to ‘bounce back’ relatively unscathed, whereas others never fully recover and become morbid or fail. Economies of scale and diversification across commodities and agro-climatic zones renders larger farming groups with greater resources much more resilient than small, undiversified and resource-poor farming operations. A shift to more resilient animal species/breeds and farming systems (climate smart agriculture) can buffer agriculture against some aridification without negatively impacting profitability or jobs.

Nevertheless, there will be ‘winners’ and ‘losers’ and the sector together with government needs to identify the latter and jointly provide support. The SmartAgri project is currently developing the Climate Change Response Framework and Implementation Plan for the province, which will provide the mechanisms for such support. We warmly invite comment on the issues summarised in this brief, and the needs of farmers and other role players in responding to climate change.

Contact us:

To find out more or send comments or questions please visit www.greenagri.org.za.
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