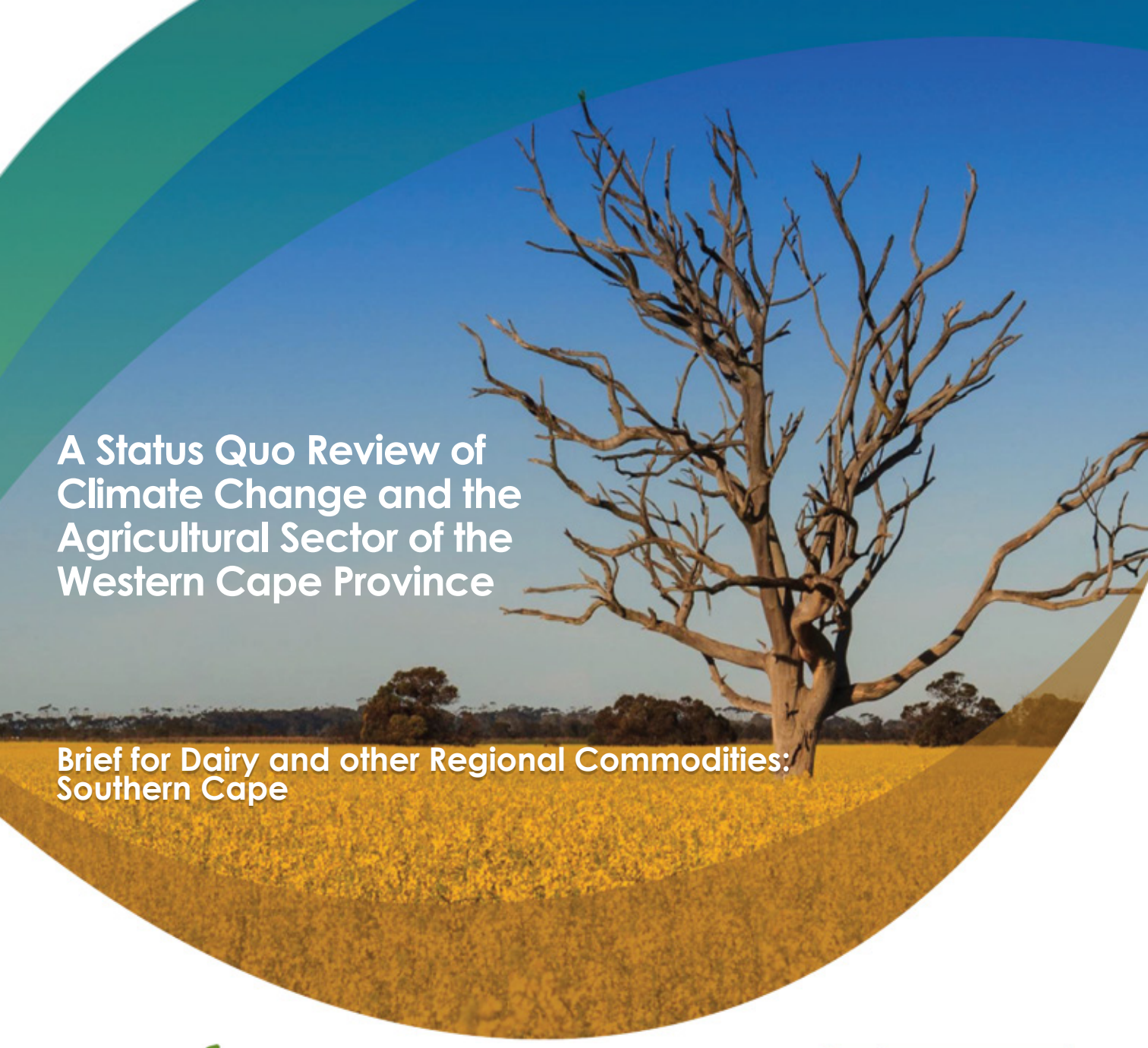

A Status Quo Review of Climate Change and the Agricultural Sector of the Western Cape Province

Brief for Dairy and other Regional Commodities: Southern Cape

SMART Agri

ACDI African Climate & Development Initiative

Western Cape Government

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 dairy and other regional commodities in the Southern Cape 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.

Contents

Climate change in the Southern Cape

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 dairy cattle and the range of other livestock and crops found in this region. 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 wheat yield. More commonly they involve far more specific influences such as dry spell duration during the germination phase, or rainfall during the harvesting period. Higher temperatures are often tolerated as long as rainfall is sufficient. However, temperature sensitivities can be much more complex, for example the reduction in fertility brought about by a heat wave, both in crops and livestock. Thus, a discussion of the impacts of climate change on agricultural production requires focused attention to specific threats to specific crops/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 Southern Cape is characterised by a transition to all-year rainfall with peaks in spring and autumn. This distinct climate, together with the ocean influence, soils and mountains, gives rise to a mosaic of agricultural production potential. The area is suited to rainfed and irrigated pastures for beef and dairy cattle, and a range of fruit and vegetable crops. The western part around Mossel Bay – Herbertsdale is drier and warmer with more erratic rainfall, primarily in winter, and occasional summer rains. Irrigation is used wherever possible to supplement rainfall. The soils are generally poor. Eastwards in the area between Groot Brak and Plettenberg Bay rainfall is spread more evenly through the year. The southern slopes of the Outeniqua mountain range enjoy relatively high rainfall and are cooler. Relative to other regions of the province the Southern Cape has a very mild climate. However, rainfall extremes are common and the region suffers from dry spells and floods.

The SmartAgri project is assessing three agro-climatic zones in the region, based on Relatively Homogeneous Farming Areas: Mossel Bay-Herbertsdale, Groot Brak-Plett, and Bo-Langkloof-Outeniqua (with emphasis on the moister southern slopes)(Figure 1).

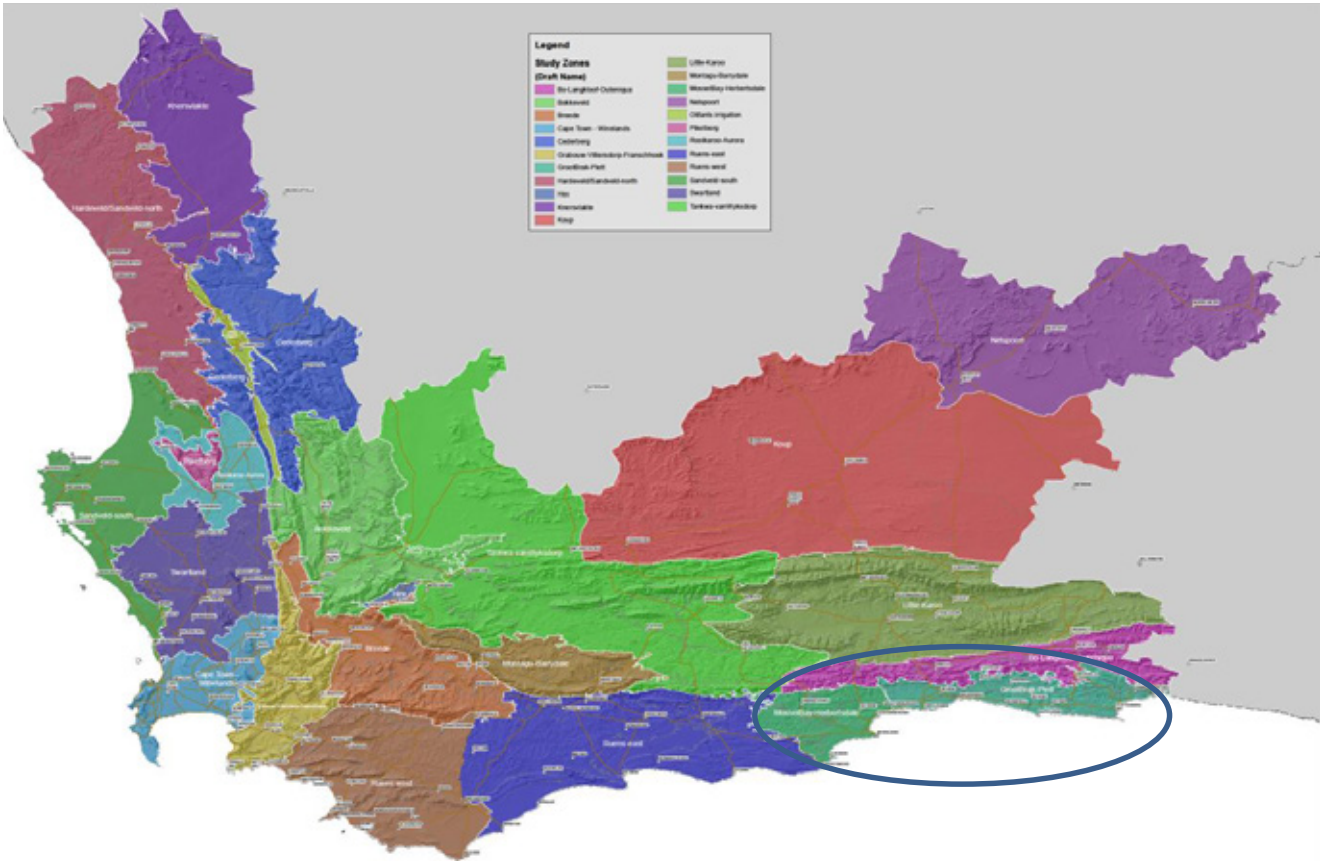

Figure 1. Map of the Western Cape Province showing the 23 agro-climatic zones used in the SmartAgri project, and the Southern Cape region (circle).

How will the climate of these zones change into the future? Climate modeling studies show with a high degree of certainty (i.e. almost all the models agree) that the western parts of the province will experience continued warming and reductions in winter rainfall by mid-century and thereafter. Some models indicate a higher probability of overall wetting in the Southern Cape, especially in the mid-summer months. The influence of the mountains and ocean will lead to more complex results at local level, particularly for rainfall. In the short term, these influences could lead to increased rainfall on the windward mountain slopes, and a higher frequency of intense rainfall events in spring and summer, for example. Future changes in total annual rainfall will depend strongly on the strength of various system responses to the changing global climate. Since the science is not yet able to provide absolute certainty, both increased and decreased rainfall should be considered by farming communities, particularly in the east of the province.

Already, the weather data shows that warming has occurred (on average approximately 1.0 °C over the last 50 years), particularly in mid- to late summer, with a decrease in annual rain days, particularly in autumn, in the Southern Cape. This trend is also perceived by the farming community according to information given during stakeholder workshops. As yet there are no detectable trends in total rainfall in the Southern Cape.

Future increased temperatures are almost a certainty. The greatest increases are likely to be inland and the lowest increases along the coast indicating a moderating effect from the Indian Ocean. 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 coastal Southern Cape likely tending towards the lower 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. Between 2003 and 2008 six significant costly flooding events occurred in the Southern Cape (Eden District Municipality) as a result of 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.

Heat waves are expected to become a larger feature than they are currently in the Southern Cape. Figure 2 shows the monthly count of days exceeding 32 °C for Mossel Bay, as well as projected changes in the same statistic for mid-century. This shows that under current climate, very hot days are very infrequent and that under climate change such occurrences are likely to increase to a small degree. Some climate models project a decreasing number of hot days in certain months.

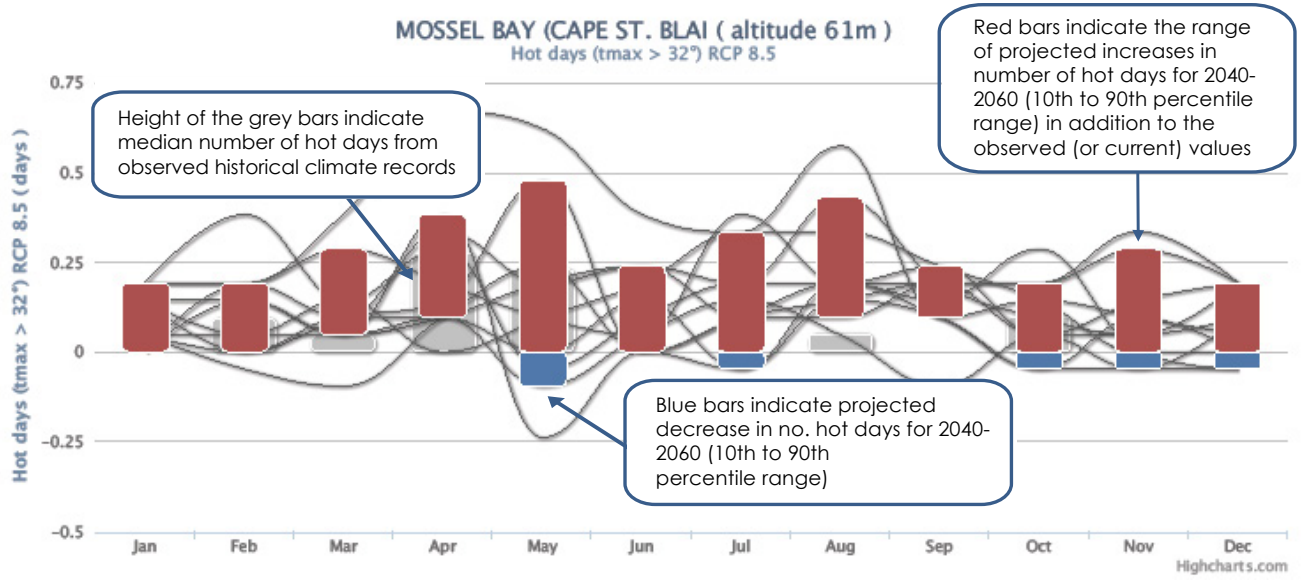

Figure 2. Observed (grey) and projected possible range of increase (red) or decrease (blue) in number of hot days (> 32°C) per month for Mossel Bay. Projections are for the 2040 – 2060 period and based on 11 different climate models.

During the serious drought of January 2009 - January 2011 the vegetable farmers in the Southern Cape 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.

In the three agro-climatic zones studied, the western Mossel Bay-Herbertsdale area lies in a climatic transition area between winter and year-round rainfall, and has low water storage capacity. This area is expected to be more responsive to either drying (negative) or wetting (positive) and shifting rainfall patterns (seasonality) than the areas to the east. Cooler and moister areas such as the southern mountain slopes (Outeniqua range) will likely be somewhat buffered to warmer/drier conditions, but exposed to heavy rainfall events. The low water storage capacity across the region renders it vulnerable to periods of low rainfall.

Climate change risks and impacts on dairy farming and other regional commodities

Farming in the Southern Cape is sensitive to higher temperatures, more frequent and longer dry spells, reduced seasonal rainfall, higher frequency of heavy rainfall and flooding, more frequent summer rainfall, an increase in hot wet days during the growth period which leads to a higher risk of diseases, and rising CO_2 levels. There may also be opportunities: under some climate change scenarios, commodities which currently dominate the warmer regions of the south-western Cape, such as fruit and wine, could become more suited to the Southern Cape.

Livestock

The impacts of climate change on dairy farming will depend indirectly on the way pastures respond to warming and shifting rainfall patterns, and the availability of water for irrigated pastures. Irrigation requirements for pastures are set to increase under conditions of increased temperature. This poses a threat to dairy farming in the area which relies on irrigation.

Direct effects on dairy cattle are also expected. These include increasing heat and nutrition stress, changes in the distribution of pests and diseases, and changes in water availability. Dairy cattle are more sensitive than other cattle breeds to heat and nutrition stress, which reduces milk production and fertility.

Other livestock reared in the Southern Cape include sheep (especially in the drier Mossel Bay area), beef cattle and ostriches. All could be at risk of reduced growth and reproduction performance, reduced meat yield and quality, and increased illnesses, due to heat and nutrition stress. These impacts are likely to be lower in sheep and ostriches compared to cattle. However, impacts of climate change on these animals are likely to be small to moderate until the mid-century.

Hop

Hop farms are primarily located in two catchments on the interior of the Outeniqua Mountains, just inland of the town of George. The plants require cold winters and long summer days (sunlight), and although this area is the best in the country it is marginal on both counts compared to global production regions. Most of the varieties grown commercially have been bred in George for the local climatic conditions.

Climate impacts on hop farming operations in this area appear to be mainly manifested through changes in temperature and resulting impacts on water demand and availability. Droughts will have serious repercussions. Under climate change projections, farmers would need to apply at least 60 m^3 more water per hectare in the period September to February. Current surface water storage will not be able to supply this and water will need to be accessed from groundwater resources.

Other impacts of projected temperature changes will include a 50% increase in the risk of the occurrence of significant fires. High frequency of fires will increase erosion risks and worsen the sedimentation of already shallow farm dams. Fire risk will also be heightened by invasive alien trees. The catchments in which hop is grown are currently heavily infested with invasive alien trees, reducing mean annual runoff by 13-20 %. Without any intervention and with the added effects of climate change these trees will continue to spread and have an increasingly detrimental impact on water yields.

The industry is currently 100 % disease-free and local hop varieties have limited resistance to diseases. No spraying programmes are in place should an outbreak occur, and this could turn into a major risk. The potential impacts of shifting and new diseases under climate change for hop production in the Southern Cape is not known.

Honeybush

The Honeybush species used commercially are indigenous within the coastal belt from the West Coast to Port Elizabeth, primarily within 50 km of the ocean. A number of harvesting and processing operations are found in the Groot Brak-Plett and Bo-Langkloof-Outeniqua regions.

The physical requirements of suitable habitat (in decreasing order of importance) are soil type, rainfall, aspect, elevation above sea level, and temperature. Research into honeybush is in its infancy and no work has been done to assess the possible impacts of climate change. The fact that soil type is so important could limit the potential of honeybush to migrate to, or be cultivated in climatically suitable areas in future. However, the milder climatic changes projected for the coastal regions and for the southern Cape could confer resilience on this crop.

Other crops grown in the Southern Cape which will be impacted by climate change include apples and pears, peaches, nuts, vegetables, berries, cutflowers and winter grains (wheat, barley and canola). Extreme weather and insufficient soil moisture and water for irrigation would cause the greatest damage to crop farming in general.

The impacts on rural communities need to be considered. Adverse impacts on the sector and its extensive value chain, 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 agricultural labour under stressful conditions.

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 Southern Cape.

Name	Main water resource features	Main climatic features	Climate change temperature projections [1]	Main commodities	Socio-economic features	Future agricultural potential [2]
Bo-Langkloof-Outeniqua	Dams, insufficient storage capacity, use of groundwater	Rainfall throughout the year with spring and autumn peaks; recent floods, droughts and fires	Low to medium range warming	Pome fruit, hops, wheat Cattle, sheep, goats	High unemployment, poverty	Increasingly marginal, constrained by water availability and extremes
Groot Brak-Plett	Rivers, low storage capacity	Rainfall throughout the year, relatively wet	Low range warming	Wheat, barley, vegetables Dairy, cattle, egg layers	High unemployment, poverty	Possibly less productive but depends on rainfall shifts
Mossel Bay-Herbertsdale	Rivers, low storage capacity	Mostly winter rainfall, but occasional rain in summer, cool with onshore wind in summer	Low range warming	Wheat, barley, canola, berries Dairy, ostrich, pigs, cattle, sheep		Transition area, productivity could improve with more irrigation capacity

[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 Southern Cape, the most important factors and threats to consider are water supply and demand by numerous competing users, fire risk, invasive alien plant infestations, and biodiversity loss. All are expected to become worse under climate change.

Water resources

Water resources are already stressed with low level of assurance for agricultural use. Climate change is likely to increase this stress through increasing evapotranspiration, more variable rainfall and increasing crop demand. However, the probability for increasing rainfall shown by some climate models means that the future of this region could take on many forms, both positive and negative.

Crop irrigation accounts for a high proportion of water use (61%) in the Gouritz Water Management Area (WMA). For this component of production, water storage capacity and maintenance of infrastructure are essential. The protection and management of high-yielding catchments and flow-regulating wetlands and river banks upstream of farmlands is critical for the optimisation of water flows serving agriculture. Options to increase water supply, such as water conservation and demand management through improved irrigation efficiencies, 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 Southern Cape will likely be more vulnerable to climate change impacts.

This region had a shortfall in surface water sources of around 64 million m^3/a (2005 data) of which 43 million m^3/a occurred between Mossel Bay and Nature's Valley. Since then, there have been a number of projects implemented in the coastal catchments towards alleviating the water shortages in that area particularly around the towns of Mossel Bay, Knysna and Sedgefield. Drought management planning is very important.

Opinion has been expressed by the farmers that building new dams will allow for infrequent floods to be captured rather than losing the water downstream. However, the erratic nature of rainfall and related sporadic runoff is unlikely to allow such dams to routinely fill, further adding to the unit cost of water from new dams. New dams will therefore not necessarily increase assurance of supply.

Groundwater plays a significant role in the southern portion of the WMA in terms of providing base flow to river systems, particularly in the George and Knysna areas. Increased groundwater abstraction from aquifers along the coast is also taking place and the correct operation and management of this abstraction is critical to avoid saline intrusion. Options for artificial recharge using treated effluent have been investigated and this has shown potential.

A recent study of the potential impacts of climate change on floods in South Africa showed a high level of variability over time and geographically. Of interest here is that one of the models shows a significant increase in the flooding risk in the Southern Cape region.

Climate change is expected to affect the way in which pollutants reduce the quality of water resources. Increased rainfall amounts and intensity could increase the organic load to rivers and streams, particularly in areas of intensive dairy farming and dairy processing industries such as around George and Kareedouw.

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.

The region contains ecosystems with exceptional biodiversity, some of which is under threat from extensive land transformation. Other threats to ecosystems within or surrounding farmlands include destruction of riverbanks and wetlands, which act as flow regulators and drought buffers. The coastal areas of the Southern Cape have a high density and total area of important wetlands, many threatened by agriculture. Freshwater ecosystems are sensitive to climate change when also impacted by intensive agriculture such as large dairies, chicken batteries and piggeries. In turn, a minimum water quality is required for livestock in order to meet hygiene standards and prevent disease outbreaks.

Invasive alien plants and wildfires are expected to become more problematic under climate change. Research shows that under climate change trees will grow more strongly, including alien invasive species. This will potentially allow them to become dominant in areas that are currently grassland, an outcome which seems likely for the Southern Cape.

High fire risk conditions are projected to increase by between 40 % and 300 % from the western to the eastern parts of the province with rising risks to crops, livestock and farming infrastructure. Future shifts in agricultural climatic potential could come up against restrictions on land conversion imposed by conservation requirements.

A climate resilient sector in the Southern Cape

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 Southern Cape, flexible adaptation options are available for all farming systems and commodities which, combined with the fertilising effects of rising atmospheric CO_2 , could provide sufficient resilience to warming of up to ~+2 °C. Additionally, planning for droughts and floods is essential.

The critical element in this region for both crops and livestock is security of water for agricultural use and an increase in water sources to account for rising demand in future. In the case of irrigated agriculture, threats can arise through malfunctioning water storage infrastructure and irrigation systems, as well as increasing competition from other water users such as growing settlements, particularly in times of drought. Farming practices will focus increasingly on conserving soil moisture.

For livestock farmers, choice of breed is the primary adaptation already being used. A range of breeds/species 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 and conserved forages (silage, hay, foggage, crop residues). There are also prospects for using novel feeds from various sources such as horticultural crop residues, insects and worms to provide alternative sources of energy and protein for livestock. Other options include stock and grazing management, reseeding pastures 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.

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 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. 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 Southern Cape 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 farming practices which protect the soil. More farmers in the region should adopt conservation agriculture practices and move towards the improvement of soil health by reducing the use of herbicides, pesticides and fertilisers. Conservation agriculture also increases the soil water holding capacity and the soil organic carbon content and biodiversity. It is also important to implement soil erosion measures which are effective under conditions of drought and flood.

2. Manage the production and use of pastures, including conservation of fodder, to allow for multi-year planning of fodder flow, which will provide resilience when rainfall and yields are very variable.

3. Improve the 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 and wetlands require conservation and good management – maintain the necessary buffer of unfarmed and undisturbed land between riverbanks / wetlands and the cultivated lands. Do not overextract groundwater. Form partnerships with neighbours and local government for better holistic drought and flood planning (pro-active risk management), monitoring and effective response.

4. Continue or get involved in the **clearing of alien invasive plants,** especially in the catchment areas of the mountains and foothills and along river courses. Considerable volumes of water begin to flow again when dense stands of the plants have been removed. It is also important to follow up on the clearing. Linked to this is the management of fire loads through alien clearing and firebreak maintenance, another example of **pro-active risk management.**

5. The energy crisis and climate change are both driving the need for **increased efficiencies of energy** use and **the greater use of renewable energy** on-farm. Farmers who need energy for irrigation pumping and for dairy operations and maintenance of the cold chain for perishable produce are particularly vulnerable. The use of variable speed pumps and strategic irrigation scheduling can reduce pumping costs (and water use) significantly. Farmers can install photovoltaic systems on the roofs of farm buildings (e.g. sheds, packhouses), or attached to water pumps, to increase reliability of supply, bring down costs, and simultaneously reduce the carbon footprint of the farm operations.

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 across the value chain.

All farms in the Southern Cape 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 crop types 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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