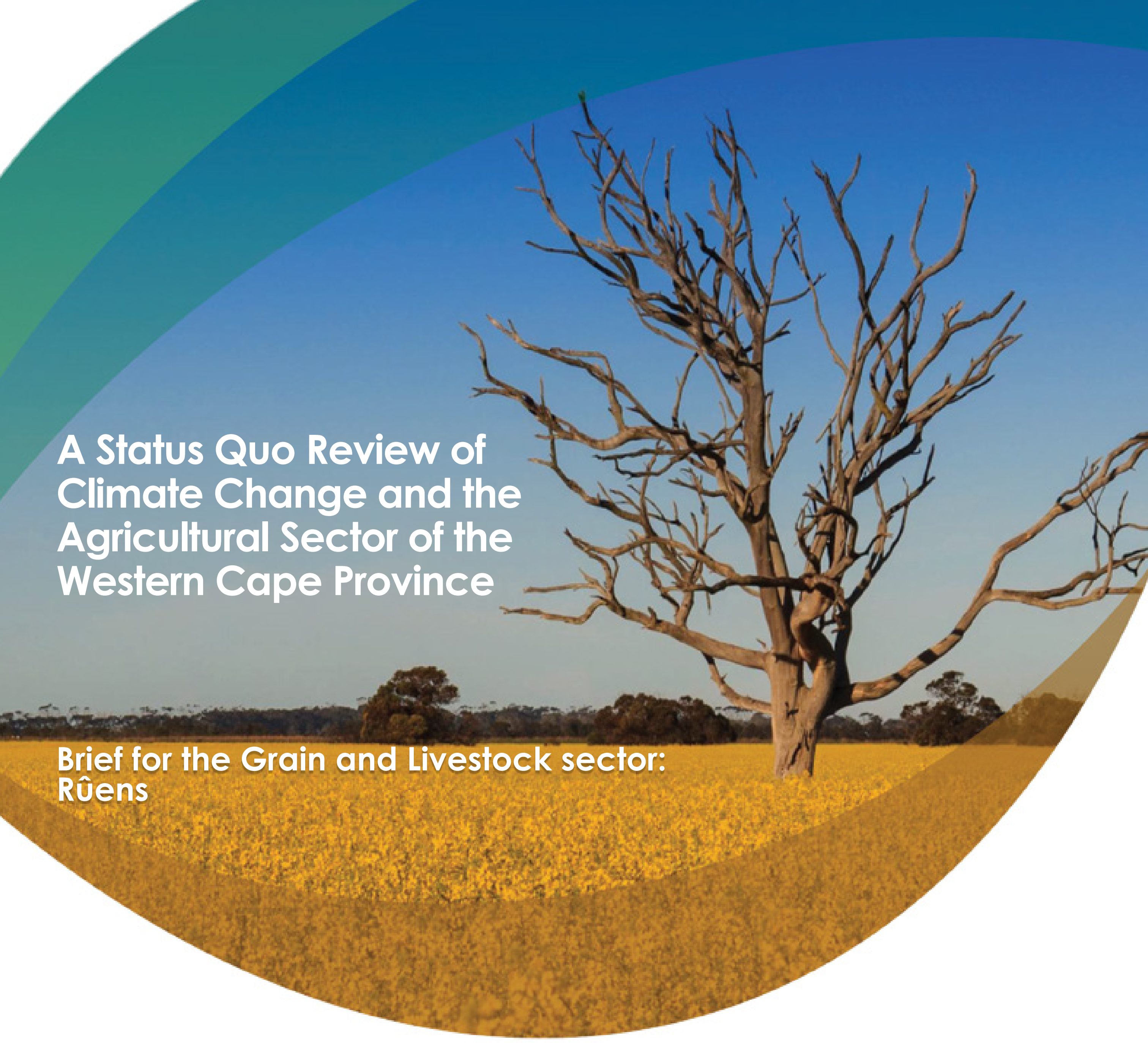

A Status Quo Review of Climate Change and the Agricultural Sector of the Western Cape Province

Brief for the Grain and Livestock sector: Rûens

SMARTAgri

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 the grain and livestock farming sub-sector of the Rûens 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 details 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 Rûens

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 winter grains, sheep 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 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 fertilisation brought about by a heat wave during flowering. Thus, a discussion of the impacts of climate change on agricultural production requires focused attention to specific threats to specific crops 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 climate of the Rûens area is diverse. This gives rise, together with the ocean influence, soils and mountains, to a rich mosaic of agricultural production potential. Production potential for winter grains and livestock is greatest in the western Rûens around Caledon and gradually decreases eastwards towards Mossel Bay as a result of lower and more erratic rainfall and higher temperatures. However, relative to other regions of the province the Rûens enjoys relatively mild temperatures.

The SmartAgri project is assessing two agro-climatic zones in the region, based on Relatively Homogeneous Farming Areas: Rûens-west and Rûens-east (Figure 1).

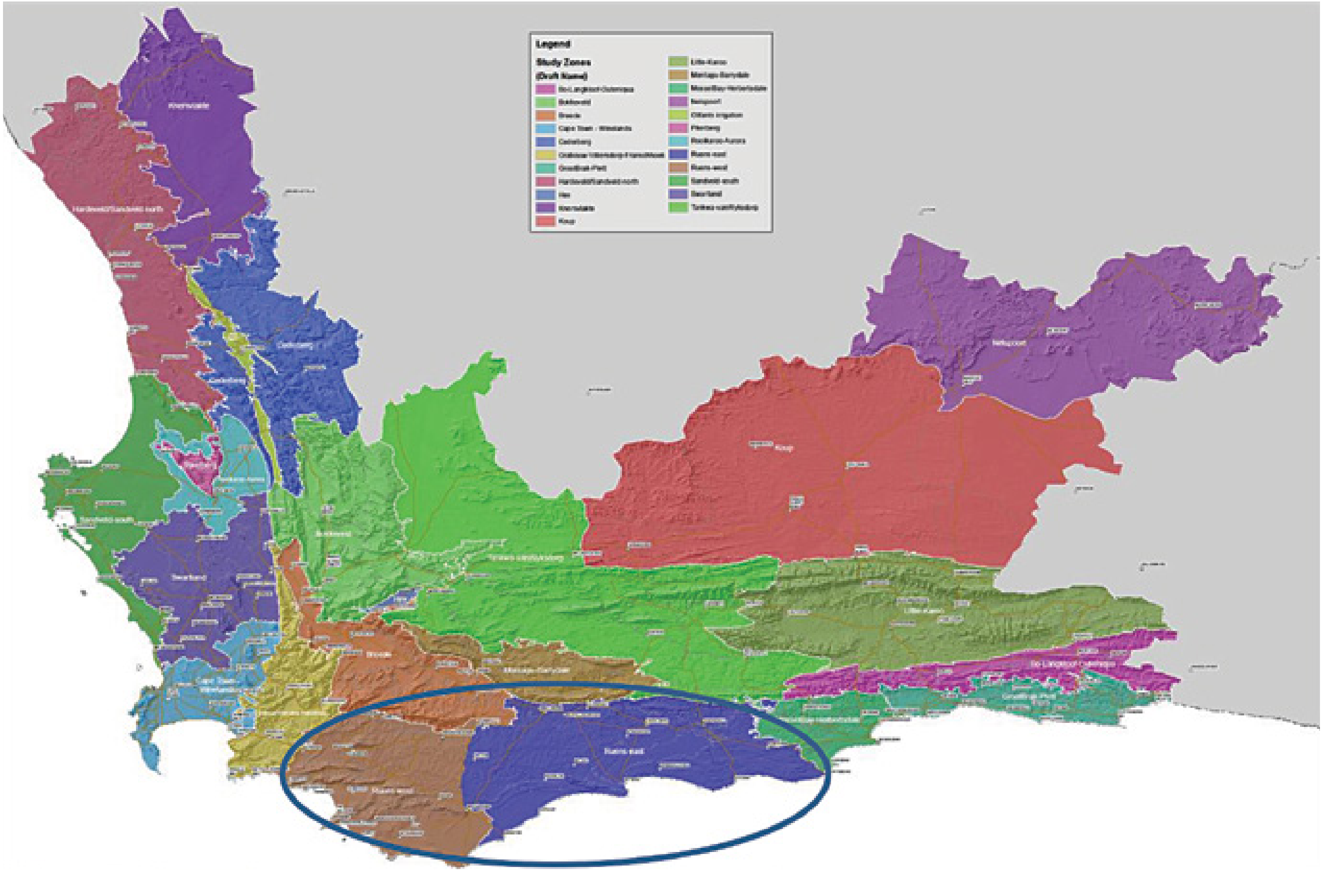

Figure 1. Map of the Western Cape Province showing the 23 agro-climatic zones used in the SmartAgri project, and the Rûens region (circle).

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. However, some of the models indicate a higher probability of wetting in the eastern parts of the Rûens. An important change in the climate system involves the shifting of the rain-bringing frontal storm tracks further south during winter. However, 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, for example, or rainfall shifting into autumn and spring. 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 this region.

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 rain days, mainly in late summer and 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 during the winter season or annually across the Rûens.

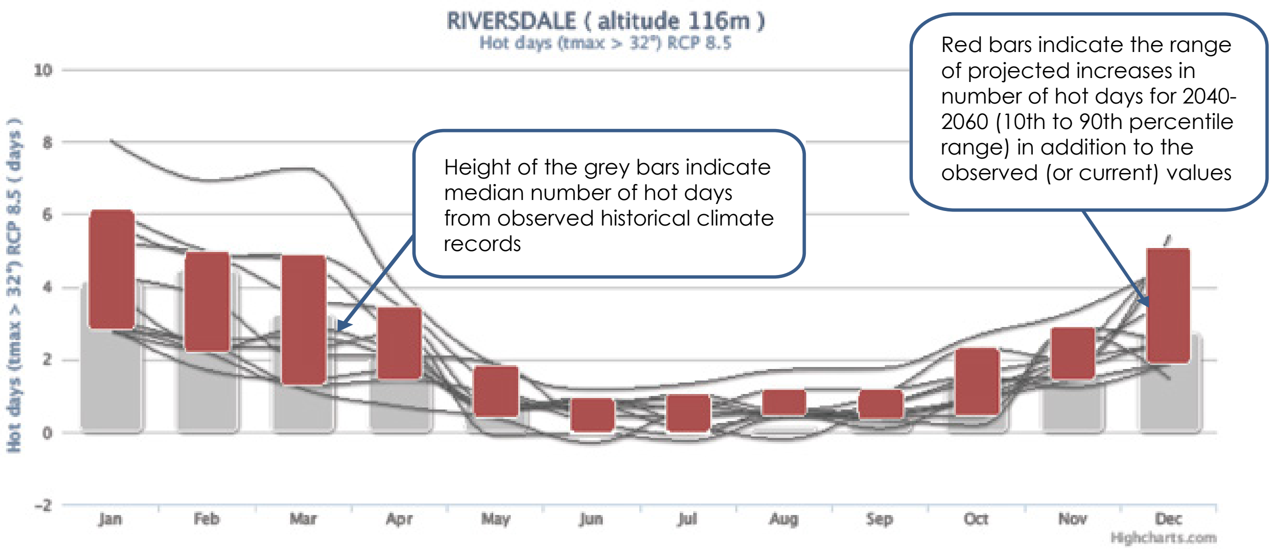

Figure 2. Observed (grey) and projected possible range of increase (red) number of hot days (> 32°C) per month for Riversdale. Projections are for the 2040 – 2060 period and based on 11 different climate models

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 flooding events occurred in the Rûens region as a result of cut-off low weather systems. Catchments such as the Duiwenhoks River have suffered repeated damage with losses to agriculture. An increase in extreme rainfall events is likely in the core of the winter season which could increase the risk of flooding.

Heat waves are expected to become more frequent. Figure 2 shows the monthly count of days exceeding 32 °C for Riversdale, 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 mid and late summer months but also that under climate change such occurrences will increase dramatically, possibly as much as doubling.

Extreme events could occur more frequently in future and will cause climatically marginal areas of the Rûens to become more marginal. Cooler and moister areas such as the southern mountain slopes (Riviersonderend and Langeberg ranges) will likely be somewhat buffered. The cooler sandy coastal plains will not be as prone to extreme temperature stress but reductions in rainfall would have high impacts on agriculture.

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 for mid-century are in the range of 1.5 °C to 3 °C. Both maximum and minimum temperatures will increase leading to increased heat stress for crops and livestock, but also lower risks associated with low temperatures.

Climate change risks and impacts on grain crops and livestock

Small grain production in the Rûens is sensitive to higher temperatures and heat waves, failure of the autumn start of the rainfall season (May/June), reduced seasonal rainfall and longer dry spells, higher frequency of heavy rainfall and flooding, more frequent and heavier late spring and early summer rainfall, an increase in hot wet days during the growth period, strong winds during the harvest period (especially damaging to canola and barley), hail, and rising CO_2 levels. Farmers have indicated that their biggest concern is the frequency of intense rainfall events, followed by extended dry periods. Already, variable climate conditions, especially in the eastern Rûens, are limiting to wheat production but the rapid rise of canola has had a positive influence on the sub-sector.

Research by the Department of Agriculture indicates that future risk patterns for wheat production are likely to remain close to those currently experienced, but agro-climatic zones which are already considered risky and marginal for wheat production are likely to experience increasing risks. There is still much uncertainty around future rainfall changes (wetting or drying) but some climate models show that rainfall may increase in the south and south-eastern wheat zones of the province. This would have a positive influence on future wheat yields and compensate for negative impacts on yield due to future warming. Significant threats of climate change to grain production are likely to lie in changes to the distribution and intensity of pest species, the spread of diseases and growth of weeds. Very little is known about this.

Extensive livestock production (cattle and sheep) will be primarily impacted by rangeland vegetation changes (fodder), changes in the distribution of pests and diseases and water availability. Livestock, especially dairy cattle, cattle reared in feedlots and the Bos taurus breeds, are sensitive to heat stress which will become more frequent in future. In dairy cattle this reduces milk production and fertility. 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. Increasing winter temperatures and fewer cold days could be beneficial to livestock farming in the colder areas.

Climate change is expected to worsen the condition of already degraded and marginal rangelands, through further loss of vegetation and erosion. Range management can either increase or decrease the negative impacts of climate change on rangelands. Subsistence, emerging and small-scale 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.

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 Rûens.

Name	Main water resource features	Main climatic features	Climate change temperature projections[1]	Main Commodities	Future agricultural potential[2]
Rûens-east	Farm dams, occasional river, low storage capacity	More variable rainfall than to the west, with recent droughts in Heidelberg-Albertinia area, mostly winter with some summer rainfall	Low range warming	Wheat, barley, canola Sheep, cattle, dairy, pigs ostrich	Currently becoming marginal for small grains but could improve given possible increases in rainfall
Rûens-west	Farm dams, occasional river, low storage capacity	More reliable dryland conditions than to the east, winter rainfall, warm dry summers	Low range warming	Wheat, barley, canola Dairy, sheep, cattle	Remains high for small grains but with increasing yield variability

[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 affect climate resilience

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

Land and soils

The Rûens region has limited areas of arable soil, with most soils being generally shallow, sandy or stony and nutrient poor. Arable land is intensively utilised for wheat and other field crops. Some areas are threatened by dense stands of invasive alien plants, especially on the Agulhas Plain and parts of the Gouritz region. Shifting agricultural land uses to other areas in response to climate change will not be easy but there remain opportunities for sensitive land development.

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 could take on many forms, both positive and negative.

Crop irrigation accounts for a high proportion of water use in the two Water Management Areas (WMAs) which have been merged into the Breede-Gouritz Catchment Management Agency: 68 % in the Breede WMA, and 61 % in the Gouritz 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 Rûens 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.

The region contains ecosystems with exceptional biodiversity, some of which is under threat from extensive land transformation, particularly the Renosterveld vegetation types. Other threats to ecosystems within or surrounding farmlands include destruction of riverbanks and wetlands, which act as flow regulators and drought buffers. The Rûens region has a high density and total area of important wetlands, many threatened by agriculture. Working for Wetlands is currently conducting wetland rehabilitation projects in the Duiwenhoks and Goukou River catchments and on the Agulhas Plain. Invasive alien plants and wildfires are expected to become more problematic under climate change. 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 Rûens

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 partners 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 winter grains in the Rûens region, it is expected that flexible adaptation approaches such as optimising planting times, the use of drought and heat hardy cultivars as well as long and short cycle cultivars, the use of rotational production systems, an increasing shift to conservation agriculture, and innovative crop-livestock combinations, combined with the fertilising effects of rising atmospheric CO_2, could provide sufficient resilience to warming of up to ~+2 °C. Additionally, during a drought or in anticipation of one, fodder can be planted instead of wheat, as it is less susceptible to dry spells, and livestock can be shifted onto marginal lands.

In the case of irrigated grain crops and pastures, 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.

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 (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.

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 management of 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 region, 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 Swartland and greater West Coast region 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. Best practice management of soil fertility, restoration of degraded soils and rangelands, and conservation of soil resources. More awareness of the benefits of Conservation Agriculture is needed amongst those farmers not already using this farming system. Land use decisions for marginal lands should be carefully made. The importance of biological diversity within soils needs to be better understood. The water holding capacity of sandy low-carbon soils, in particular, must be improved through suitable farming practices. Optimal rangeland management systems must be implemented.

2. Improved management of surface water and groundwater resources to optimise water use efficiency, reduce water losses in the system, and preserve and restore good water quality. Maintain an organic soil cover at all times, and remove water-thirsty alien invasive plants. Water infrastructure must be well maintained to pevent losses and crises. 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.

3. Strive for the **optimum balance between crops and livestock,** and manage this balance flexibly depending on the local climatic conditions and capacity of the land. Use livestock strategically for diversification of resource use and income, and move them onto marginal lands during drier years when conditions are not suited to sowing.

4. 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), greater attention to firebreak management, and accessing the best available weather forecasts for decision making purposes. In the future, the development of early warning systems relating to pests and diseases will be critical.

5. Take and active part in skills development and on-farm research relevant to farming in this region under conditions of climate change. Technologies which can help to confer resilience must become available and affordable to all.

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 Rûens 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:

Further information on all these responses and opportunities, and others, can be found on the GreenAgri information portal: **http://www.greenagri.org.za**

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