CONFRONTING
CLIMATE
CHANGE

A SOUTH AFRICAN
FRUIT & WINE INITIATIVE

South African Fruit and Wine Climate Change Program

Component 1 - A review introducing:

- What is Climate change and how will it affect the South African agricultural sector?
- How do agricultural activities play a role in global greenhouse gas emissions?
- The South African Fruit and Wine climate change program going forward

February 2009

EXECUTIVE SUMMARY

Climate change and what it means - There is no doubt that a change in climatic patterns will affect fruit and wine production and such impacts are already being felt within the South African industry. The direct impacts include the physical changes in climate such as increased CO_2 levels and temperatures for example. Such changes affect the productivity, quality of yield, farming costs and suitable crop cultivars and have associated consequences for water resources and pest/disease distributions. Climate change also impacts indirectly, through the growing awareness amongst consumers and the corresponding demand for carbon-efficient business processes. In response to the market driven awareness, suppliers internationally are now being required to report on the greenhouse gas emissions that result from the farming and production processes. Several large international retailers have launched aggressive climate change and environmental programs in the past year. Such programmes are generally focused on reducing the greenhouse gas emissions throughout the supply chain. The South African export market has already felt this pressure from the international retailers, and this pressure is only going to increase in to the future. The industry needs to respond to this from a unified and informed position and in a swift manner before competing countries take the advantage. That is the essence of this project – to assist fruit and wine export producers in understanding and quantifying their greenhouse gas emissions, to provide reduction opportunities, and to suggest marketing and reporting mechanisms to get their stories to the market.

Adaptation and Mitigation – Farming communities inherently utilize adaptation measures such as crop rotations or improved irrigation techniques to overcome variable weather patterns. In many cases adaptation and mitigation measures are implemented synchronously, for example where improved organic inputs will decrease the risk of soil erosion and drought stress, while increasing the soil carbon stocks and improving stability. Overall effects on cropping systems and farm activities will vary regionally, and most importantly, they will depend on the specific management systems in use and their adaptive capacities. As agriculture accounts for 70% of current water withdrawals from rivers, improving the productivity of water use in agriculture remains a growing challenge. Farming practices that utilize technologies and processes that use resources sustainably will be better equipped to face the varied challenges of climate change.

Food Miles – This is the term used to quantify the distance food travels from the producer to the consumer. It is usually used to refer to the overall environmental impact of imported goods in comparison to locally produced goods. The general consensus is that food miles cannot be evaluated in exclusivity. Several interdependent factors need to be considered, for example, consumer product choice (red meat versus vegetables), farm-scale production practices, and the social and economic benefits of international food trade. However, overall, transportation distance and vehicle choice (air freight versus shipping) have the largest impact within the supply chain and should therefore be prioritized for emission reduction interventions.

Heavy emissions from agriculture - The agricultural sector is an energy and fossil fuel intensive industry and contributes between 10-12% of the global greenhouse gas emissions. Globally, the greatest source of emissions are the result of forested or virgin land being converted to agriculture, often termed deforestation and degradation. This accounts for more greenhouse gas emissions than the entire global transport sector. Excluding land-use change, the second highest emission source is from the release of nitrous oxides from mismanaged and over-fertilized soils, followed by methane emissions from livestock farming. This is as a result of the high global warming potentials of nitrous oxide and methane, which are 298 and 25 times greater than carbon dioxide respectively.

Emission reduction opportunities - Within the converted agricultural land such as vineyards and orchards, aside from the transport elements addressed above, significant emission reduction opportunities lie in land management practices. Sustainable farming methods include improved soil management practices, effective irrigation and fertigation, and the use of alternative energies for on-farm production needs (like solar, micro-hydro, biogas and biodiesel), all of which assist in reducing GHG emissions. In addition, by implementing alternative energy interventions, individuals will reduce their dependency on the energy and fuel markets, thereby reducing farm management costs and ensuring sustainability. Technological and skills development activities are significant potential buffers for the agricultural sector to mitigate and adapt to climate change.

This project is set to run for three years with the aim of establishing a credible greenhouse gas accounting system for the South African Fruit and Wine industry. This report serves as the first component and aims to raise awareness and create a platform of common understanding of climate change issues, within the agriculture sector in particular. The second component is the development of a carbon footprinting tool that is standardized, user-friendly and serves as an industry-wide standard and protocol. The first draft of this standard will be publically available in early 2009 and will assist all entities within the fruit and wine export sector by providing the necessary tools and documents to establish their emission status. The third and final component of the project is the industry strategic framework, which will provide a clear context and guidelines for strategic decision-making around an effective response to the threats and opportunities posed by climate-change including clear emission reduction targets and mitigation and adaptation opportunities. The strategic framework aims to be completed by late 2009, with annual updates until the end of 2010.

INTRODUCTION

A global survey by McKinsey (2008) shows that consumers place trust and support in entities that actively address environmental issues, particularly climate change . In addition, action and advocacy at an individual level is leading to government support, legislation and incentives. The South African government is planning legislation that will penalise high energy consumption and reward emission reductions. In the Minister of Finance's budget speech to parliament this year (2008), tax breaks were proposed for farmers who decide to conserve biodiversity and natural habitats. Moreover, the Minister of Environmental Affairs and Tourism recently launched a progressive climate change policy including the introduction of a 'carbon tax' for industry. In general, climate change and associated environmental and economic implications have moved from being seen as a 'green agenda' a few years ago, to an accepted part of economic and business planning.

The primary and secondary agricultural sector plays an important role in South Africa's economy, generating 15% of the GDP and employing 940 000 people. Agricultural exports represent 8% of the country's exports that generates R 20 billion in foreign income. Maintaining and increasing South Africa's share of global fruit and wine markets is therefore important to the long-term economic well-being of South Africa, as well as providing valuable jobs and income streams in rural areas.

The agricultural sector does however contribute significantly to the greenhouse gas (GHG) emissions though the use of agrochemicals, liquid fuels such as petrol and diesel, as well as land-use change. As awareness of human driven climate change has emerged over the past decade, there is an increasing focus on the 'GHG footprint' of agriculture produce and in identifying opportunities to mitigate climate change through soil carbon sequestration and renewable energy technologies.

To preserve South Africa's competitive position in global fruit and wine export markets it is therefore crucial to develop a comprehensive, industry-scale response to climate change. There is a need for a credible, impartial and relevant information resource for the industry that:

- Provides and supports an industry-wide perspective
- Serves to highlight climate change issues, opportunities and threats
- Benchmarks the industry's GHG emissions with global competitors
- Enables informed and authoritative comment, debate and negotiation by stakeholders and policy-makers
- Enables the standardised measurement, reporting and comparison of individual farm and exporter emissions
- Creates an industry standard for GHG auditing and the communication of results
- Guides short and long term strategy formulation by decision-makers across the industry

The aim of this project is to fulfil these requirements through an interactive process involving interested and affected parties. This document serves to introduce the concept of climate change, its impact on the fruit and wine industry, and the South African Fruit and Wine Industry Initiative going forward. Efforts have been made to keep the document brief and links to key additional information have been provided at the end of the document. If queries exist with regard to the industry initiative or climate change in general, please feel free to contact Hugh Campbell, Tony Knowles or Shelly Fuller (contact details at the end of this document) or your own industry contact representative.

THE CONTEXT: CLIMATE CHANGE & AGRICULTURE

INTRODUCING HUMAN-DRIVEN CLIMATE CHANGE

Climate change is not a new phenomenon. Fluctuations in weather patterns over time are a natural occurrence. However, human generated greenhouse gas (GHG) emissions in the form of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are resulting in changes to the climatic patterns beyond natural background rates. Recent reports authored by the world's leading scientists confirm that the increased rate of change is indeed human-induced, due to GHG gases released during fossil fuel use and land use change practices (Rosenzweig et. al., 2008; IPCC, 2007).

In natural quantities, these gases form a thin layer in the atmosphere and regulate the way the atmosphere absorbs and releases energy from the sun. This keeps the earth about 30 degrees Celsius warmer, thus allowing life on earth to exist. However, since the industrial revolution, there has been an excessive build up of GHG. The result is similar to what happens in a greenhouse- heat is absorbed and 'trapped' causing temperatures and humidity to change - hence the term 'Greenhouse Effect' being used in the press.

Scientists predict that an increase of 0.2-6°C will occur, depending on how quickly we change the way we do things. To avoid the worst impacts of climate change, humankind needs to limit the temperature increase to 2°C above pre-industrial levels. Although it seems small, such a change in the average global temperature will have an impact on frequency and intensity of storms, seasonal droughts and floods, flowering and fruiting times, and the types of crops grown. And humankind needs to act immediately. The global climate is already approximately 0.7°C above pre-industrial levels. Even if humans halted greenhouse gasses immediately, the expected warming rate would still be approximately 0.2°C per decade for the next two decades (IPCC, 2007).

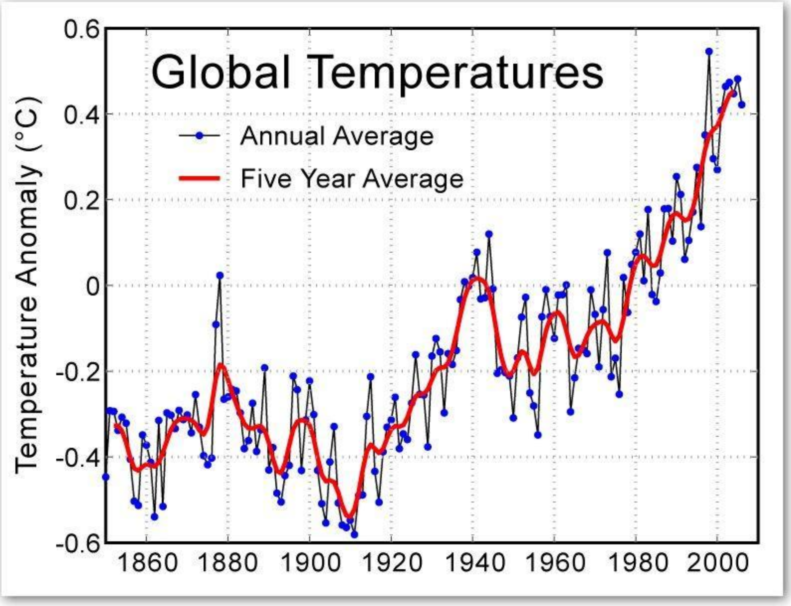

FIGURE 1: Mean Global temperature measured from Global NASA meteorological stations (Source: NASA 2007)

THE ROLE AGRICULTURE PLAYS IN THE GLOBAL GHG LEVELS

The agricultural sector is an energy and fossil fuel intensive industry and directly contributes between 10-12% of the global greenhouse gas emissions on a global scale. The largest source of emissions is the conversion of forested or virgin land to agriculture, which emits 5900 million tons of CO$_2$ equivalent per year. To put this in perspective, 5900 million tons of CO$_2$ is more than that emitted by all transport globally – a sector which is usually targeting for its fossil-fuel based high emissions. Excluding land-use change, the second highest contributor is the release of nitrous oxides from mis-managed and over fertilized soils, followed closely by methane emissions from livestock farming (Figure 2).

The estimates in Figure 2 illustrate global emission trends, which are valuable for indicating emission hotspots within the agricultural sector as a whole. However, depending on farm-scale activities and regional conditions these figures can differ. Particular commodity and farm management practices use differing processes which will impact emissions levels. For this reason, GHG audits are undertaken at a farm-scale. An understanding of the emission hotspots at a farm-scale provides useful information which in turn allows for informed and appropriate management decisions.

Local studies estimate the agricultural sector to be responsible for approximately 9% of the total GHG emissions for the country, the majority resulting from enteric fermentation and manure management (National Greenhouse Gas Inventory Database). In general, electricity usage (Eskom power) is the activity with the highest emissions through the supply chain. This is due to two reasons; firstly, Eskom generation is mainly coal based and secondly, the majority of processing activities (such as the cold storage units, water pumps and power for factory sheds) are powered on electricity sourced from the national grid. Electricity supply is therefore an area where the largest emission reductions could occur if energy efficient technologies are implemented. By implementing renewable energy or energy efficient technologies will also decrease reliance on Eskom for energy which may lower the cost of energy to farm management and reduce exposure to load-shedding activities and secure sustainability going in to the future.

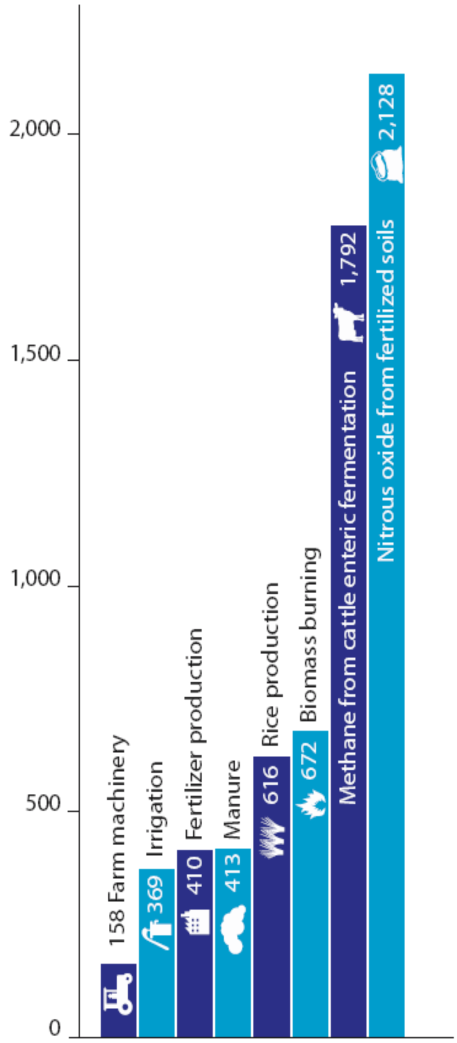

FIGURE 2: Sources of agricultural greenhouse gases excluding land use change measured in million tonne units of CO$_2$e per year (Greenpeace, 2008).

Other reduction opportunities include switching from mass-application to the precision application of synthetic fertilizers, as well as the incorporation of more organic fertilizers which could greatly reduced the GHG emissions while increasing soil carbon levels. Overall, changes in crop selection, fertilization and irrigation can improve the soil carbon levels and reduce the nitrous oxide and CO$_2$ emissions. In addition, improved waste management has the potential to reduce fossil fuel usage while simultaneously reducing methane and nitrous oxide emissions.

THE IMPACTS OF CLIMATE CHANGE FOR THE AGRICULTURAL SECTOR

It is easier to understand the effects of climate change within the agriculture sector if one separates them into two classes, namely *direct* and *indirect* impacts. Direct effects include the physical changes in climate, for example rainfall, temperature and chill units, which affect the productivity of crop species and their geographic distribution. Indirect effects of climate change in comparison are the changes in consumer behaviour and market demand due to increasing public awareness of climate change and environmental issues. Both are explored further below.

DIRECT IMPACTS

Africa has been identified as one of the most vulnerable regions in the world due to a low capacity to respond to climate change. Forecasts for Africa from the latest IPCC report (2007) and others (Walker and Schulze, 2008; Carter, 2006; Benhin, 2006) illustrate the vulnerability and extent of the impacts as summarized below.

- Evidence indicates that South Africa has been getting hotter over the past four decades, with average yearly temperatures increasing by 0.13 °C a decade between 1960 and 2003. There has also been an increase in the number of warmer days and a decrease in the number of cooler days, in particular higher temperature levels for autumn, winter and summer periods.
- At a broad scale, if South Africa were divided into two halves by a north-south line, climatic conditions west of the line are projected to become warmer and drier, while conditions east of the line may become warmer and wetter.
- Seasonal weather patterns will be less predictable and drought and flood events will become more frequent and intense.
- There may be large scale soil erosion, resulting in significant losses of nutrient rich soil, due to increased variability and intensity of rainfall events.
- Overall surface and groundwater resources are projected to decline.
- The increase in temperatures together with the reduction and altering of the timing of the rains is likely therefore to intensify the pressure on the country's scarce water resources, with implications for agriculture, employment and food security.
- By 2020, as many as 75-250 million people are expected to experience water scarcity, in either the physical or economic sense.
- It is expected that crop net revenues may decrease by as much as 90% by 2100, particularly in the western parts of the country.
- It is forecasted that productivity (yield) will decrease, particularly for rain-fed agriculture. Irrigated agriculture will be less vulnerable although the overall decrease in surface and groundwater supplies will put pressure on irrigated agriculture in the future.
- Small scale and monoculture farming is expected to be more vulnerable than multi-crop and/or large scale farming.
- Predicted changes in pests and disease vectors will result in more frequent and intensive outbreaks, combined with changes in their distribution, will cause major crop losses.
- Nutrient and pest control inputs may need to increase as crop varieties become less suitable and less productive in the new climate. Alternative crops or varieties may need to be selected to replace less suitable ones which will have financial consequences for the producer.
- A decline in human health due to direct temperature stress resulting in an increase in the range of disease vectors, particularly malaria and cholera.

It is important to remember that climate change is not just a shift in a single climatic condition, such as temperature, but a shift in a many interlinked climate variables such as temperature, rainfall, humidity, frost, chill units and atmospheric carbon dioxide. Each change is interrelated and plays a role in contributing to the overall affect on crop yield and land productivity as illustrated in Figure 3. For example, when exposed to increases in CO_2 exclusively, crop yields may increase due to amplified root and biomass capacity (Midgley et. al., 2004; Kimball et. al., 2002). However, an increase in temperature coupled with raised CO_2 levels may cause an increase in the rate of soil organic depletion from agro-ecosystems (Walker and Schulze, 2008). This means that larger quantities of artificial nutrient compounds will need to be used, or a shift in cultivars, to maintain productivity.

An increase in temperature to the predicted temperature range (between 0.2 – 6°C) will result in increased evapo-transpiration which, together with the expected drying of ground water supplies, will require an increase in irrigation quantities, or a change in crop choice, both of which will again have cost implications. In addition, climate change is expected to increase the quantity, variety and strength of pests, diseases and weeds species and producers can therefore expect to alter farming practices to avoid major crop damage and losses. The genetic variety of crops can assist in pest and disease resistance. Research has shown that certain varieties are less susceptible to drought, heat stress, pest infestations and diseases and are therefore more suitable for the predicted climate.

As a change in each climate variable may result in a number of impacts on crop production, management decisions need to be considered in a holistic manner to ensure sustainability over the long-term. Short term fixes such as increased irrigation measures may seem to make sense in the short term, but may have great financial and land-use consequences in the long term.

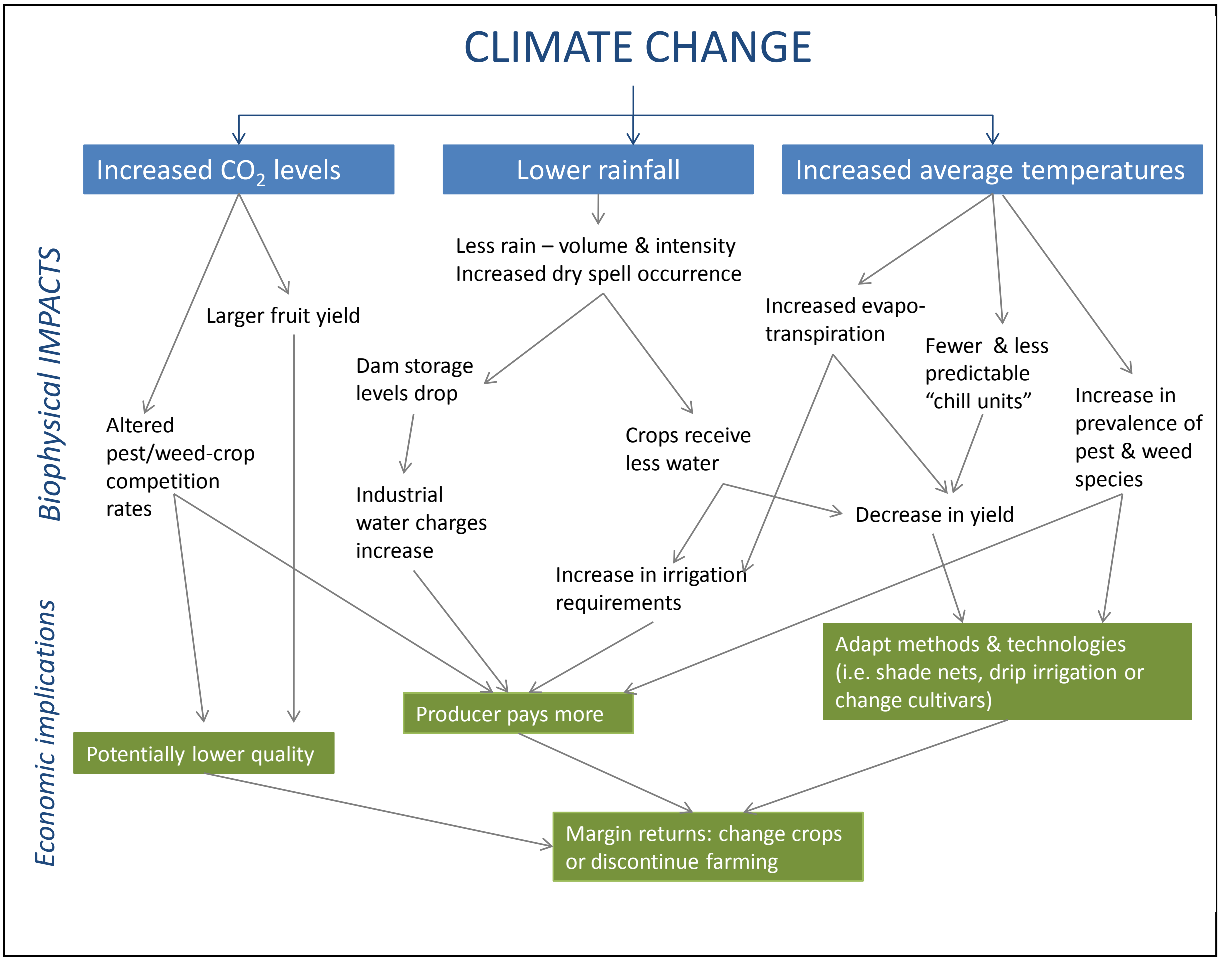

FIGURE 3: Potential impacts of climate change on agricultural crops (adapted from Carter, 2006; Rosenzweig and Tubiello, 2007)

INDIRECT IMPACTS

Climate change also impacts the agricultural industry indirectly through consumer behaviour and purchasing patterns which are currently favouring environmentally "friendly" products. In response to the market driven awareness, suppliers to international markets are now requested to report on the greenhouse gas emissions that result from the farming and production processes. Several large international retailers have launched aggressive environmental programs in the past year. Such programmes are generally focused on the specific retailer reducing the emissions under their control in order to meet certain targets.

Emission reduction targets however filter through the entire supply chain and place substantial pressure on those wishing to supply the UK, Far East and European markets. Pressure has already been felt within the South African fruit and wine industry and an effective and unified response is needed to maintain market share. South African producers need to account for and report on their GHG emissions in terms of their current status, future targets, and reduction initiatives. The disclosure of such information is seen as a good marketing strategy offering an opportunity to differentiate among competing producers. In addition, reducing energy usage will reduce exposure to fluctuating energy and fuel markets.

Food Miles – The concept of "food miles", which is the distance food travels from source (producer) to shelf (consumer), is contentiously seen as a suitable manner of evaluating the overall environmental impacts of imported products versus locally produced goods. The general consensus however is that transport distances cannot be the only factor evaluated in the environmental audit of product choice. Several additional factors need to be considered, for example, product type (red meat versus vegetables), farm-scale production practices, as well as the social and economic benefits associated with international food trade (Carlsson-Kanyama et al., 2003; Sim et. al., 2007, Tukker and Jansen, 2006; Weber and Matthews, 2008). While transportation distance and vehicle choice (air freight versus shipping) have the largest impact within the supply chain and should therefore be prioritized for emission reduction interventions; factors such as timing of consumption (seasonality), the packaging and storage facilities required to keep out of season stock available, and the energy necessary to maintain full year product choice, need to be considered in order to see the full perspective of "food miles".

In addition, local social circumstances and the employment opportunities provided by the production processes cannot be excluded from the food miles debate (Milà i Canals et al. 2007, Sauerbeck, 2001). Generally speaking, in developing countries manual labour still forms the backbone for most of the agricultural production processes, while in developed countries much of those processes are mechanised. A recent study (MacGregor and Vorley, 2006) estimated that over one million livelihoods in Africa are supported by the UK consumption of imported fruit and vegetables alone. This means that although an apple from Grabouw has to travel much farther to get to the UK retailer, the skills development, job creation and local economic growth that result from that imported good, need all be considered as part of the product choice and price equation.

DEVELOPING AN APPROPRIATE RESPONSE TO CLIMATE CHANGE

There are two broad means of responding to climate change, namely adaptation and mitigation, both of which alleviate the potential negative effects of climate change. Climate change **mitigation** is defined as any human action taken to permanently eliminate or reduce the sources[1], or enhance the sinks[2], of greenhouse gases (IPCC, 2001). **Adaptation** refers to the ability of individuals, groups and natural systems to prepare for and respond to changes in climate or their environment (IPCC, 2001). While mitigation tackles the causes of climate change, adaptation tackles the effects of the experience, and both are therefore crucial in reducing vulnerability to climate change.

The potential to adjust and thereby minimize negative impact and maximize any benefits from changes in climate is known as **adaptive capacity**. The greater the degree of prepared action (i.e. adaptation), the lesser the impacts associated with any given degree of climate change. To adequately cope with the challenges of a changing climate, we therefore must mitigate *and* adapt- it is not an either/or.

ADAPTATION MEASURES

Farmers have been practicing adaptation strategies to overcome weather and/or market changes for centuries and have built up valuable knowledge. Cropping rotations, integrated pest management, soil conservation and fallow techniques are all examples of adaptive processes and can contribute significantly to the adaptive capacity of the farm production. The key is to integrate the local knowledge from farmers and land managers with insights and findings from the physical and social sciences in order to select the most appropriate and effective strategy. Such strategies that enhance local adaptation capacity are fundamental to minimize climatic impacts and to maintain regional stability of food production.

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[1] An example of a GHG source is fossil fuel (diesel, petrol or coal) usage or nitrous oxide emissions from over-fertilized soils.

[2] A sink is a process that absorbs and traps carbon dioxide such as those found in forests, soils and oceans.

MITIGATION MEASURES

The agriculture and associated land use change sector is responsible for about a quarter of the CO_2 (through deforestation and soil carbon depletion, machine and fertilizer use), half the methane (through livestock and rice cultivation), and three quarters of the nitrous-oxide (through fertilizer application and manure management) emissions on a global annual basis (Rosenzweig and Tubiello, 2007). Modifying current land and agricultural management techniques could therefore greatly assist in mitigating climate change. Increasing carbon sequestration[3] through improved soil management and reducing electricity and diesel usage are the two most effective mitigation measures within the agricultural sector.

The main difference between the two measures is that the direct benefits of carbon sequestration are limited in time, typically 20-40 years, while those arising from reduced CO_2 emissions will last as long as the relative management changes are maintained (Rosenzweig and Tubiello, 2007). It is therefore recommended to implement a combined approach which incorporates both technological and sequestration measures for high impact and long term sustainability. The availability and advancement of technology will affect the utilization and effectiveness of implemented mitigation measures, as well as the sustainability of the shift to conservation agriculture practices.

THE ROLE OF TECHNOLOGY AND SUSTAINABLE AGRICULTURE

There are several mechanisms that could form a buffer against variable climatic patterns. Technology is one such mechanism, which may be in the form of skills development and knowledge sharing, or mechanical technologies that assist in improving farming efficiency such as waste to energy equipment. Research has shown that the impact of climate change on farming will vary depending on the use of technology and the way the land is managed (Walker and Schulze, 2008).

Sustainable farming practices incorporating resource conserving methods and technologies (water, soil and genetic resource conservation), can lead to an increase in yield going forward as well as forming a cost-efficient means of adapting to climate change (Pretty et al., 2006). Adaptation and mitigation measure need not always involve expensive complicated interventions; simple, cost efficient changes can make a substantial difference.

Energy efficiency is considered to be a key indicator of sustainable farming. Crop production methods that reduce energy requirements while maintaining output are important components of a sustainable agricultural system. Simple, sustainable technologies relevant to a South African context include:

- **Water management** - Sustainable water utilization technologies and improved waste- and rain-water management practices would greatly reduce our food security and economic risk.
- Improvements in organic matter accumulation in **soils and carbon sequestration** (Figure 4) through integrated nutrient management, and effective cover crop and mulching practices would improve soil quality and lessen the nutrient input and water requirements.
- Pest, weed and disease control emphasising in-field **biodiversity** (i.e. genetic resources) and reduced pesticide use would enhance the crops natural ability to protect itself, thereby requiring fewer chemical inputs.
- Incorporating **social learning and skills development** in process forms a vital part of the success of the transition and long term sustainability of conservation agricultural practices.

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[3] "Sequestration" infers long-term storage, generally longer than 20 years. It is a scientific term that is common used in climate change literature to denote the long term storage of carbon in wood or the organic content of soil. See also Appendix for Glossary of Terms

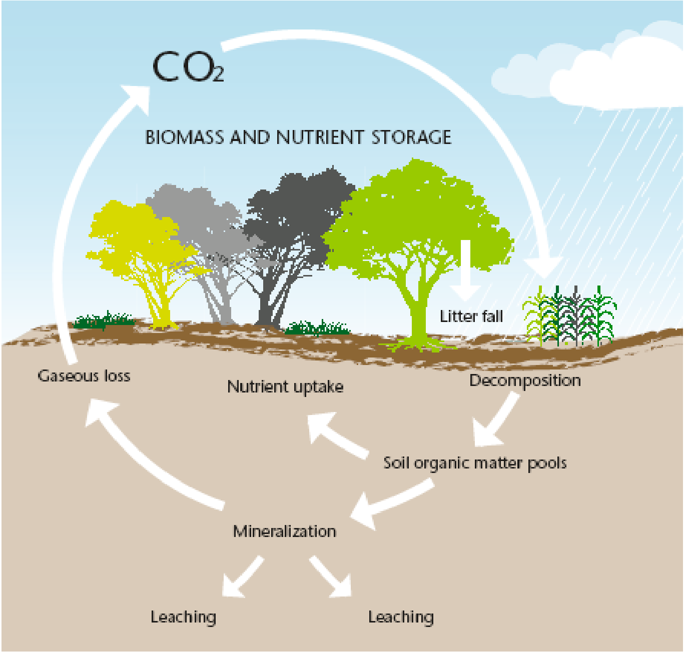

FIGURE 4: Above ground and below ground sequestration (WBCSD, 2008)

THE THREE STAGES TO DEVELOPING A RESPONSE

There are three broad stages to developing a comprehensive climate change response:

1. An audit of current greenhouse gas emissions throughout the supply chain

This allows each entity to gain an understanding of GHG emissions resulting from their own activities and throughout the supply chain.

2. The development of a comprehensive strategy including clear goals and costs

The information obtained from the GHG assessment will be used to strategically identify reduction opportunities and establish realistic goals and targets. It will incorporate an analysis of similar initiatives in ‘competing countries’ such as Australia, New Zealand and the United States, and conclude with a communication and marketing advice for the South African industry as well as individual farmers and exporters.

3. An implementation plan

The plan will provide a clear pathway to achieving the goals and targets outlined in the strategy document. It will include a detailed description of opportunities, the process required to realise such opportunities, potential costs, and how to communicate climate change initiatives to stakeholders.

THE GHG FOOTPRINT AUDITING PROCESS

Quantifying greenhouse gases enables business to develop and prioritise opportunities that will effectively reduce emissions, cut costs and create new commercial opportunities. Although this process relies on collaborative work through the supply chain, most companies are generally inward-focused and fairly secretive regarding energy consumption and GHG emissions. A study done in the United Kingdom by the Carbon Trust (2006) illustrated that when companies were willing to work collaboratively with the companies in their supply chain, it resulted in additional opportunities to build influence, create knowledge, reduce carbon emissions and generate financial returns.

THE DIFFERENT STANDARDS

In order to ensure comparable assessments that are accurate and consistent, a standardized global-scale method for greenhouse gas audit needs to be used consistently throughout the audit. To date, the **Greenhouse Gas Protocol** (GHG Protocol) is the leading peer-reviewed authority and protocol for broad-based GHG accounting and reporting (www.ghgprotocol.org). Due to the intensive peer-review process and input from many companies, organisations and individual experts, the protocol has become the most widely used international accounting tool and is considered to represent “best practice” (Forum for the Future, 2008).

The GHG Protocol provides step-by-step guidance for entities at all scales, from governments, corporations, farms and individuals to quantify greenhouse gas emissions. It is designed to offer guidelines on how to develop a verifiable inventory but does not provide in depth guidance for how the verification process should be conducted. This is more comprehensively accomplished by the ISO 14064:3 (Greenhouse gases- Part 3: Specification with guidance for the validation and verification of greenhouse gas assertion). Moreover, it is consistent with Intergovernmental Panel on Climate Change Greenhouse Gas Guidelines (IPCC) and is designed to be program or policy neutral, thereby providing an accounting framework for most GHG programs around the world. Due to popular demand, the GHG Protocol team is also in the early phases of developing a “Product/Supply Chain Standard”, which based on a life-cycle approach and aims to be available by May 2010.

In addition to the framework provided by the GHG Protocol, the Carbon Trust and the BSI (British Standards Institute) have together been developing a publically available standard called the **PAS 2050**. The first draft of the PAS 2050 was published in late October 2008 and is specifically aimed at measuring embodied GHG emissions of goods and services. It is a life cycle assessment, meaning that it incorporates the GHG emissions throughout the supply chain, which includes the creating, modifying, transporting, storing, using, providing, recycling or disposing of products – otherwise known as “cradle to grave”.

By using this methodology, organisations can improve their understanding of the GHG emissions arising from various goods and services at each stage of the supply chain. It is however, a thorough process and commitment from all parties in the supply chain for the process to be successful and valid. Although the PAS 2050 is based on methods established by ISO 14040 (Environmental management – Life cycle assessment – Principles and framework) and ISO 14044 (Environmental management – Life cycle assessment – Requirements and guidelines), it is in its inception phase and is therefore not regarded as a British Standard, European Standard or International Standard. For these reasons, it is felt that the PAS 2050 is too detailed for the current scope required by the South African Fruit and Wine Industry Tool. Any relevant aspects, however, will be incorporated in to the industry tool where applicable.

Aside from the GHG Protocol and PAS 2050 standards, the Integrated Production of Wine (IPW) collaborated with industry bodies from USA, NZ and Australia to develop the **International Wine Carbon Calculator Protocol** (Provisor, 2008). Based mainly on the GHG Protocol and incorporating some elements for the life cycle approach outlined in the PAS 2050, the Protocol aims to “provide general guidance on the significant emissions associated with individual products” (Provisor, 2008). It does not qualify as a full life cycle analysis in terms of international standards, although it does include elements relevant to the wine processing and supply chain, thereby allowing a holistic understanding of GHG emissions in the specific wine industry.

It is the aim of this project to develop the South African industry standard based on the most relevant and scientifically sound processes which will incorporate elements from standards introduced above. It will be based on local data where possible and be reflective of local conditions and circumstances.

THE PATHWAY FORWARD FOR THIS PROJECT

This project is divided in to three main components, as illustrated in Figure 5. This report serves as the first component- a general introduction to global climate change and climate change issues within the South African agriculture sector. The second component is the development of a standardized industry carbon footprinting protocol and tool. The tool will allow individual farmers to calculate their carbon footprint based on their data input and will be web-based and thus freely available. Initially based on local input, the aim is to develop a standard and footprinting tool that is globally recognized, accredited and utilized by all agricultural export sectors. The first draft of this standard will be publically available in early 2009, with final version trailed and ready by mid 2009. An example of typical inputs required for an agro-production GHG audit is illustrated in Figure 6.

The third and final component of the project is the industry strategic framework, which will be developed using the data collected by the carbon calculator tool of Component Two. The framework will provide a clear context and guidelines for strategic decision-making around an effective response to the threats and opportunities posed by climate-change, including clear emission reduction targets and mitigation and adaptation opportunities. It will have a strong research and development focus and will be aligned with the national and international policies and processes already in place, and those planned for the future, so as to ensure the support and sustainability of the project and related processes. Additionally, the framework will ensure flexibility within the system to allow accessibility by other industries with similar processes, notably those within the agricultural export industry (such as the tea and flower exporters), thereby broadening the network and assisting in making sure the same standard is used throughout the industry. Finally, the strategic framework will be reviewed annually and updated accordingly. See Figure 7 for a schematic flow chart of expected timeframes of the project.

HOW CAN YOU BE INVOLVED?

The success of this project is highly dependent on industry involvement to ensure adequate representation and consultation throughout the process. This will take place through workshop engagements which will provide a platform where feedback, suggestions and progressive planning can be discussed. Aside from the strategic workshop sessions, communication is encouraged throughout the process. Please do not hesitate to contact any member of the project team (details below) if further information is required.

Overall there will be several tiers of interaction. The project will be directed by the steering committee, a ten person group representing industry stakeholders, funders and expert advisors. The role of the steering committee will include the following:

1. Set the scope of the project
2. Monitor and review the progress at set intervals throughout the project
3. Guide the project
4. Ensure the outputs are communicated to the various industries

A second tier of interaction with the project will be with the Interest and Stakeholder Group. This group will play a major role in communicating the progress and outputs to the sector. The third tier of interaction will be in the form of direct communications to the growers, processors, exporters and different role-players in the greater industry. This process will be further clarified by the steering committee.

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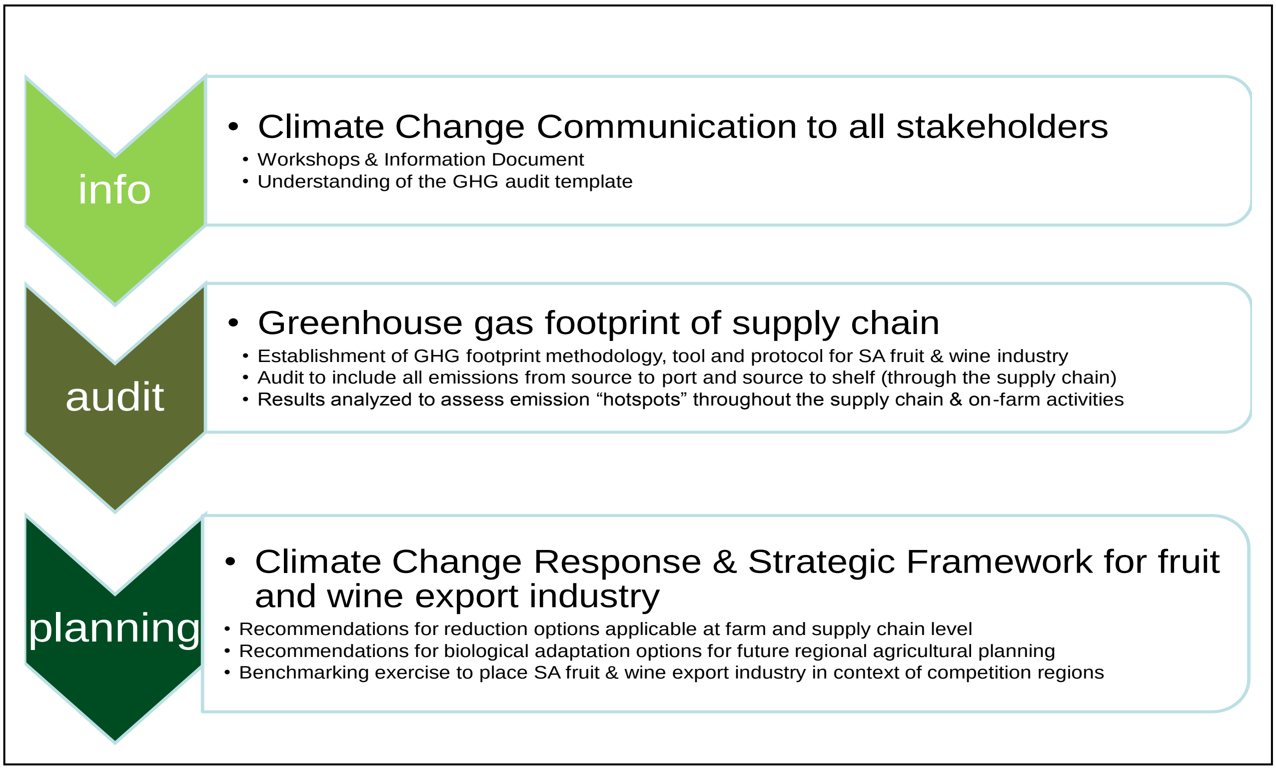

- Climate Change Communication to all stakeholders
  - Workshops & Information Document
  - Understanding of the GHG audit template
- Greenhouse gas footprint of supply chain
  - Establishment of GHG footprint methodology, tool and protocol for SA fruit & wine industry
  - Audit to include all emissions from source to port and source to shelf (through the supply chain)
  - Results analyzed to assess emission “hotspots” throughout the supply chain & on-farm activities
- Climate Change Response & Strategic Framework for fruit and wine export industry
  - Recommendations for reduction options applicable at farm and supply chain level
  - Recommendations for biological adaptation options for future regional agricultural planning
  - Benchmarking exercise to place SA fruit & wine export industry in context of competition regions

FIGURE 5: Schematic flow chart of the broad-level project processes

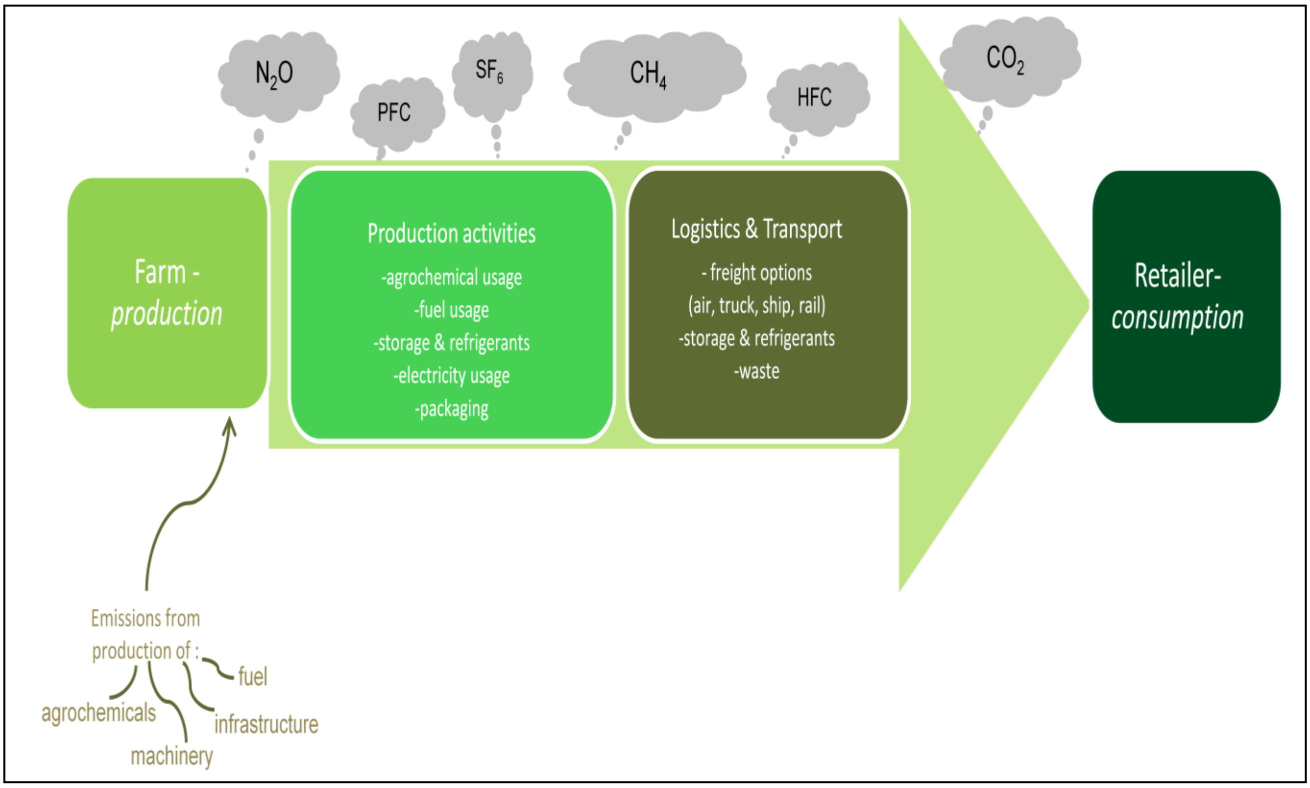

FIGURE 6: Schematic flow chart illustrating what can be included in a typical GHG audit of an agro-production supply chain (Note: Abbreviations follow the Kyoto Protocol’s identification of the major GHGs: N_2O – Nitrous oxide, PCF-perflurocarbons , SF_6 –sulfur hexafloride, CH_4 - Methane, HFC- hydroflorocarbons, and CO_2 – Carbon dioxide).

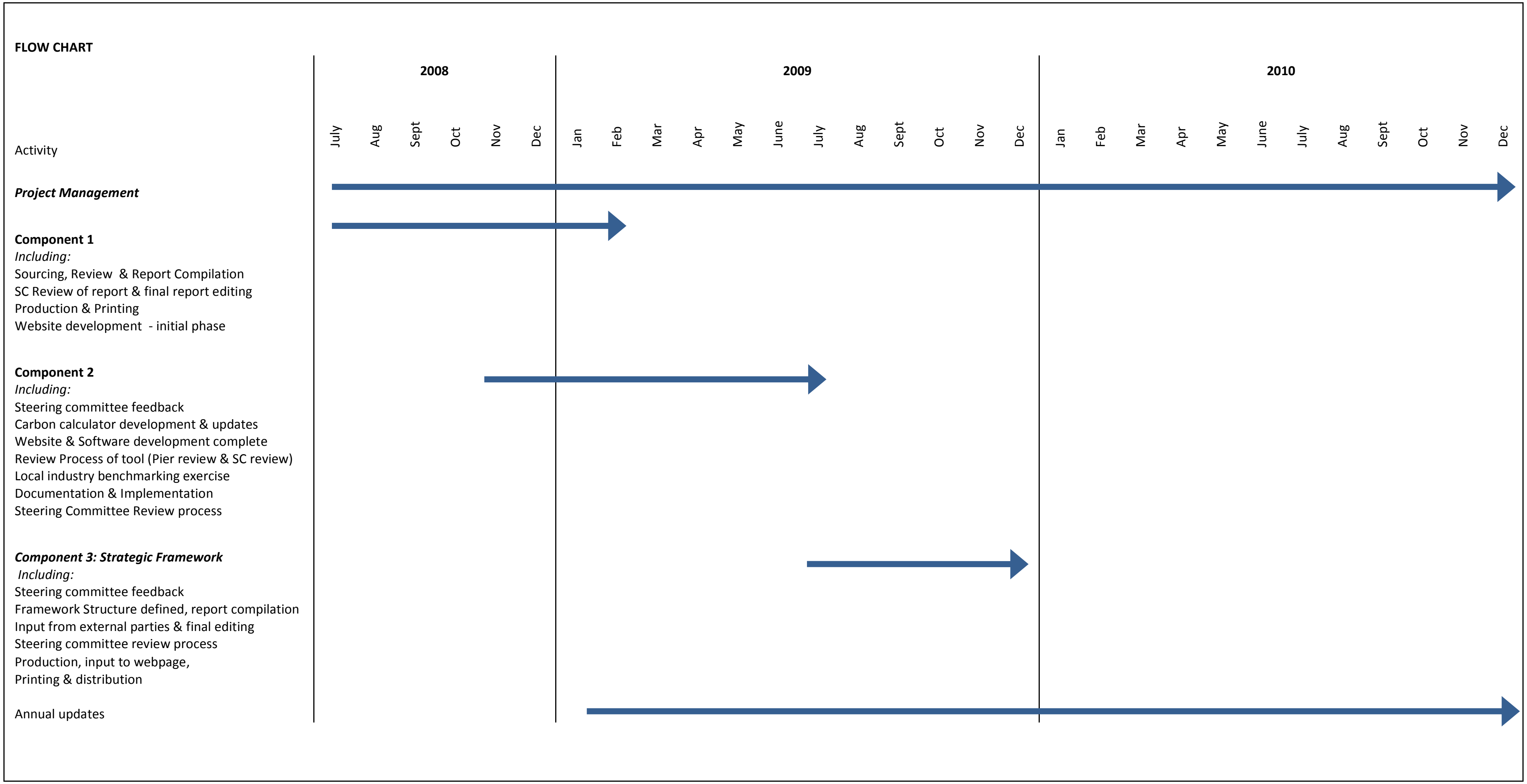

FIGURE 7: Schematic flow chart of project time deliverables and time frames

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Figures

Figure 1: NASA (2007) GISS Surface Temperature Analysis. Global Temperature Trends: 2007 Summation

Figure 2: Greenpeace (2008). Cool farming: climate impacts of agriculture and mitigation potential.

Figure 4: WBCSD (2008). Agricultural Ecosystems. Facts and Trends.World Business Council for Sustainable Development. www.wbcsd.org

APPENDIX 1: GLOSSARY OF TERMS

Carbon sequestration
Carbon is stored in both plants and the soil. Through the process of photosynthesis, plants 'breath' in carbon dioxide on a daily basis. The plants break down the carbon dioxide in to carbon, which is stored in the plant, and the oxygen is released back in to the atmosphere. The absorption and storage of carbon is known as carbon sequestration and is most commonly used in reference to woody biomass and forests as wood is approximately 50 percent carbon. Through decomposition of plants, carbon and other nutrients are returned to the soil. Figure 4 illustrates the carbon cycle through the above ground and below ground sequestration process. Improvements made in the form of regeneration of forests or woodlands, and/or increased soil carbon storage through no tillage and efficient soil management practices, will lead to a net increase in stored carbon over time. If such improvements are in addition to the business-as-usual farm activities, and the resulting additional carbon sequestered can be quantified (as units of carbon stored or units of CO_2 sequestered), then these carbon units can be traded as carbon credits in the carbon market and become an additional revenue stream for the farm. Soil carbon sequestration offers a great potential to decrease CO_2 emissions within agricultural land through accumulation of soil organic matter and by producing suitable biomass as a substitute for on-site fossil fuel use (Lal, 2004; Sauerbeck, 2001; Prentice et. al., 2001).

Carbon dioxide equivalent (CO2e)
It is asserted that the increased carbon dioxide (CO_2) emissions is the predominant cause of global warming and climate change. However other GHGs play a role, particularly methane (CH_4) and N_2O in the agricultural sector. To allow for an equal comparison between the different gases, scientists have defined multipliers for the gases in relations to their global warming potential (GWP), all relative to one CO_2 unit. For example, methane (CH_4) has a GWP of 25 and therefore 1 unit of CO_2 = 25 units of CO_2e (CH_4).

Carbon neutrality
An entity, be it an individual, a farm or an industrial complex, can be defined as "carbon neutral" when the sum of the atmospheric carbon dioxide emissions and reductions due to their activities equals zero. Carbon neutrality is usually assessed through a full life-cycle analysis that includes all potential sources and sinks of atmospheric carbon dioxide within predefined boundaries. Carbon neutrality is calculated over a defined period, usually a calendar year.

Emission factor
The average emissions rate of a given pollutant for a given source, relative to the intensity of a specific activity. Emission factors are used to derive estimates of greenhouse gas emissions based on various types of activities, such as the amount of fuel combusted, the number of stock in an animal husbandry, the distance travelled or on any industrial production process or similar activity data. The activity data is then multiplied by the emission factor to estimate the global warming potential of that activity, for example if a vehicle travelled 100 km and the emission factor for a petrol-based vehicle is 2.40 kg CO_2e/litre used then the GWP of the vehicle driving 100 km is 100 x 2.40 = 240 kg CO_2e.

Emission reduction
The term used to define the quantity of greenhouse gases (GHGs) that are prevented from entering the atmosphere, usually measured as a unit (tonne) of carbon dioxide equivalent (CO_2e).

Global warming potential (GWP)
A measure given to estimate how much mass of a specific greenhouse gas contributes to global warming. It is a relative scale that compares the specific gas to that of the same mass of carbon dioxide (whose GWP is by definition = 1). The GWP is calculated over a specific time interval, more often over a 100 year timeframe. The global warming potential (GWP) of the seven main GHGs over a 100 year lifespan is:

- Carbon dioxide (CO_2) = 1 GWP
- Methane (CH_4) = 25 GWP
- Nitrous oxide (N_2O) = 298 GWP
- Hydrofluorocarbon (HFC) 134a = 1,430 GWP
- Perfluorocarbon (PFC) = 6,500 GWP
- Hydrofluorocarbon (HFC) 23 = 14,800 GWP
- Sulfur hexafluoride (SF_6) = 22,800 GWP