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

Brief for the Intensive Livestock sector
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 intensive livestock farming sector in the Western Cape. 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 intensive livestock production regions

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 intensive livestock (chickens and pigs). 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. These will indirectly affect intensive livestock production through impacts on feed availability and prices. 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 grain yields. 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 growth rates brought about by high temperatures. Thus, a discussion of the impacts of climate change on agricultural production requires focused attention to specific threats to specific crops and animals and at specific times in the seasonal cycle. In addition, local conditions such as microclimate influence the extent of the threat.

Intensive livestock production is not limited by local rainfall or soils, but the drier and hotter inland regions of the Western Cape are not well suited due to the high costs of cooling systems. In these areas, sufficient clean water supplies for drinking purposes, for cleaning, and for processing facilities are also not always available. Thus, most of the chicken and pig farming enterprises are situated along the south-western and southern coastal plains, particularly in the 200 km radius from Cape Town and in the vicinity of George in the Southern Cape. Pigs are also produced in some inland areas of the Little Karoo.

The SmartAgri project is assessing nine agro-climatic zones in the region, based on Relatively Homogeneous Farming Areas: Breede, Cape Town-Winelands, Groot Brak-Plett, Little Karoo, Mossel Bay-Herbertsdale, Rûens-West, Rûens-East, Sandveld-South and Swartland (Figure 1).
Figure 1. Map of the Western Cape Province showing the 23 agro-climatic zones used in the SmartAgri project, and the chicken and pig farming regions (circles).
How will the climate of this area change into the future? Climate modelling 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. An important change in the climate system involves the shifting of the rain-bringing frontal storm tracks further south during winter. Some models indicate the possibility of wetting in the eastern part of the province. 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.

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, with a decrease in annual rain days, particularly in autumn, and an increase in rain days apparent in early summer. It may indicate a progressively later start and end to the seasons. As yet there are no detectable trends in total rainfall during the winter season or annually across the intensive livestock production areas.

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 coastal areas tending towards the lower and middle part of this range. Both maximum and minimum temperatures will increase.

Heat waves are expected to become more frequent. Figure 2 shows the monthly count of days exceeding 36 °C for Moorreesburg and Paarl, and days exceeding 32 °C for George (P.W. Botha Airport), 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, especially in the south-west.

The Western Cape also experiences regular flooding events and droughts, and occasional hailstorms. 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.
Figure 2. Observed (grey) and projected possible range of increased (red) number of hot days (> 36°C) per month for Moorreesburg and Paarl, and projected number of hot days (> 32°C) per month for George (P.W. Botha Airport). Projections are for the 2040 – 2060 period and based on 11 different climate models. Height of the grey bars indicates median number of hot days from observed historical climate records. Red bars indicate the range of projected increases in number of hot days (10th to 90th percentile range) in addition to the observed (or current) values.
Climate change risks and impacts on intensive livestock production

The likely climate-related risk factors in the area include higher temperatures in the warmer areas, more hot days and more intense heat waves, unseasonal cold snaps, more frequent and longer dry spells and droughts, and higher frequency of heavy rainfall and flooding.

The production of pigs and poultry is characterised by intensive production systems where animals are mostly housed in climate-controlled units and feed is provided.

The direct impacts of climate change include increasing levels of heat and nutrition stress, which lead to reduced growth and reproduction performance, reduced meat yield and quality, and increased illnesses and deaths. Reliable climate control of the houses will become even more important and will require more energy, thus pushing up the costs. Access to a reliable source of sufficient and clean water is equally important, and droughts could place pressure on water allocations. Climate change will increase the risks of various current and potentially new diseases in poultry and pigs, and this could likely become one of the highest impact on these industries. An increasing prevalence and extended distribution of parasitic and vector-borne diseases can be expected due to increased temperatures and changes in the quantity, intensity and distribution patterns of rainfall. Given the increasing intensity of rainfall and incidence of flash flooding in many parts of the province, poultry and pig houses should be built well away from flood prone areas.

Climate change will affect the pig and poultry industries indirectly via the feed supply chain. The main feed input includes raw materials such as maize, soybean, salt, vitamins and minerals. Maize is the major component of the feed ration at about 65%. Significant amounts of maize and soybean fed to poultry and pigs are produced in the crop growing belt of the Free State, Northwest and Mpumalanga. The Western Cape produces very little of the feed ingredients used in the pig and poultry industries in the province, meaning that they have to be transported here. This pushes up the carbon footprint and price. South African crop production is strongly influenced by climatic risks associated with rainfall variability, as well as droughts and floods. Annual production determines the shortfall, which is imported largely from South America. At the producer level, feed costs constitute a major portion of the total input costs. Other input costs include veterinary services, heating and cooling, bedding, transport, labour and overheads. Costs play a significant role in the margins achieved and profitability across the value chain.

Both poultry and pig production is largely controlled by breeding companies who own Intellectual Property (IP) on breeds and breeding technologies. In the pig sector there are a few stud breeders running family farms but these are declining in number.
Exotic breeds are in use exclusively in both industries. More resilient heat- and drought-tolerant indigenous breeds are available but are currently used mainly by smallholder and subsistence farmers. Companies use breeding technologies to determine what traits to incorporate in the final end user animal.

The main thrust is towards the efficient utilisation of feed for production of more lean meat per animal. Current Feed Conversion Rate for chickens is around 2:1, and 3:1 in pigs. The resulting trend is that fewer animals are being used to produce the same amount of product compared to the past.

In most commercial production outfits animals are housed indoors all the time with very little or no time spent outdoors largely for biosecurity and disease control reasons. In addition this is done to facilitate climate control of the houses. There is a significant push by animal welfare and consumer stakeholders to have animals spend more time outdoors. Given the expected increase in intensity of extreme weather events i.e. flooding, heat waves and cold snaps, innovative housing technologies will be called for.

There are a small but significant number of pigs and chickens kept by smallholder farmers, often in urban and peri-urban settings. These are largely free-ranging animals that also receive some supplementary feeding from the household e.g. kitchen wastes. They typically contribute to the livelihoods and food security of the keepers. The chickens are largely of indigenous stock and have undergone some natural selection to reproduce and survive under harsh conditions. This could be an important source of genes for breeding future genotypes that could withstand climate change.

Urban and peri-urban agriculture is part of the overall food system, although participation rates by poor households in Cape Town (5 % in 2007) and in the province (2 %) are very low. However, commercial and smallholder urban and peri-urban production areas such as the Joostenbergvlakte make an important contribution to the chicken and pork supply of the city and provide access to affordable protein to many urban residents. Peri-urban agriculture also provides various employment opportunities related to animal husbandry but also in the areas of transport and trading. The potential impacts of climate change on this sector requires further investigation and identification of key vulnerabilities.

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 intensive livestock production regions. The summary indicates overall agricultural sensitivities and is not specific to intensive livestock production.

<table>
<thead>
<tr>
<th>Name</th>
<th>Main water resource features</th>
<th>Main climatic features</th>
<th>Climate change temperature projections(^1)</th>
<th>Main commodities</th>
<th>Future agricultural potential(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breede</td>
<td>Breede River, dams, farm dams, very large storage capacity</td>
<td>Winter rainfall; hot dry summers</td>
<td>Medium range warming</td>
<td>Wine grapes, wheat, stone fruit, pome fruit, olives Broilers, egg layers</td>
<td>Remains high as long as dams fill up</td>
</tr>
<tr>
<td>Cape Town-Winelands</td>
<td>WCWSS large dams, farms dams, rivers, large storage capacity, almost fully committed</td>
<td>Winter rainfall; warm to hot dry summers, snow on very high ground, windy in summer</td>
<td>Low range warming</td>
<td>Wine and table grapes, wheat, stone fruit, vegetables, olives, canola, berries Broilers, egg layers, pigs</td>
<td>Remains high as long as dams fill up</td>
</tr>
<tr>
<td>Groot Brak-Plett</td>
<td>Rivers, low storage capacity</td>
<td>Rainfall throughout the year, relatively wet</td>
<td>Low range warming</td>
<td>Wheat, barley, vegetables, (onions) Dairy, cattle, egg layers</td>
<td>Possibly less productive but depends on rainfall shifts</td>
</tr>
<tr>
<td>Little-Karoo</td>
<td>Farm dams, few seasonal rivers, large storage capacity</td>
<td>Hot summers, cold winter minimum temperature</td>
<td>Medium to high range warming</td>
<td>Wheat, vegetables, wine grapes, stone fruit, olives Dairy, ostriches, sheep, cattle, goats, pigs</td>
<td>Remains moderately high as longs as dams fill up</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
<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>
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<tr>
<td>Mossel Bay-Herbertsdale</td>
<td>Rivers, low storage capacity</td>
<td>Mostly winter rainfall, but occasional rain in summer, cool with onshore wind in summer</td>
<td>Low range warming</td>
<td>Wheat, barley, canola, berries</td>
<td>Transition area, productivity could improve with more water storage capacity</td>
</tr>
<tr>
<td>Rüens-west</td>
<td>Farm dams, occasional river, low storage capacity</td>
<td>More reliable dryland conditions than to the east, winter rainfall, warm dry summers</td>
<td>Low range warming</td>
<td>Wheat, barley, canola, honeybush</td>
<td>Remains high for rainfed crops</td>
</tr>
<tr>
<td>Rüens-east</td>
<td>Farm dams, occasional river, low storage capacity</td>
<td>More variable rainfall than to the west, with recent droughts in Heidelberg-Albertinia area, mostly winter with some summer rainfall</td>
<td>Low range warming</td>
<td>Wheat, barley, canola, honeybush (biggest area) Sheep, cattle, dairy, pigs, ostrich</td>
<td>Currently becoming marginal for rainfed crops but could improve given possible increases in rainfall</td>
</tr>
<tr>
<td>Name</td>
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<td>Climate change temperature projections¹</td>
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<tr>
<td>Sandveld South</td>
<td>Very low storage capacity, extensive use of groundwater, Berg River</td>
<td>Rainfall in winter, warm to hot in summer, windy in summer</td>
<td>Medium range warming</td>
<td>Wheat, potatoes, rooibos Sheep, cattle</td>
<td>Increasingly marginal</td>
</tr>
<tr>
<td>Swartland</td>
<td>WCWSS large dams, Berg River, farm dams, large storage capacity</td>
<td>More reliable dryland conditions than further north. Winter rains, with cool conditions, hot to very hot in summer</td>
<td>Low to medium range warming</td>
<td>Wheat, wine and table grapes, canola, olives, citrus, vegetables, stone fruit Dairy, pigs, sheep, cattle</td>
<td>Remains high but with increasing yield variability</td>
</tr>
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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 poultry and pig production areas, the most important factor and threat to consider is water supply, which is expected to become worse under climate change.

The livestock sub-sector both impacts on water quality of river systems, and is itself highly sensitive to water quality problems. Intensive chicken farms and piggeries across the Swartland, Drakenstein and George areas abstract water and return treated effluent into the rivers. As with crops, a minimum water quality is required for livestock in order to meet hygiene standards and prevent disease outbreaks.

Water quality is a major concern and poses a significant risk to livestock production. The negative impact of agriculture, for example runoff from poorly managed chicken operations and piggeries, on downstream water quality needs to be addressed. Water quality is sensitive to warming and variable or extreme rainfall.

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

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 pig and poultry farmers, flexible adaptation options are available which could provide some resilience to warming. 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. While these are being used primarily by smallholder and subsistence farmers, such genetic traits will become very important in the commercial breeding programmes in future.

Provision of alternative supplements can reduce the effects of heat stress in all farmed animals. 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. In addition, animal health monitoring and management can be stepped up, including regular vaccination programmes and other proactive practices, provision of advisory services to farmers, and the cooperation of the abattoirs. Each industry should have a disaster plan which includes the risks being brought on by climate change.

In commercial enterprises, pig and chicken houses are environmentally controlled, and rising temperatures will demand even greater attention to good maintenance of cooling systems and backup systems. Failure of cooling systems, or inadequate systems which cannot deal with heat extremes, will have increasing consequences for overheating and animal deaths. Where animals are able to roam outside, reductions in heat stress can be achieved through the provision of shade in these areas.

The critical element in the Western Cape is security of water for agricultural use and an increase in clean water sources to account for rising demand in future. Intensive livestock producers and processors should have a clear understanding of their role within the greater water sector, including the impacts of effluent management and the risks associated with periods of low water availability or poor water quality.
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 lower carbon footprint associated with non-ruminant production means that more pigs and chickens will likely be produced in response to the pressure to reduce methane and carbon dioxide from animal production (in addition to existing rising market demand).

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. The implementation of anaerobic biogas digestion provides 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. This option is particularly suited to intensive pig and poultry production systems.
Livestock waste from piggeries and chicken farms (as well as cattle feedlots and dairies), would be handled in a conventional manner where waste is allowed to settle out in settling ponds, prior to being distributed over fields or into landfills.

The key is to have a sufficient concentration of input material to sustain economically viable digester units. A study that assesses the level of aggregation and particularly the existence of substantial feedlot, dairy, piggery or chicken farm nodes, would significantly improve our understanding of opportunity in the Western Cape. The study should not only focus on livestock waste but municipal and other waste in the area surrounding the node. The pending national South African Waste Management Act effectively bans organic waste from landfills from 2015 onwards. Such regulation will result in a significant amount of waste that needs to be processed in the province. Biogas offers options for dealing with organic waste, but other options also exist, for example the use of organic waste in fly farming, where the flies are then processed into protein-rich feeds.
Key actions which farmers can implement

What are key actions intensive livestock farmers can take to be able to respond effectively to existing climate risks and projected climatic changes? The following priorities can be highlighted:

1. Identify and use breeds which exhibit resilience to heat, diseases and parasites. Develop production methods to optimise production and income on low levels of external inputs and natural resources by using suitably resilient genetic material.

2. Ensure that environmental control systems in housing are able to reliably function even during heat waves. Also optimise the feed and nutritional management to minimise animal stress.

3. Use pro-active animal health management approaches and have a clear risk management plan ready for instances of disease outbreak. Maintain excellent relationships with veterinarians and follow their advice.

4. Have a responsible and compliant water and waste management plan which minimises risks associated with contamination and re-uses water and waste as much as possible. Consider installing waste-to-energy systems.

5. Do not position poultry and pig houses in flood prone or damp areas.

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 intensive livestock operations 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 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 breeds and farming systems (climate smart agriculture) can buffer agriculture against some impacts of climate change 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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