Climate Change Response Strategy for the Deciduous Fruit Industry of South Africa

EXECUTIVE SUMMARY

DRAFT FINAL

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Executive Summary

Hortgro Science, on behalf of Hortgro grower members and the wider deciduous fruit industry of South Africa, funded the development of a climate change response strategy for the South African pome and stone fruit industries. The brief was that the strategy must be science-based and co-developed with industry stakeholders to ensure relevance, clear prioritisation, and region-specific identification of climate risks and solutions. Furthermore, it focuses on climate change adaptation and building resilience, but also incorporates climate change mitigation actions (the reduction in greenhouse gas emissions).

This is an extended Executive Summary of the full project report, covering the high-level recommendations, background and context, climate trends and future projections, methodology, key results, strategic statement, and the Response Strategy structures around four Strategic Focus Areas.

Recommendations

From the results of this project, seven broad recommendations are made to take forward the implementation of the Hortgro Climate Change Response Strategy. The existing strengths (structures, processes, and staff) within Hortgro and Hortgro Science can be leveraged for most actions, but it is important that the envisaged outcomes must be achieved at farm level, in agri-businesses, processing and storage facilities, and the export business community.

1. Assess the findings of the study and identify (a) those that can be integrated into existing industry strategic planning and initiatives; (b) those that can be quickly implemented where funding and other resources exist; (c) those that must urgently be actioned through the allocation of resources and work streams; (d) those for which additional resources, either internally or externally, must be sought; (e) those which require partnership development between industry and government, with a pathway for achieving this.
2. Identify the Hortgro “champion” (preferably a unit/position rather than a specific person) to take ownership of strategy implementation, with a clear mandate from both members (growers) and top management, sufficient access to resources and support, and accountability.
3. Identify the high impact co-benefits of the actions taken, in order to leverage maximum benefit and value addition regardless of the climate change trajectory, which will always have elements of uncertainty. However, do not allow these uncertainties to delay action; rather, adopt the “precautionary principle” and monitor/leverage the additional economic, environmental and social benefits (i.e. sustainability) of actions.
4. Link strategic action to nurturing and developing the next generation of industry role players, experts and leaders, who will take the climate change response forward for decades to come. Allow spaces for young people from diverse backgrounds and varied skill sets to learn, and to “sit at the table” and contribute their thinking and innovations.
5. Continue to build partnerships within the industry, with other crop and export agricultural industries, and particularly with government, since a strong collaborative

and holistic approach will be necessary to respond effectively amidst complex global environmental, geo-political and social crises.

6. Integrate the suggested research actions into the Hortgro Science research planning, evaluation and prioritisation processes and the revision of the Hortgro Research Strategy.
7. Roll out the dissemination and communication of the Strategy, the internally developed implementation plan and progress on implementation, to the members (growers), suppliers and value chain using existing structures, processes and communications products, with opportunities to assess the effectiveness of communications and unmet information needs.

Introduction

The deciduous fruit industry of South Africa (pome and stone fruit) is already feeling the impacts of warming and changing patterns of rainfall and extreme weather events associated with climate change. The future sustainability, productivity, competitiveness and profitability of the industry, in view of current and future climate changes, must be safeguarded. This requires greater resilience, effective and timeous adaptation, and a shift towards a lower-carbon industry and a pathway towards net zero carbon.

In 2021, Hortgro commissioned a strategic foresight study ("Vision of the Future") for the pome and stone fruit industries. Water availability and climate change were ranked in the top five high-impact and high-uncertainty drivers of change. The Vision, together with focused climate-related initiatives by Confronting Climate Change (CCC), the Sustainability Initiative of South Africa (SIZA), TerraClim, and a research portfolio with a strong focus on climate and water risks and technology development, make up an already effective set of tools assisting the industry in its planning and decision-making.

Within this context, Hortgro Science commissioned the development of an integrated, science-based and pro-active strategic roadmap for the future under climate change, drawing on diverse stakeholder inputs and best practice that will guide the response across the value chain, from farm to port.

Background and context

There are many drivers of change, both local and global, that are affecting the pome and stone fruit industries - climate change is only one of many systemic challenges. Together, these drivers may lead to any one of many possible futures, with some being preferred futures. Decisions made, and actions taken today, will influence the trajectory and whether or not a preferred future is reached.

The current project did not duplicate the analysis conducted for the foresight study, but links to it, providing more detail on the climate change related aspects. Strong links to infrastructure and water availability, and to some extent also to market access, were identified. In addition, attention was given to the industry needs relating to research, technology transfer and skills development in the context of this climate change response strategy.

The project was undertaken against the backdrop of, and in alignment with, international agreements relating to climate change and sustainable development, as well as the national, provincial and sectoral climate change policy framework in South Africa. Critically important for this study was the science basis – the best available scientific analyses and syntheses at international, national and local level were used. The industry- and area-specific knowledge of a diverse range of industry role players also played a very important role.

Climate trends and future projections

The global climate is changing because of the steady increases in atmospheric concentrations of carbon dioxide (CO_2) and other greenhouse gases (GHGs) such as methane (CH_4) and nitrous oxide (NO_x). Measured changes in rainfall amounts and rainfall patterns are mixed across South Africa, with both increases and decreases being recorded, as well as many areas where a signal for change is not yet clear. Trends of decreasing rainfall over the winter rainfall region since the 1960s (especially 1982-2020, and especially in autumn – March to May) have been detected, and are to a large degree linked to the severe drought of 2015-2018.

Temperatures in South Africa have been rising strongly since at least 1850, with the rate accelerating over the last 30 years. The countrywide trend in mean annual temperature from 1951 to 2015 was approximately 0.14°C per decade compared to the global trend of just under 0.1°C per decade. Hot extremes have increased, and cold extremes (including frost risk) have decreased. The strongest temperature increases have occurred in the shoulder seasons of autumn and spring (September-November). Increases in potential evapotranspiration (PET) have been the strongest during the spring and summer (December-February) months.

Across Sub-Saharan Africa, global warming will continue for the foreseeable future for all scenarios developed from the various socio-economic projections. The climate models project changes in the intensity and frequency of hot temperature extremes over land, extreme precipitation over land, and agricultural and ecological droughts in drying regions.

The Western Cape is topographically and climatologically complex, and through interactions of the terrain with different atmospheric dynamics in different parts of the region, different climate change outcomes will be forced. The expected declines in rainfall may be more intense in some places compared to others. Elsewhere in the country, in the summer rainfall areas, rainfall changes (both the direction and magnitude) are less certain in the medium term (Figure 1).

There is confidence in the projections of rising temperatures, which are expected to rise faster in the interior of South Africa compared to the coastal areas (Figure 1), with increases in the number of very hot days. Due to the warming, many current pome and stone fruit production areas will not achieve sufficient chill units in future, especially for the higher chill cultivars. With the increase in minimum temperatures, frost risk will continue to decline across all regions, with the fastest rates of decline in the interior and high-lying regions.

Reduced or even relatively static mean annual rainfalls and increasing temperatures will drive higher evaporative demand (PET). Projected increases in temperature, for which there is little uncertainty, strongly dominate any uncertainty in rainfall, resulting in a general drying of plants

and soils. Furthermore, the climate models project an increased incidence of meteorological and agricultural drought, especially for south-western Southern Africa.

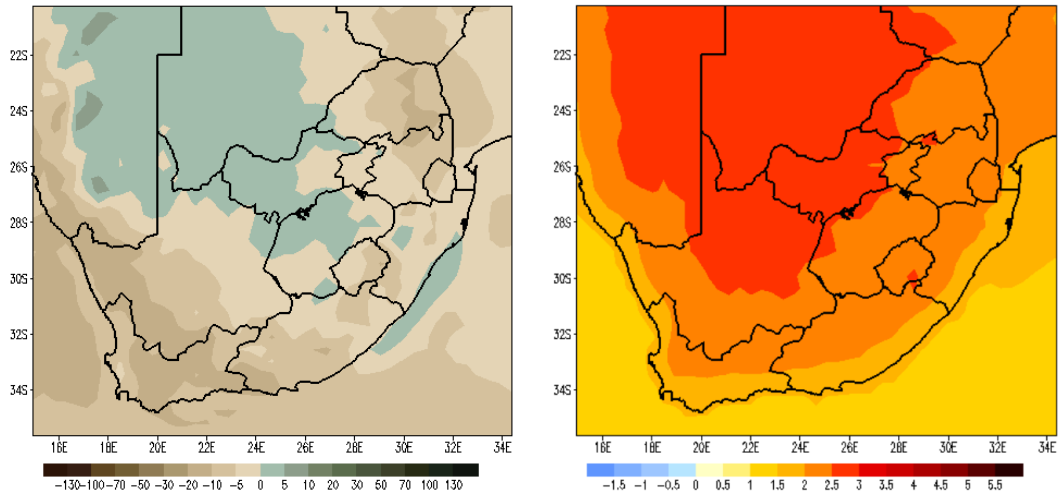

Figure 1 Multi-model ensemble projection of (left) precipitation changes by 2050, and (right) changes in mean annual temperature by 2050. Source: (SAWS, 2017)

Methodology

The project process and timelines are shown in Figure 2. The methodology comprised a mixed approach incorporating desktop literature, science and policy review, and inputs from a group of industry experts (Steering Committee). This was followed by a series of workshops with growers and other industry stakeholders. Collation and analysis of workshop outputs followed the Multi-Criteria Analysis (MCA) methodology. The outcome was a prioritised set of adaptation and mitigation responses for the industry, within a framework of four Strategic Objectives.

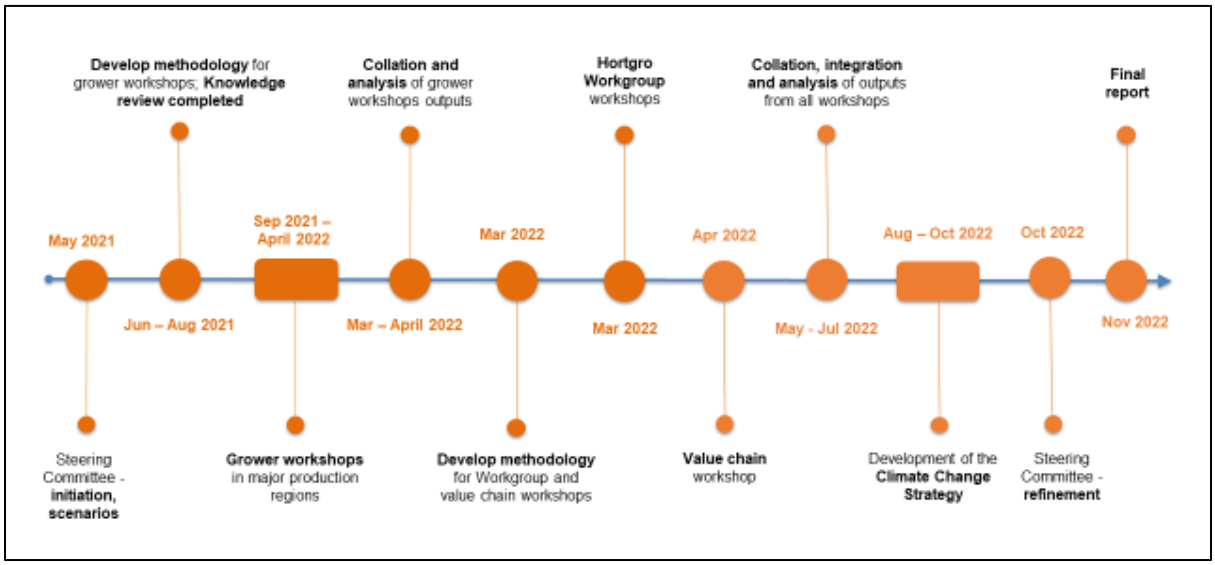

Figure 2 Project process overview

Results

The following tables present a selection of the results. The full set of results is presented in the full project report.

Table 1 Description of each climate risk category identified by the growers and regional advisors.

Climate risk category	Description
Winter chilling decrease	Reduction in winter chilling units leads to poorer bud break, uneven and extended flowering and poorer fruit quality.
Temperature and heat increase	Warming/heat reduces fruit quality (size, sunburn, internal browning, and insufficient red colour); heat/dryness during flowering and fruit set reduces pollination, fruit set and yield.
Rainfall change	Reduction in annual rainfall; rainfall becoming more intense; rainfall more localised; changing seasonality of rainfall (usually starting later).
Water quantity decrease and drought increase	Water resource available for farming is reduced through capped dam storage capacity, reduced water allocation, drought, and increased evaporation from water surfaces, or constraints in farm irrigation system.
Water quality decrease	High iron content when dam water levels are low (Limpopo); sediment (Klein Karoo, Stellenbosch-Berg) and high electrical conductivity (Klein Karoo) when dam water levels are low.
Hail/sleet change	Increasing hail frequency and changing seasonality; late last hail and early first hail can cause damage, in interaction with cultivar chilling requirements.
Pests change	Warming accelerates pest life-cycles; pests survive warmer winters better; new species are appearing.
Wind speed increase and whirlwinds/tornados	High temperatures combined with dry winds in pollination and fruit set period affect yield; stronger winds; changing seasonality of strong wind; no change but stricter market requirements for wind marks; increasing frequency of whirlwinds / tornados in the eastern Free State.
Flood increase	Heavier rainfall causing more flash flooding off mountain slopes, not necessarily causing damage but water cannot be stored and there is a risk of heightened erosion.
Fire increase	Risk, frequency and intensity of wildfires can increase; dangerous if close to orchards and infrastructure.
Frost change	Risks relating to frost increase; insufficient frost protection system design; limiting water resources where overhead water application is used.
Snow change	Changing dynamics between hail and snow in late winter and autumn (Free State), late last snow and early first snow can cause damage to netting structures.

Table 2 Concerns of growers and regional advisors regarding climate change trends (T) and shocks (S) per production region. Pome/stone = both; Stone = mostly stone fruit production; P = mostly pome fruit production. EGVV = Elgin-Grabouw-Vyeboom-Villiersdorp.

	Production region																	
Risk	**Limpopo Pome/stone**		**Free State Pome/stone**		**Langkloof Pome/stone**		**Klein Karoo Pome/stone**		**Ceres/ Piketberg Pome/stone**		**Tulbagh/ Wolseley Pome/stone**		**Stellenb-Berg Stone**		**Wider EGVV Pome**		**Breede Stone**	
	T	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**	**T**	**S**
Chilling																		
Heat/ dry air																		
Rainfall - heavy																		
Rainfall - lower																		
Rainfall - timing																		
Water quantity / drought																		
Water quality																		
Hail/sleet																		
Pests																		
Wind speed / whirlwind-tornado																		
Flood																		
Fire																		
Frost																		
Snow																		

Table 3 Description of climate change adaptation options identified by the growers and regional advisors.

Climate adaptation category	Description
Water efficiency – application	Applying water more efficiently eases shortages. This can include more efficient irrigation systems, and precision irrigation scheduling based on actual (monitored) crop demand and/or crop water status.
Water efficiency - soil cover	Managing soil water and health through soil covers. Practices include mulching, compost, cover crops and weed management that optimises water available to the tree roots. Soil fertility / soil health is improved. Mitigation co-benefits are linked to soil carbon sequestration.
Protective netting	Netting protects against weather risks. Growers need better / stronger netting structures that can withstand heavier hail and wind storms. Visual impacts on the landscape must be minimised.
Cultivar/rootstock choice	Climate-adapted cultivar and rootstock choices (and “basket”) for local conditions, while providing high economic value. Consider chill requirements, conditions for red colour development, and heat / sunburn sensitivity (current and future climate).
Water resources management	Managing water resources better. Attention to on-farm infrastructure development, management and monitoring. Diversify sources of water (groundwater, recycled) and increase water storage capacity where possible. Remove invasive alien plants from water bodies and catchment areas. Investigate methods to reduce evaporation from dam surfaces. Grower/industry involvement in public management of shared dams / water schemes and water rights.
Relevant information	Improved availability and access to information for adaptation. Topics for information development (under different contexts) include irrigation systems and scheduling, the use of low chill cultivars, the use of netting, climate-adapted cultivar and rootstock choices, frost mitigation options, how to reduce the use of agro-chemicals.
Crop choice	Switch to other crops for sustainability. Considerations include chilling requirements, water requirements, sensitivity to damage / blemishes caused by weather conditions, and economic value.
Technological innovation	Technological innovation can solve some problems. This could include irrigation, netting structures, biological products for plant protection, frost mitigation, climate / weather forecasting, water recycling, cultivar breeding and testing. Some technology can be bought in and tested / adapted. [Note: this category links to several other categories and was likely undercounted]

Climate adaptation category	Description
Marketing	Expand market access and diversity. Issues to address include market restrictions (MRLs), and better use of “farmers’ stories”.
Frost mitigation	Better frost protection systems. Better system designs and alternative systems needed to mitigate more extreme frost and out-of-season frost.
Reflective mulch	Improve light environment for red and blushed cultivars. This approach is especially useful under netting and for high value cultivars.
Proactive planning	Better and more proactive enterprise planning. In some areas, growers may still be in a comfort zone but climate change will catch up with them.
Orchard design	Use climate-adaptive orchard designs. Use designs that promote light penetration into the orchard and tree, to stimulate red colour development. Factors to consider include row orientation, spacing / density, training system, and canopy management.
Soft pest control	Adopt natural and non-chemical methods for pest control. Use natural methods (pest-predator complexes), mulching and other practices to manage and disrupt pests.
Value chain support	Motivate for better support from retailers and banks. The implementation of adaptive farming practices can be boosted with the support of retailers and banks. Current systems often work against developing adapted and resilient orchards.
Cultivar breeding	Breed and test cultivars for climate adaptive traits. Extend the range of options in some categories. The focus should be on chilling requirements, high temperature resilience (including sensitivity to sunburn and poor red colour), and drought resilience (water requirements).
Green/biological products	Adopt biological (“green”) products for plant protection (especially for pest control) to replace harsher chemical products.

Table 4 Preferred climate change adaptation actions identified by growers and regional advisors per growing region. P/S = both pome and stone. P = mostly pome. S = mostly stone. EGVV = Elgin-Grabouw-Vyeboom-Villiersdorp.

	Production region								
Adaptation action	**Limpopo P/S**	**Free State P/S**	**Langkloof P/S**	**Klein Karoo P/S**	**Ceres/ Piketberg P/S**	**Tulbagh/ Wolseley P/S**	**Stellenb-Berg S**	**Wider EGVV P**	**Breede S**
Water - application	■	■	■	■			■	■	■
Water - soil cover	■	■	■	■		■	■	■	■
Protective netting	■	■	■	■	■	■	■	■	■
Cv/rootstock choice	■	■	■	■	■	■	■	■	■
Water resource mgt	■		■	■	■	■	■	■	■
Relevant information		■	■	■	■		■	■	
Crop choice	■		■	■	■			■	
Tech innovation		■	■			■	■	■	■
Marketing						■			■
Frost mitigation		■							
Reflective mulch			■						
Proactive planning					■				■
Orchard design								■	
Soft pest control						■			
Value chain support						■			
Cultivar breeding	■					■			
Green/biological products						■		■	■

Table 5 Description of climate change mitigation options identified by the growers and regional advisors.

Climate mitigation category	Description
Resource efficiency	Increasing resource use efficiency reduces emissions. This can include recycling and responsible waste disposal, irrigation efficiency, agrochemicals efficiency, precision farming, and water recycling and desalination.
Alternative energy	Changing to lower-carbon emissions energy sources. Options include solar (photovoltaic), electric farm vehicles, green/biofuels, wind power, and hydropower.
Energy efficiency	Using energy more efficiently. Options include energy efficient and low emissions vehicles, VSD drives on pumps, irrigation outside peak demand period, gravity irrigation, energy efficient design of pack houses and cold stores, changing gases in cold stores, dispatch of only full load trucks, more use of rail freight, and establishment of inland ports.
Carbon sequestration	Carbon sequestration into orchard soils. An increase in soil organic matter (and thus C) can be achieved with compost, mulching, cover crops, no/reduced tillage and reduced use of agro-chemicals.
Carbon footprinting	Measuring the farm and pack house carbon footprint (greenhouse gas emissions) using a recognized carbon calculator tool. This can help identify areas where emissions can be reduced.
Change market acceptance	Motivate for greater market acceptance for aesthetically imperfect fruit. This would greatly reduce the carbon footprint at whole farm and pack house levels.

Table 6 Preferred climate change mitigation actions identified by growers and regional advisors per growing region. P/S = both pome and stone. P = mostly pome. S = mostly stone. EGVV = Elgin-Grabouw-Vyeboom-Villiersdorp.

	Production region								
Mitigation action	**Limpopo P/S**	**Free State P/S**	**Langkloof P/S**	**Klein Karoo P/S**	**Ceres/ Piketberg P/S**	**Tulbagh/ Wolseley P/S**	**Stellenb-Berg S**	**Wider EGVV P**	**Breede S**
Resource efficiency	■	■	■	■	■	■	■	■	
Alternative energy	■	■	■	■	■		■	■	■
Energy efficiency	■	■	■	■	■		■	■	■
Carbon sequestration			■	■	■	■	■	■	
Carbon footprinting		■							
Change market acceptance							■		

Table 7 Description of climate risks (both trends and shocks), adaptation options and mitigation options for the value chain.

Climate risk category	Description
Carbon intensity	Increase in pest pressure – more spraying and CO_2 emissions. Higher carbon footprint / intensity will affect market access.
Product quality	Storage potential and shelf life decrease through effects of pre-harvest high temperatures and water stress on fruit quality. This impacts on marketing.
Logistical capacity	Shifting harvest windows and changes in crops / cultivars impact on logistics. Extreme weather damages infrastructure.
Financial	Dealing with climate change increases costs along the value chain.
Supply reliability	Changing climate / severe weather affect reliability of fruit supply into the market.
Market window	Fruit production season misses specific market windows. This can have severe financial impacts.
Climate adaptation category	**Description**
Transport infrastructure	Good road / rail / ports infrastructure and management absorbs impacts.
Improved technology	More precision agriculture and improved technology across the value chain can increase efficiencies and mitigate impacts.
Skills development	Develop the skills across the value for dealing with the demands brought by climate change.
Cultivar choices	Better cultivar choices are made for logistics, marketing and value in the context of shifting production seasons and product quality for different crops / cultivars.
Crop diversification	Introduce new crops to optimise logistics, marketing and value along the value chain, and mitigate crop losses in specific categories.

Climate mitigation category	Description
Transport emissions	Reduce emissions from transport along the value chain
Market empathy	Increase market empathy re mitigation burden on suppliers
Subsidies for mitigation	Provide subsidies that increase mitigation actions
Industry support	Increase support throughout the industry for mitigation actions
Carbon intensity	Reduce carbon intensity in the value chain – alternative energy
Bureaucracy	Reduce bureaucratic burdens (“red tape”) on mitigation actions
Resource efficiency	Increase resource use efficiencies across the value chain; includes recycling and waste management

Climate Change Response Strategy

Strategic statement

The proposed Vision and Goal of the Climate Change Response Strategy for the Deciduous Fruit Industry of South Africa are:

Vision: A sustainable deciduous fruit industry that is productive, competitive, equitable and resilient across the value chain, with net zero emissions by 2050.

Goal: To provide a road map for the deciduous fruit industry to respond to climate change risks and opportunities through innovation, leadership and collective action, while securing the environmental and societal goods and services that underpin a productive, resilient and sustainable industry in the long term.

Strategic Objectives

This vision and goal are unpacked as four overarching strategic focus areas, as shown in Figure 3:

Figure 3 The climate change response framework for the pome and stone fruit industries of South Africa, showing the four strategic focus areas.

Response Strategy

The Objectives to be achieved for each Strategic Focus Area are summarised in Table 8 and the details expanded upon in Table 9, Table 10, Table 11 and Table 12.

Table 8 Summary Table of the Objectives for each of the four Strategic Focus Areas.

STRATEGIC FOCUS 1: BUILD CLIMATE RESILIENCE AND ADAPTIVE CAPACITY	**STRATEGIC FOCUS 2: TRANSITION TO LOW-CARBON FRUIT PRODUCTION AND VALUE CHAIN**
Objective 1.1 Create a strategic water-resource plan for each region in conjunction with the government to manage all water resources, including groundwater, holistically. Objective 1.2 Research and promote the implementation of water-saving irrigation technology. Objective 1.3 Develop a public-private partnership with the Department of Water and Sanitation for the maintenance of infrastructure. Objective 1.4 Research and promote the water-related benefits of soil covers and management practices. Objective 1.5 Restore and maintain on-farm ecological infrastructure, amongst other Nature Based Solutions, and contribute to catchment and landscape (area wide) planning and coordination forums. Objective 1.6 Risk reduction of water quality challenges and potential disasters. Objective 1.7 Research and promote effective and sustainable use of protective netting over orchards. Objective 1.8 Research and promote climate-adapted cultivar, rootstock and crop choices for local contexts and future climate. Objective 1.9 Strengthen knowledge of options available for effective frost protection.	Objective 2.1 Promote increased resource use efficiencies for fertilizers, agro-chemicals and waste. Objective 2.2 Promote increased energy use efficiencies for electricity, diesel and other fuels. Objective 2.3 Promote the change to alternative low-carbon energy sources across the value chain. Objective 2.4 Research and promote practices to effectively build up soil carbon content through carbon removals from the atmosphere. Objective 2.5 Start planning a pathway towards industry-level net zero emissions by 2050.

Objective 1.10 Improve postharvest quality relating to effects of growing season climate stress. Objective 1.11 Support technological innovation to solve climate-related challenges across the value chain.	
STRATEGIC FOCUS 3: STRENGTHEN FORMAL ENABLERS	**STRATEGIC FOCUS 4: STRENGTHEN INFORMAL ENABLERS**
Objective 3.1 Investigate PPPs and other options for strengthening transport infrastructure, and reduce transport-related greenhouse gas emissions. Objective 3.2 Influence the development of national water policy that is evidence-based, equitable and supportive of horticulture in the context of climate change risks and impacts. [Adaptation] Objective 3.3 Assess the need for and feasibility of additional water storage capacity. [Adaptation] Objective 3.4 Improve access to finance for pro-active transitions, risk reduction and recovery from disasters. Objective 3.5 Engage with and support government on regulatory pitfalls (“red tape”).	Objective 4.1 Improve availability and accessibility of relevant contextual information. Objective 4.2 Strengthen skills development across the value chain for climate change adaptation. Objective 4.3 Drive a dialogue with the market to encourage understanding and empathy for the mitigation burden.

Table 9 Draft Climate Change Response Strategy for the Deciduous Fruit Industry: Resilience and Adaptation

STRATEGIC FOCUS 1: BUILD CLIMATE RESILIENCE AND ADAPTIVE CAPACITY			
Objective 1.1 Create a strategic water-resource plan for each region in conjunction with the government to manage all water resources, including groundwater, holistically. **Aligns with: Hortgro Foresight Study 2022**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus areas**
Identify opportunities for conjunctive water use from diverse sources (surface, ground, recycled, saline water) in each region, in conjunction with government.	Industry-government partnership Value chain	2030 2050	All
Create a strategic water-resource plan for each region in conjunction with government, including sustainable groundwater management plans in vulnerable regions, and equitable approaches to managing the competition for shared water resources between the Greater Cape Town urban area and irrigation agriculture.	Industry-government partnership	2030 2050	All
Communicate / raise awareness of the importance of responsible legal water use and management (including accurate metering) to growers.	Industry	2030 2050	All
Objective 1.2 Research and promote the implementation of water-saving irrigation technology. **Aligns with: Hortgro Foresight Study 2022; Hortgro Science Gap Analysis 2023; SmartAgri plan 2016**			

Actions	Implementation level	Timeframe	Spatial focus area
Research and promote water-saving irrigation systems, real-time soil and plant water monitoring, and precision scheduling that avoids both over- and under-irrigation and optimises water productivity. Encourage technological innovation, including an evaluation of the role of remote sensing - both satellite and unmanned aerial vehicles (drones) - to support efficient resource use and scheduling.	Industry Research (with Water Research Commission) Farm	2030	All
Through research, benchmarking and target setting, increase the current and future water productivity of orchards for each region.	Industry Research (with Water Research Commission)	2030 2050	All
Objective 1.3 Develop a public-private partnership with the Department of Water and Sanitation for the maintenance of infrastructure. **Aligns with: Hortgro Foresight Study 2022**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Engage with DWS to achieve an agreement-based partnership for mutually beneficial joint maintenance of public agricultural water infrastructure.	Industry-government partnership	2030 2050	All
Objective 1.4 Research and promote the water-related benefits of soil covers and management practices. **Aligns with: Hortgro Science Gap Analysis 2023; SmartAgri plan 2016** **Mitigation co-benefits**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**

Technology transfer and promotion of mulching, composts, cover crops, weed management and other soil management practices to increase soil water holding capacity of various soil types. Encourage the broader development of regenerative agricultural practices to promote co-benefits such as increased soil organic matter (see Objective 2.4) and improved soil health. Sharing of innovations (case studies, demonstrations).	Industry Research Farm	2030	All
Objective 1.5 Restore and maintain on-farm ecological infrastructure, amongst other Nature Based Solutions, and contribute to catchment and landscape (area wide) planning and coordination forums **Aligns with: Hortgro Foresight Study 2022; SmartAgri plan 2016**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Remove invasive alien plants from rivers, streams, seeps and wetlands, and on-farm catchment areas, and re-plant with indigenous species appropriate to the location, in collaboration with local partners, to increase stream flows and groundwater recharge, and reduce flood risks.	Farm (with other catchment role players)	2030 2050	All
Active membership of existing or new collaborative multi-stakeholder catchment and area/ecosystem wide management forums that aim to strengthen water-related and other ecosystem services to reduce landscape vulnerability to climate shocks.	Industry Farm	2030 2050	All
Research the opportunities afforded by a Science Based Nature Based Targets[1] initiative for the deciduous fruit industry, with recommendations to the industry.	Industry Research	2030	All
Objective 1.6 Risk reduction of water quality challenges and potential disasters			

[1] https://sciencebasedtargets.org/blog/nature-based-solutions-in-science-based-targets

Aligns with: SmartAgri plan 2016			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Draw up an industry risk mitigation plan for the management of geology-based poor water quality challenges (e.g. iron, salt) in vulnerable regions.	Industry (with Water User Associations	2030	Limpopo; Klein Karoo
Draw up an industry risk mitigation plan for the avoidance and management of human-induced poor water quality challenges, focusing on potentially disastrous pollution events and chronically contaminated water (from poor agricultural practices, overuse of fertilisers, pesticides; and other pollution of water resources) in vulnerable regions.	Industry (with Water User Associations) Value chain	2030	Berg River Others to be identified
Commission research on feasible and cost-effective water filtration and treatment technologies for in-bound water, for pro-active risk management in vulnerable regions.	Industry Research (with Water Research Commission)	2020	All
Objective 1.7 Research and promote effective and sustainable use of protective netting over orchards **Aligns with: Hortgro Foresight Study 2022; Hortgro Science Gap Analysis 2023**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Conduct research and technology transfer on cost-effective netting choices / technologies for different regional and cultivar contexts. Encourage technological innovation.	Industry research	2030	All
Collaborate with the private sector to develop stronger netting structures that can withstand heavier hail and windstorms. Encourage engineer-designed specs suited to local conditions and net purpose.	Industry research (with private sector)	2030	All
Conduct technology transfer and promote adjusted practices for netted	Industry research	2030	All

orchards to optimise benefits/value (e.g. reflective mulch, drip irrigation, mulching, cover crop management, and pest and disease management). Include an assessment of adaptive and regenerative practices with and without netting.			
Conduct a pre-emptive study on the possible environmental / biodiversity impacts, regulatory developments, aesthetic factors and societal acceptance of large-scale expansion of protective netting in fruit production regions.	Industry research	2030	All
Objective 1.8 Research and promote climate-adapted cultivar, rootstock and crop choices for local contexts and future climate **Aligns with: Hortgro Foresight Study 2022; Hortgro Science Gap Analysis 2023; SmartAgri plan 2016**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Collate and make available the necessary information on climatic suitability (current and future, including maps) of cultivar and rootstock choices per region: genetic stability, chill requirements, conditions for colour development, heat and sunburn sensitivity, wind mark sensitivity, water requirements and drought response.	Industry research (with private sector)	2030	All
Mainstream the consideration of climate change into the Hortgro Plant Material Management (PMM) portfolio to ensure that the cultivar basket and plant material of the future are climate-resilient (e.g. viable low chill options). Promote strategic diversification.	Industry (with SAPO Trust, Plant SA, Culdevco and private sector)	2030 2050	All
Promote the availability, accessibility and affordability of tested climate-adapted cultivar choices in all regions for current and projected future climates.	Industry (with SAPO Trust, Plant SA, Culdevco and private sector)	2030 2050	All

Existing relevant industry working groups assess the risks to logistics, marketing and value posed by sub-optimal crop/cultivar choices/“baskets”, and opportunities to optimise the basket through better choices and new options.	Industry Value chain	2030	All
Objective 1.9 Strengthen knowledge of options available for effective frost protection			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Assist affected growers in assessing currently available and innovative new frost protection technologies that are effective, practical and affordable (through technology transfer).	Industry research	2030	Free State Klein Karoo
Objective 1.10 Improve postharvest quality relating to effects of growing season climate stress **Aligns with: Hortgro Science Gap Analysis 2023**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Conduct research and technology transfer on effects of growing season climate stress on postharvest quality and storage potential, and response options across the value chain.	Industry research Value chain	2030	All
Objective 1.11 Support technological innovation to solve climate-related challenges across the value chain **Aligns with: Hortgro Foresight Study; Hortgro Science Gap Analysis 2023**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**

Expand the Hortgro Science Research Strategy and annual Gap Analysis, and the research management/ prioritisation/ review process to cover both 1) adaptation and resilience (already a focus area), and 2) key mitigation strategies and research needs.	Industry research CCC	2030	All
Prepare broad cost-benefit studies on different aspects of adaptation and mitigation technologies.	Industry research	2030	All
Launch an annual or bi-annual competitive postgraduate bursary for innovative research on climate-adaptive 4IR technologies and practices. Prospective students write their own proposals/submissions.	Industry research (via bursary program)	2030	All

Table 10 Draft Climate Change Response Strategy for the Deciduous Fruit Industry: Mitigation

STRATEGIC FOCUS 2: TRANSITION TO LOW-CARBON FRUIT PRODUCTION AND VALUE CHAIN			
Objective 2.1 Promote increased resource use efficiencies for fertilizers, agro-chemicals and waste **Aligns with: CCC program** **Adaptation co-benefits**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Conduct research and technology transfer on identifying and evaluating non-synthetic fertilizer and agro-chemical alternatives that will allow decoupling from the dependence on the current portfolio of synthetic (fossil fuels based) options. Concurrently, in the short term, promote the more efficient and effective use of synthetic options to contribute to emission reductions, including the wider use of weather-based disease prediction models/ technologies.	Industry, with CCC Value chain Farm	2030 2050	All
Conduct a risk analysis of increasing carbon footprints of export produce resulting from pest control measures linked to threatening outbreaks and extreme phytosanitary standards in the market. Promote more research and investment in integrated and biological low-carbon pest disruption and management technologies.	Value chain (with industry research)	2030 2050	All
Promote responsible waste disposal and recycling, and opportunities in the circular economy (more options for recycling and re-use).	Industry, with CCC Farm Value chain	2030 2050	All
Use the CCC benchmarks to analyse/identify achievable and time-bound industry emissions reductions targets for fertilizers, agro-chemicals and waste at farm, pack house, and cold store levels.	Industry, with CCC Value chain	2030	All

Objective 2.2 Promote increased energy use efficiencies for electricity, diesel and other fuels **Aligns with: CCC program**			
Actions	**Implementation level**	**Timeframe** **Stone/Pome**	**Spatial focus area**
Promote energy-saving pumps, irrigation systems and irrigation scheduling, based on broad cost-benefit analysis and research/ evidence.	Industry, with CCC Farm	2030	All
Promote the more efficient use of vehicles and trucks across the value chain, logistical infrastructure, energy efficient building designs, and use of alternative gases in cold stores. Include an assessment of the emissions, cost-benefit and practicality of electric farm vehicles and other renewables-based options.	Industry, with CCC Value chain	2030 2050	All
Objective 2.3 Promote the change to alternative low-carbon energy sources across the value chain **Aligns with: CCC program**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Promote the change to alternative low-carbon energy sources at farm level and across the value chain, focusing on accessible information detailing technical and financial (cost-benefit) factors of various options for decision-making. Include developments in cost-effective energy storage options to deal with variability / seasonality in solar and wind. [Also see Objective 3.3]	Industry Value chain	2030 2050	All

Objective 2.4 Research and promote practices to effectively build up soil carbon content through carbon removals from the atmosphere **Aligns with: Hortgro Science Gap Analysis 2023** **Adaptation co-benefits**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Conduct research and technology transfer on production practices (under the "regenerative agriculture" umbrella) with proven ability to increase long-term carbon content in different soils through carbon removals from the atmosphere[2].	Industry research, with CCC and private sector	2030	All
Support growers in exploring the technical and financial viability of generating and selling Verified Carbon Units (measured and verifiable emission reductions), through area-wide grouped projects registered with an approved Verified Carbon Standards governing body.	Industry research, with CCC and private sector	2030	All
Objective 2.5 Start planning a pathway towards industry-level net zero emissions by 2050 **Aligns with: CCC program**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Start a multi-stakeholder dialogue to begin a process of agreeing on an embedded proactive mitigation pathway that is economically viable, market- and policy-aligned and socially acceptable.	Industry, with CCC Value chain (with market)	2030 2050	All

[2] https://sciencebasedtargets.org/about-us/sbtn

Use the CCC benchmarks to analyse/identify science-based[3], achievable and time-bound industry emission reduction targets at farm, pack house and cold store levels, in conjunction with soil carbon sequestration.	Industry, with CCC Value chain	2030	All

[3] https://sciencebasedtargets.org/about-us/sbtn

Table 11 Draft Climate Change Response Strategy for the Deciduous Fruit Industry: Formal enablers

STRATEGIC FOCUS 3: STRENGTHEN FORMAL ENABLERS			
Objective 3.1 Investigate PPPs and other options for strengthening transport infrastructure, and reduce transport-related greenhouse gas emissions. [Adaptation and Mitigation] **Aligns with: Hortgro Foresight Study 2022**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Work with government to investigate PPPs and other options for the improvement, development and efficient management of road, rail and port infrastructure.	Industry-government partnership Value chain	2030 2050	All
Engage with sectoral (transport) and government greenhouse gas emissions/mitigation experts to assess cost-effective strategies from short- to long-term that will reduce emissions from transport from farm to port.	Industry Value chain	2030 2050	All
Objective 3.2 Influence the development of national water policy that is evidence-based, equitable and supportive of horticulture in the context of climate change risks and impacts. [Adaptation]			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Engage with policymakers and represent the horticultural sector in platforms where water policy development can be influenced. Ensure that science-based evidence, including risks and impacts of climate change on water resources and orchard water requirements, is available and communicated.	Industry-government partnership Industry research	2030 2050	All

Objective 3.3 Assess the need for and feasibility of additional water storage capacity. [Adaptation]			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
In collaboration with hydrologists, geohydrologists and climate change scientists, assess the need for and feasibility of additional public and private water storage capacity under current and future climate variability per agro-climatic production region. Focus on areas where recent shifts in rainfall patterns and expected future shifts indicate a need for additional water storage. Communicate with water planners and regulators in this regard.	Industry Research (with Water Research Commission) Industry-government partnership	2030 2050	All
Objective 3.4 Improve access to finance for pro-active transitions, risk reduction and recovery from disasters. [Adaptation and Mitigation]			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
On behalf of the members (Hortgro playing the role of "aggregator"), engage with the financial / banking sector to explore the barriers, needs and opportunities regarding cheaper access to capital and bridging finance for adaptation and mitigation actions and the transition to sustainable farming models, as well as debt restructuring and recapitalisation following disasters.	Industry (with Hortfin) Value chain	2030	All
Engage with the insurance sector to explore the changing risks across the value chain brought about by climate change, and options for reducing risk and sharing risk. Explore alternative insurance approaches / products.	Industry (with Hortfin) Value chain	2030	All
Objective 3.5 Engage with and support government on regulatory pitfalls ("red tape"). [Adaptation and Mitigation] **Aligns with: Hortgro Foresight Study 2022**			

Actions	Implementation level	Timeframe	Spatial focus area
Engage with and support relevant government departments on the barriers to sustainable, timeous and cost-effective adaptation and mitigation actions on farms and across the value chain brought about by interpretations and implementations of laws and regulations. This pertains particularly to applications of NEMA, NEMBA, CARA and NWA, registration of new products for crop management (e.g. dormancy breaking agents) and plant protection, unlocking market access, and time and costs borne by applicants. Develop case studies for this engagement.	Industry Value chain	2030	All

Table 12 Draft Climate Change Response Strategy for the Deciduous Fruit Industry: Informal enablers

STRATEGIC FOCUS 4: STRENGTHEN INFORMAL ENABLERS			
Objective 4.1 Improve availability and accessibility of relevant contextual information. [Adaptation and Mitigation] **Aligns with: Hortgro Science (Resources and Communications)**			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Develop and disseminate information products on practical and cost-effective adaptation technologies and practices for diverse contexts (region/ climate/ chill/ frost risk, crop/ cultivar/ rootstock, soils, water availability).	Industry research	2030	All
Develop and disseminate information products on cost-effective mitigation technologies.	Industry research CCC	2030	All
Institute a mechanism to assess whether the relevant required communication / information is reaching growers and value chain actors, and improve as necessary.	Industry research	2030	All
Objective 4.2 Strengthen skills development across the value chain for climate change adaptation. [Adaptation]			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Assess current level of, and gaps in, knowledge and skills development of growers and agri-workers (including vulnerable groups), and across the value chain, and incorporate into industry planning and related curricula/programs.	Industry research (with academia / NGOs) Industry, Value chain	2030	All

Promote continuous learning through farmer- and worker-centric study groups and fora, through existing industry-wide symposia and technology transfer events, and in collaboration with other agricultural organisations. Where gaps exist, encourage the creation of adaptation/ mitigation/ regenerative learning forums that support “bottom up” experimentation, learning, information sharing.	Industry research (with farmer organisations and other agricultural organisations) Value chain	2030	All
Objective 4.3 Drive a dialogue with the market to encourage understanding and empathy for the mitigation burden. [Mitigation]			
Actions	**Implementation level**	**Timeframe**	**Spatial focus area**
Begin a dialogue between role players in industry and in the market (including consumers) to increase understanding and empathy for the mitigation / sustainability burden carried by growers and suppliers, with identification of options going forward. Pro-actively showcase positive existing initiatives and “stories”. Foster positive engagement and a culture of collaboration across the value chain as the basis for positive joint solution finding.	Industry Value chain (with market)	2030	All
Contribute to sectoral stakeholder engagements on legal and regulatory developments in South Africa in the global climate change context, and bring into strategic discussions within the industry and market.	Industry Value chain (with market)	2030	All