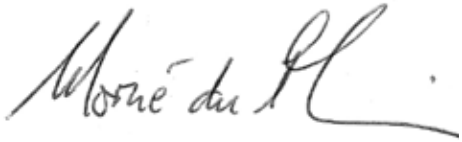
AGRICULTURE: FACTS & TRENDS
South Africa

FOREWORD

This report provides a snapshot of the overwhelming evidence that we need better environmental practices if we want to ensure ongoing productive agricultural systems and food security in South Africa. It also serves to underpin WWF's drive to promote the protection of natural ecosystems, which produce the critical goods and services that underpin agricultural practices in the country. We have not attempted to specify every issue, but rather aimed to provide a broad view of the negative impacts of agricultural development that is focused on maximum productivity by exploiting natural resources while disregarding the complex hidden costs – financial and otherwise – of food production. It also highlights some of the best-practice solutions we need to follow if we want to meet our growing demand for food and fibre – one of the key challenges of the 21st century.

The information has been compiled from diverse and reliable sources to construct a vivid picture of the state of our agricultural resources. It is intended to stimulate debate and catalyse collaboration throughout the agricultural value chain.



Dr Morné du Plessis, *CEO WWF-SA*

Agriculture has done more to reshape the natural world than anything else we humans do, both its landscapes and its fauna and flora. Our eating also constitutes a relationship with dozens of other species – plants, animals and fungi – with which we have co-evolved to the point where our fates are deeply intertwined.

Michael Pollan, The Omnivore's Dilemma

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Agriculture is the foundation of developing economies. As one of these economies, South Africa needs to ensure a healthy agricultural industry that contributes to the country's gross domestic product (GDP), food security, social welfare, job creation and ecotourism, while adding value to raw materials. But the health of the agricultural sector depends on the sustainability of farming methods. Farming practices must therefore not only protect the long-term productivity of the land, but must also ensure profitable yields and the well-being of farmers and farm workers.

THE CONTEXT

South Africa's agricultural regions

South Africa is a rich and diverse country. It has a vibrant cultural diversity and a spectacular range of vegetation types, biodiversity, climates and soil types. The country can be divided into distinct farming regions, and farming activities range from intensive crop production in winter rainfall and high summer rainfall areas, to cattle ranching in the bushveld and sheep farming in the more arid regions.

Climate-soil combinations leave only 12% of the country suitable for the production of rain-fed crops. With only 3% considered truly fertile land, South Africa falls short of other countries, such as India, where arable land covers 53% of the country. Most of South Africa's land surface (69%) is suitable for grazing, and livestock farming is by far the largest agricultural sector in the country.

Agricultural regions of South Africa

Source: FAO Corporate Document Repository

Sustainable farming is about meeting the needs of South Africans today and in the future. The recent global rise in food prices and repeated reports about social unrest in a large number of countries reveal the strategic and basic importance of the agricultural sector for social and economic stability.

Increasing need and changing food consumption

South Africa's population is growing at almost 2% per year. The population of 49 million in 2009 is expected to grow to 82 million by the year 2035. Food production or imports must more than double to feed the expanding population, and production needs to increase using the same or fewer natural resources. In addition, the demand for certain food types will shift as more people become wealthier.

South Africans have already shown interesting changes in food consumption since the 1970s. Thanks to increased wealth and post-apartheid reforms, the country's middle class has increased by 30% between 2001 and 2004. This has allowed a shift from staple grain crops to a more diverse diet. South Africans have shown a decrease in the consumption of the staples maize and bread, and have massively increased their annual consumption of chicken from 6 kg to 27 kg per person. Per capita egg consumption has also doubled. Interestingly, the per capita consumption of fruit and vegetables has remained constant, while beef, mutton, pork and milk consumption has declined (Agricultural Statistics, 2008).

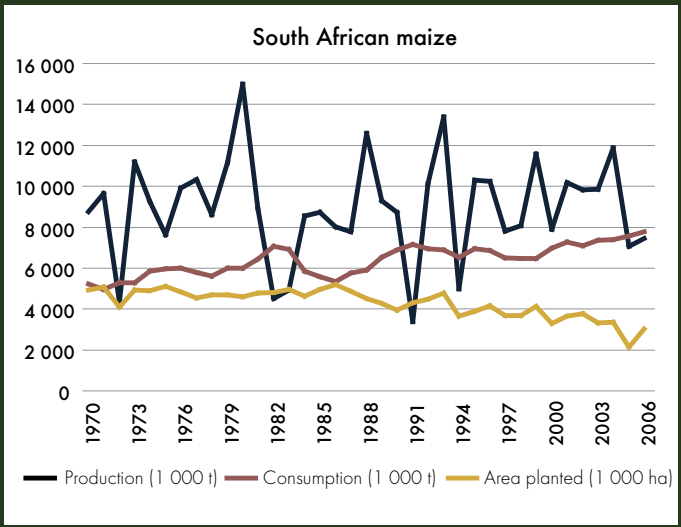
Production vs Demand

Maize and wheat: The shift to the consumption of chicken and eggs is a less efficient use of South Africa's maize than direct human consumption. About half of South Africa's maize is used for animal feed, and about 70% of the feed is used for poultry. Nevertheless, the conversion of maize to chicken is more efficient than the conversion of maize to feedlot beef (exclusively range-fed beef has no impact on South Africa's maize supplies).

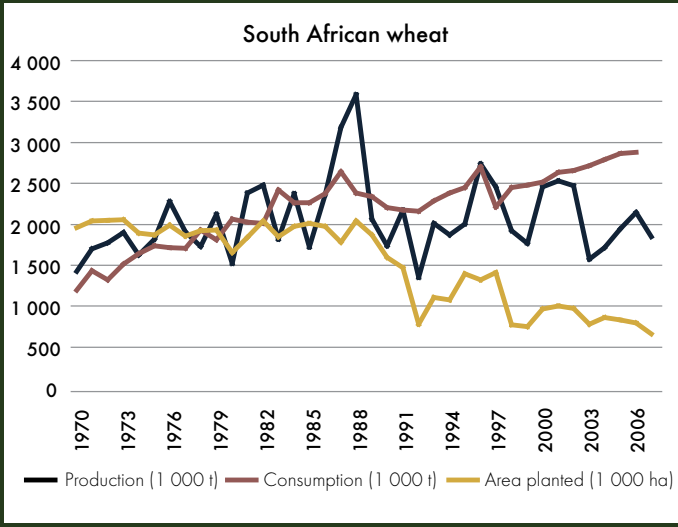
While annual national maize production in South Africa fluctuates widely according to rainfall, average production has remained constant over time. This is a concern, as consumption has increased with the growing population and maize production may soon not meet local demand, affecting both local and regional supply. Like maize, wheat production also fluctuates and again average production has remained constant while consumption has increased dramatically over time. In recent years, wheat imports have increased massively to meet local demand.

Red meat, chicken and dairy: South African red meat production has kept up with consumption, although there has been some export of higher-grade meat and import of lower grades. Local poultry production has increased significantly over the last 20 years, but has not been able to meet the massive increase in local demand for white meat, and chicken is now one of South Africa's largest agricultural imports. South African milk production has been relatively constant, although imports of dairy products have exceeded exports since 2000.

Deciduous fruit and citrus: South Africa is well known for the high quality of its deciduous fruit and citrus, over half of which is exported. The volume of these agricultural exports has increased dramatically over the past 20 years, generating foreign exchange and profits for local farmers.



Source data: Agricultural Statistics, 2008



Source data: Agricultural Statistics, 2008

Water availability is the single most important factor that limits agricultural production in South Africa. Furthermore, the situation is likely to become dire due to rapidly increasing demand from other sectors of the economy and climate change.

Shifting trend towards intensified agriculture

Declining farming profitability and water scarcity (drought, declining rainfall or over-demand for water) has left South Africa with less than two-thirds of the number of farms it had in the early 1990s. In many instances the lost farms have been changed to other land uses, or consolidated into larger farming units to achieve effective economies of scale. Although the area under maize, wheat and dairy (5% of the national herd) has decreased significantly over the last 20 years (Agricultural Statistics, 2008), production remains relatively constant, indicating an increasing trend in intensified production.

The remaining farms have generally increased their irrigation, fuel, fertiliser, mechanisation and genetically modified seed inputs. In many cases, advisory services provided by fertiliser companies and agribusinesses have entered the vacuum of the underresourced government extension service. These corporate companies provide their own extension staff and build relationships with farmers, which can create a dependence on the products they promote and sell.

Poorly managed intensive farming has many negative impacts on the natural environment, on people's well-being and on a farmer's ability to adapt to change. A dependence and overuse of synthetic fertilisers, pesticides and herbicides reduces long-term soil fertility, causes soil erosion, pollutes water supplies, poisons fragile ecosystems, exposes farmers and farm workers to toxins, and contributes to climate change through greenhouse gas emissions.

If we can reduce food loss and wastage, we won't need to produce so much more. A lot of food is lost between the farmers' field and the dinner table – in food storage, transport, food processing, retail ... and in our kitchens.

Input costs required for intensive farming are increasing. These costs are also subject to changes in the oil price, the price of raw materials and exchange rate fluctuations, leaving the farmer with little control over his/her affairs.

The cumulative impact of these factors degrades farmlands and their vital catchment areas. As a result, the long-term productivity declines and these areas become more vulnerable to climate change. Intensified agriculture often also means increased mechanisation, which in turn means fewer jobs on farms. This affects the country's social well-being. The move towards genetically modified (GM) crops that depend on herbicides and fertilisers make farmers increasingly reliant on profit-orientated companies. Use of genetically modified crops and certain pesticides, herbicides and fertilisers may also isolate South Africa from lucrative export markets. Relying on single-variety crops is also risky. If these crops fail to perform, it will have a significant impact on national production.

Consumers throw away more than a third of the food they have paid for and taken home.

(Lundqvist et al., 2008)

In 2007, fertiliser imported from China and used on Eastern Cape pineapple farms was found to contain toxic levels of cadmium, arsenic and lead, and resulted in an export ban by the EU. As a result, pineapple farmers lost a fortune and important EU markets were jeopardised.

An exciting new trend

The organic (chemical free) industry is the fastest-growing industry segment worldwide. World organic food sales jumped from $23 billion in 2002 to $52 billion in 2008 (Datamonitor, 2009).

It's tough out there

Being a conventional farmer in South Africa is one of the toughest jobs around.

Here are some of the challenges faced daily:

- Rising input costs and dependence on external factors that the farmer cannot control, such as the oil price and the exchange rate
- Finite natural resources (looming water scarcity, increasing loss of soil)
- Lack of subsidies and extension support, for established commercial farmers and for emerging/developing black farmers
- Very little market predictability, and non-tariff trade barriers in importing countries
- Increasing competition from cheap, subsidised imports
- Exposure to toxic chemicals
- High murder rate and increasing tenure insecurity
- Predicted negative long-term changes in the climate
- Decline in the health and functioning of our supporting and underpinning natural systems.

An emerging trend – sustaining living farms

South Africa requires a more sustainable approach, or the welfare of our nation – both current and future generations – is at risk. Mismanaged agricultural industrialisation and intensification could compromise food safety and increase unemployment and environmental degradation.

In contrast, sustainable agricultural practices aim to:

- ✔ Change the way land and water resources are managed, so that their long-term productivity is optimised and sustained
- ✔ Contribute to the economic and social well-being of all
- ✔ Ensure a safe and high-quality supply of agricultural products
- ✔ Safeguard the livelihood and well-being of farmers, farm workers and their families
- ✔ Maintain healthy, functioning agricultural ecosystems rich in biodiversity
- ✔ Mitigate and adapt to climate change.

The benefits of sustainable farming should be:

- ✔ Reduced or predictable input costs
- ✔ Stabilised yields
- ✔ Reduced environmental pollution
- ✔ Reduced exposure to toxins
- ✔ Increased water use efficiency
- ✔ Living soils – increased soil fertility and/or nutrient-holding capacity
- ✔ Reduced soil erosion
- ✔ Carbon sequestration (mitigating climate change)
- ✔ Enhanced, robust natural systems protecting biodiversity and ecosystem services.

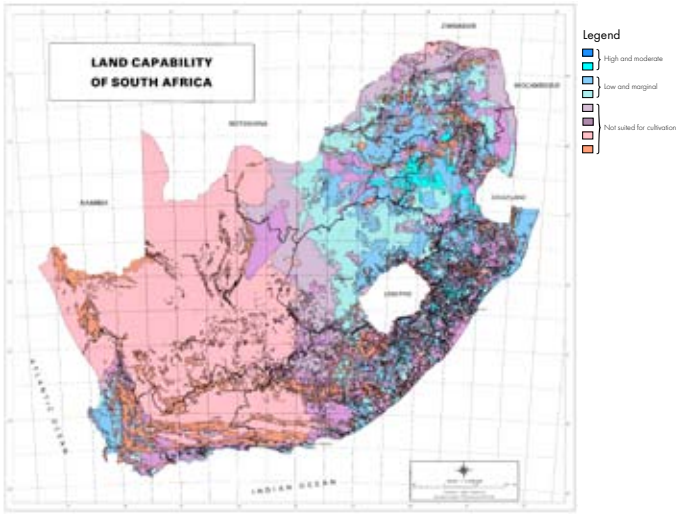
South Africa has a history of change, and is a country that adapts well to social and political changes. Once again we need to draw on our common strengths and our commitment to mobilise our resources and change for the better. We need to realise that all South Africans are affected by the health of our agricultural sector. Sustainable solutions will require collaboration between government, industry, producers and the scientific and conservation community.

The whole of creation depends upon the soil, which is the ultimate foundation of our existence.

Friederich A Fallow

South Africa has limited fertile land and the majority of crop farmers need to increase the fertility of their soils to achieve good crop yields. Farmers in the fertile areas also need to maintain the fertility of their soils, as frequent cropping depletes the soil of nutrients. How farmers improve or maintain soil fertility is central to the sustainability of their operation.

LAND & SOIL



Land capability including climate restrictions
Source: Institute for Soil, Climate and Water, Agricultural Research Council

While a third of South Africa receives sufficient rain for crop production, only a third of this area (approximately 12% of the country) has fertile soil. Most of this is marginal for crop production and less than 3% of South Africa is considered as high-potential land (high and moderate areas on map).

Setting the scene

Changing land management practices

Since ancient times, organic fertilisers (manure, urea, plant matter, bones, shells, lime) have been used to improve soil. Synthetic fertilisers emerged in the 17th century and the industry burgeoned after the First World War, when facilities that had produced ammonia and nitrates for explosives were converted to produce nitrogen fertilisers. The development of the South African fertiliser industry dovetailed with the country's mining industry, which necessitated the production of explosives in South Africa.

Correctly applied, fertilisers have a positive impact on soil fertility and plant growth, and were one of the main drivers behind the 20th century's Green Revolution. By increasing the production potential of land, fertilisers also protect the natural environment from agricultural expansion. Yet, if overused, both organic and synthetic fertilisers cause major damage to the environment. Both run off into rivers and pollute groundwater, and when applied in single large doses, their nitrogen is released into the atmosphere as nitrous oxide – a greenhouse gas 300 times more potent than carbon dioxide.

Poorly applied, synthetic fertilisers also reduce soil fertility – the opposite effect to what they are intended to achieve (Mulvaney et al., 2009). Exclusive use of synthetic fertilisers leads to a decline in soil organic matter and soil life. Eventually the soil becomes devoid of life, and only provides physical support to the plant. At this stage the farmer is completely reliant on fertiliser and may increase inputs to compensate for the reduced soil fertility. If continued, this practice leads to acidic and salty soil with, in some cases, high levels of toxic metals and radioactive elements.

More than 5 million hectares (more than double the size of Kruger National Park) of cultivated land have already been seriously acidified in South Africa (SA Yearbook, 2008/9). This degraded soil is prone to erosion, and the subsurface soil layers that remain are significantly less fertile and less absorbent.

Salty soils

Irrigation, which is used to expand crop production beyond South Africa's rain-fed areas, can reduce soil fertility by building up salts in the soil (salinisation). An estimated 260 000 ha of irrigated land in South Africa is affected by salinisation. About 15 000 ha of this is serious enough to limit the choice of crops to salt-tolerant species only and would require costly rehabilitation. The main cause of salinisation is irrigation in arid areas where evaporation rates are high and rainfall is too low to leach salts from the soil. Irrigation with salty water dramatically worsens the problem, for example in coastal areas where the overexploitation of groundwater lowers the water table, causing the intrusion of marine water.

Crops can be grown for several years without ploughing. This practice, called minimum or no-till farming, ensures that the soil is less prone to erosion and effectively retains its organic matter, water and nutrients. Reduced ploughing also reduces fuel costs on the farm. Between plantings, the soil should be planted with cover crops to reduce soil surface temperatures, protect it from wind and rain erosion, increase soil organic matter and maintain healthy populations of soil microbes. Legumes are beneficial as they increase soil nitrogen.

Ploughing the land

Ploughing (otherwise known as tillage) is one of the oldest methods of preparing the soil for planting and controlling weeds, but is also one of the most abused methods. The mould board plough originated in Europe to turn over, dry out and warm up frigid, water-logged European soil in spring. In the South African context, the use of this imported practice results in ploughing dry, sun-baked soil and makes little sense.

Poorly managed, tillage can have a detrimental effect on the soil. It can cause a compaction layer (a plough pan) below the plough level, which can lead to decreased water infiltration and erosion of the topsoil. The increased use of heavy machinery has also caused compaction layers on top of many soils, making these areas prone to erosion. Excessive ploughing stimulates the breakdown of organic matter in the soil. This not only diminishes this precious soil resource, but also releases carbon dioxide into the atmosphere, contributing to climate change.

A characteristic of most South African soils is that they are extremely vulnerable to degradation and have low recovery potential. Thus even small mistakes in land management can be devastating, with little chance of recovery. It is estimated that 25% of South Africa s soils are highly susceptible to wind erosion. These include the sandy soils of the North West and the Free State – the areas that produce 75% of the country's maize.

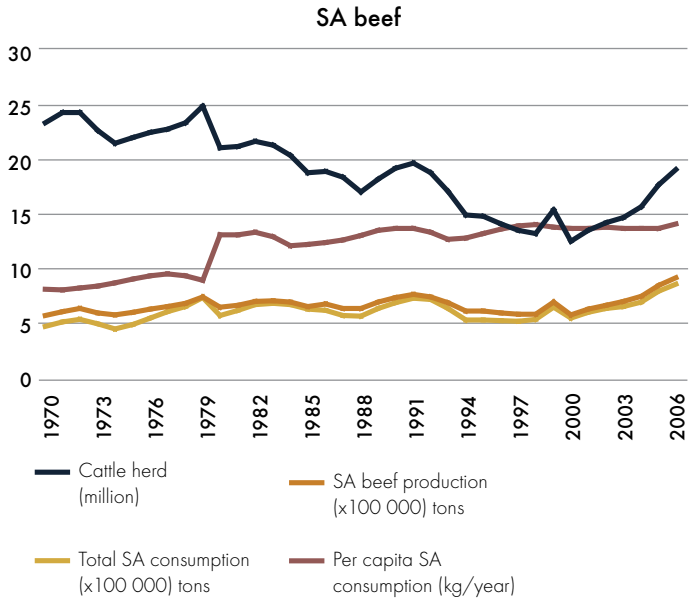
Commercial and sustainable

ZZ2, a commercial farming company based in Limpopo and a world leader in tomato production, has introduced the concept of Natuurboerdery (Nature Farming) to their operations. Since 2002 the ZZ2 farming enterprise has implemented a programme for the gradual conversion of all its farming activities from a predominantly conventional chemical to a more ecologically balanced nature farming approach. They aim to achieve long-term improvement and stabilisation of the soil and optimum sustainable yields through the use of compost and manures, compost tea, Effective Micro-organisms (EM), bioproducts, minimum tillage, cover crops and crop rotation.

Livestock

Most of South Africa's land surface (69%) is suitable for grazing, and livestock farming is by far the largest agricultural sector in the country. The South African national cattle herd has increased by about 6 million head since the 1970s and now stands at near 14 million (Palmer & Ainslie, 2006). This increase has almost met the increased demand from South Africa's growing population. Interestingly though, per capita consumption of beef has declined since the 1970s. The consumption of chicken is on the increase in South Africa and exceeds the total consumption of red meat; a trend that is likely to continue.

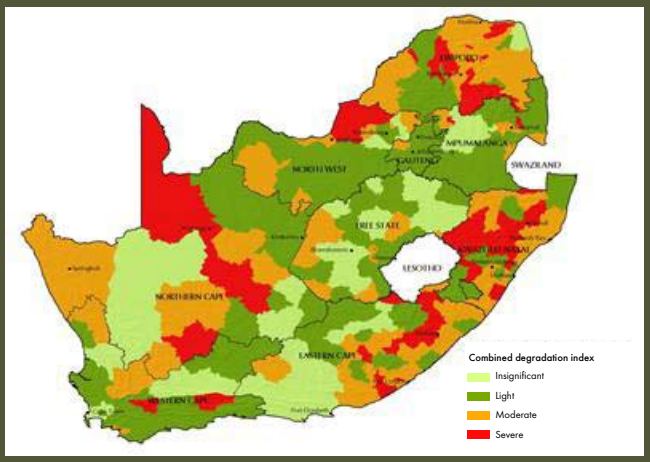
The carrying capacity (i.e. potential stocking rate) of land in South Africa increases eastwards, in accordance with increased rainfall. Cattle are concentrated in the eastern, wetter regions of the country, as well as in the North West Province and the Northern Cape, while sheep are largely farmed in the drier western and central areas of the country. The total area of grazing land has declined over time owing to expanding human settlements and activities (such as crop farming, forestry and mining). This decline is most notable in Gauteng and the Western Cape with their high rates of urbanisation, but communal districts in Limpopo, KwaZulu-Natal and the Eastern Cape have also lost grazing lands.



Source data: Agricultural Statistics, 2008

Overstocking

Most of South Africa's grazing land is stocked beyond its long-term carrying capacity. Overstocking is most evident in the communal rangelands of Limpopo, KwaZulu-Natal and the Eastern Cape, which support more than half of South Africa's cattle. Overstocking can cause trampling and crusting of the soil and denude the veld of vegetation. This leads to reduced productivity, reduced soil fertility and erosion. As much as 91% of South Africa is defined as arid or semi-arid, and it is in these areas that land degradation (compounded by climate change) can lead to desertification and the irreversible loss of productive land (Gbetibouo & Ringler, 2009).



Degradation in South Africa
Source: State of the Environment, National Department of Environmental Affairs

Improved pastures

Some commercial farmers increase the carrying capacity of their land by adding fertilisers, planting additional palatable species (called 'reinforcement') and/or planting pastures. All these techniques require the application of fertilisers, which are costly and can pollute the environment.

Poorly managed, fertilisation can also change the species composition and decrease the basal grass cover. This reduces productivity and increases water run-off and erosion. Veld reinforcement and pasture cultivation both require irrigation in most areas, which is limited by water availability and may lead to soil salinisation. In general, fertilising and irrigating non-arable land is costly and not a viable option for most farmers. 'Improved' pastures appear to have a significant negative impact on sensitive grassland bird and insect species because they alter not only the structure of the habitats, but also nutrient regimes and animal populations.

Good practice

Soil fertility

- Analyse both soil and crop samples to determine the exact amount and type of fertiliser required, and aim to fill nutrient gaps rather than simply increasing total N and P.
- Use precision agriculture to calculate the fertilisation regime based on a realistic estimate of potential yield.
- Time and target fertiliser application to coincide with maximum plant uptake periods and apply fertiliser in regular smaller doses rather than few large doses.
- Store synthetic fertilisers on an impermeable floor. Avoid interim storage in open fields, as this poses a high pollution risk.
- Fertiliser spreading machines should never be washed in rivers, lakes or near drinking water wells and springs.
- Where possible, use organic fertilisers that contain a carbon source (for example compost, manure and plant matter – especially from legumes).
- Use crop rotation and inter-cropping to increase soil organic matter and nutrients. Where possible, rotate between grains and nitrogen-binding legume crops.
- Maintain a permanent soil cover – use either cover crops or mulch.
- Avoid excessive irrigation and ensure good water quality.
- Reduce the use of pesticides and herbicides that cause a decline in soil micro-organisms.

Soil structure

- Practice crop-appropriate minimum tillage.
- If tillage is required, till at the correct speed and only when the soil has the correct moisture content.
- If possible, avoid crops that require soil disturbance to harvest.
- Prevent soil compaction by limiting heavy machinery, especially in wet conditions. Where traffic is necessary, use radial-ply tyres with low tyre pressures to minimise soil compaction.

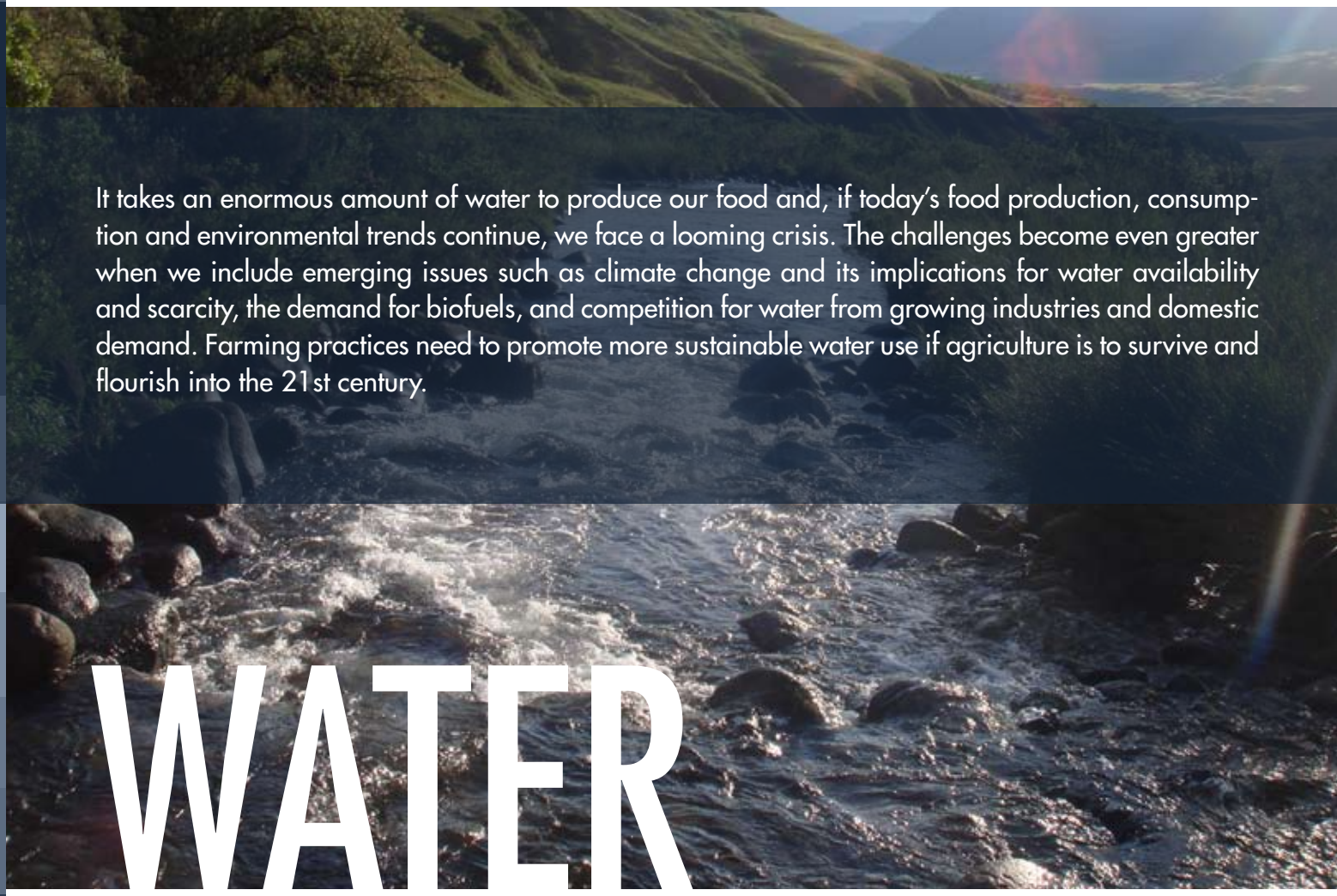
Livestock

- Ensure stocking rates are within the land's carrying capacity, based on the commercial stocking rates for a given area and the present veld condition.
- Monitor and manage veld condition for optimal productivity with minimal environmental damage.
- Maintain or improve veld condition and the health of the soil by ensuring appropriate rest periods after relevant grazing and/or fire events.
- Prevent overgrazing, trampling and soil erosion.
- Rehabilitate degraded veld.
- Ensure that veld improvement techniques are well understood and well managed to avoid environmental damage and a long-term decrease in productivity.

What does healthy soil look like?

The health of an agricultural ecosystem depends largely on the way the land is used, the quality of the soil and the input and output of nutrients. To a farmer, healthy soil is rich in organic matter, has the right balance of plant nutrients, the right pH and a diversity of beneficial soil micro-organisms, and is well aerated and moist. Organic matter in the soil retains water and nutrients for slow release to plants and provides good soil structure for root penetration. The small and microscopic soil animals and fungi hold the soil together (preventing erosion), aerate the soil, provide sustained breakdown and release of plant nutrients from organic matter, and – importantly – control soil-borne diseases. As the use of synthetic fertilisers is not allowed in organic production, organic farmers focus their efforts on building a healthy soil that feeds crops and keeps them healthy.

The topsoil, the fertile source of our food, can be conserved and improved through on-farm nutrient cycling. Farm resources such as manure and plant residues can be used optimally while cutting down on input costs from non-renewable inputs (pesticides and fertilisers) that damage human health and the environment.



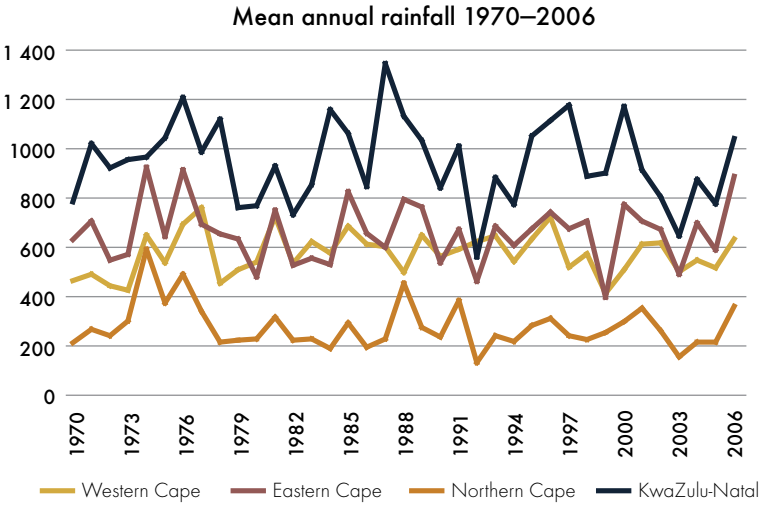
It takes an enormous amount of water to produce our food and, if today's food production, consumption and environmental trends continue, we face a looming crisis. The challenges become even greater when we include emerging issues such as climate change and its implications for water availability and scarcity, the demand for biofuels, and competition for water from growing industries and domestic demand. Farming practices need to promote more sustainable water use if agriculture is to survive and flourish into the 21st century.

WATER

Setting the scene

Water deficit

Southern Africa is the second region in the world to be confronted by a debilitating water deficit (the first was the Middle East and North Africa) (Turton, 2000). Within the region, South Africa stands out as one of the most water-scarce countries. The country is also characterised by extremely variable rainfall, both geographically and over time. In the 12% of the country that is suitable for the production of rain-fed crops, productivity tracks rainfall, making farming a challenging business. Climate change predictions are that rainfall will be more infrequent but more intense. This will shrink the country's arable land and increase agricultural unpredictability. Farmers will find it increasingly difficult to increase productivity to meet the growing demand for food. This highlights the need for sound cropping and rangeland production practices to retain soil integrity despite these predicted intense rainfall events.



Mean annual rainfall across four South African provinces

Source: SA Weather Service

We need a Blue Revolution in agriculture that focuses on increasing productivity per unit of water – more crop per drop.

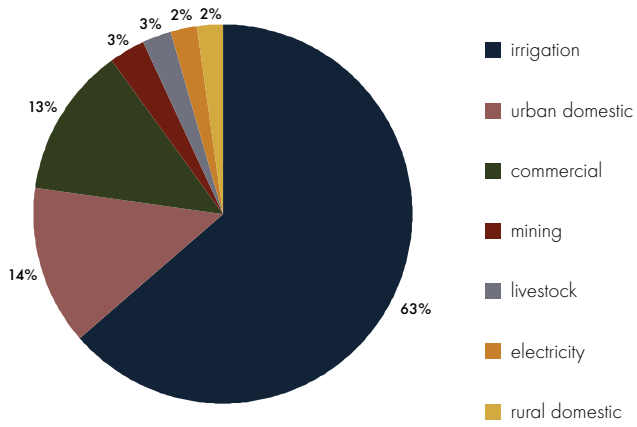
Kofi Annan, UN Secretary General

Irrigation

Irrigation is an age-old method of increasing agricultural productivity. It expands the arable area, improves yield and increases cropping frequency (sometimes enabling two or even three crops a year). In South Africa only 1,5% of the land is under irrigation, producing 30% of the country's crops (South African Yearbook, 2008/9). At first glance, expanding irrigation seems the obvious means of increasing productivity, but all of South Africa's irrigable land (estimated at 1,2% of the country) is already cultivated, with irrigation now rapidly expanding into unsuitable areas and negatively impacting the environment.

Of particular concern is that irrigation is already by far the biggest water use in South Africa. Year 2000 data showed irrigation extracting 63% of the country's available surface water (Water Accounts for South Africa, 2000). With 98% of the available water resources allocated, there is little room for increased extraction, particularly as other sectors compete for the surplus (which is itself dependent on rainfall). South Africa has few exploitable aquifers and extracts groundwater for only 13% of its supply. There is some room for increased groundwater extraction in the south-east of the country, but in other areas groundwater is already overexploited, with water tables falling at an alarming rate (South African Yearbook, 2008/9).

Surface water withdrawal in 2000 (Total = 12,5km^3)



Source data: Water Accounts for South Africa, 2000

South Africa has no surplus water and all future development will be constrained by this fact. Farmers will have to double their use of water by 2050 if they are to meet growing food demands using current farming practices. To avoid a crisis, water supply needs to be enhanced and water use efficiency increased.

Drought in Eden

Recent droughts in the Southern and Eastern Cape have highlighted just how vulnerable South African farmers are to reduced rainfall. Livestock farmers in these regions have had to truck in water and feed, drill boreholes and sell off cattle to survive the drought. In November 2009 the Eden District in the Southern Cape was declared a Disaster Area and drought relief was granted to the region's livestock farmers in the form of feed vouchers. No relief was provided to ostrich or crop farmers. AgriSA has predicted that countless farmers are facing insolvency in 2010 because of the drought. This may be a taste of things to come as water demand begins to exceed supply across South Africa in the context of a changing climate.

Land management impacts

Water quality: Land management on farms has a major impact on water availability and quality. Soil from eroded areas, for example, flows into rivers, changing their flow and reducing the storage capacity of dams. This results in the need for expensive water treatment/filtration systems before water can be used by industrial and domestic users. Poorly applied fertilisers run off into rivers, polluting water sources and causing algal blooms. These blooms deplete the water's dissolved oxygen and produce toxins, killing aquatic life.

Pesticides from poorly managed farms are also a major source of water pollution, with devastating effects on the health and well-being of people and the environment. Often less than 0,1% of crop-sprayed pesticide reaches the target pest – the rest enters the environment (Pimental & Levitan, 1986). A 2004 water quality study of the Lourens River in the Western Cape detected high pesticide levels downstream of the farming area (Dabrowski et al., 2002). Levels of contamination were extremely high, exceeding both the national water quality standards and those established by the US Environmental Protection Agency (EPA). One of the pesticide chemicals found in the water was endosulfan, a highly toxic bio-accumulating neurotoxin and endocrine disruptor that is banned in more than 50 countries (National Resources Defence Council, 2008).

Water availability: Invasive alien vegetation has a major impact on water – using more than twice the water of indigenous vegetation in some areas. Invasive alien vegetation is estimated to consume about 3 billion litres of water a year in South Africa. This is the equivalent of 26 large dams or 7% of total supply (Le Maitre et al., 2000; Dye & Jarmain, 2004).

Clearing alien vegetation is a cost-effective way of increasing water supply on the farm. The CSIR measured changes in stream flow in three Western Cape water catchments cleared of alien vegetation. In the dry summer months, stream flows increased by an impressive 9, 10 and 12 m^3 a day per hectare cleared (Prinsloo & Scott, 1999).

Wetlands – free benefits from nature: Natural ecosystems in South Africa's catchments provide essential water services. Wetlands, for example, purify water, moderate water flow and provide flood protection by capturing and slowing the water flow. They also slowly release the water into the groundwater, providing resilience in times of drought. Restoration and protection of these natural ecosystems is essential to increase water quality and quantity on the farm. The National Water Act (No. 36 of 1998) recognises the essential benefits provided by natural ecosystems and has ascribed equal status to the requirements of aquatic ecosystems and humans.

A river runs through it

The first Biodiversity and Wine Initiative (BWI) Champion, Vergelegen Wine Estate in the Western Cape, has cleared 1 200 ha of dense alien vegetation on their farm to date and in the process restored vast tracts of wetland areas, where streams now flow throughout the dry summer. On another BWI estate, Boschendal near Franschhoek, alien clearing activities resulted in sustained flow of three streams previously not known to exist, and the farm weir overflowed for the first time in the farm manager's 25-year experience. During the intense and unseasonal rainfall events of October 2009, when 60 mm fell within an hour, these restored wetland systems fulfilled their role of capturing and attenuating water. While other estates suffered massive wash-aways, these wetlands demonstrated the free benefits of wetlands by capturing the excess run-off and preventing large-scale erosion and destruction in the vineyards.

Exporting our water

Virtual Water is a recent concept that encourages a country to view its agricultural crops in terms of the amount of water required to produce those crops, with a view to implementing trading policies that promote the saving of scarce water resources. For example, it takes up to 1 000 litres of water to produce 1 kg of maize in South Africa (Dabrowski et al., 2009). This is the Virtual Water value of maize, and the amount of water South Africa exports with every ton of maize. A water-scarce country like South Africa needs to look at importing its water-intensive products (like oranges, beef and sugar cane), and focus on growing crops that use water efficiently.

Good practice

Increasing supply

- Remove invasive alien plants and replace with indigenous vegetation.
- Restore and protect wetlands (remove alien plants, control burning and grazing, do not cultivate).
- Leave at least a 30–40 m natural vegetation buffer zone between cultivated land and a river, and a 25–70 m buffer around a wetland.

Reducing demand

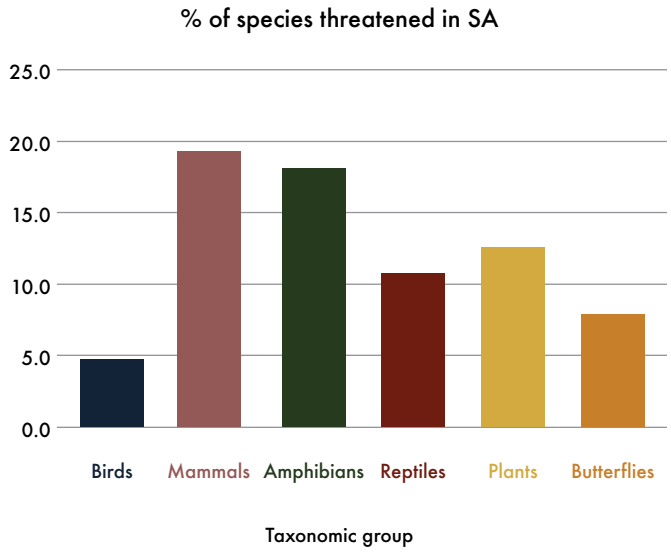
- Build up soil organic matter to reduce evaporative water loss and maximise the soil's water-holding capacity.
- Use more efficient irrigation systems, such as drip irrigation.
- Ensure efficient irrigation techniques that take into account soil type, crop type, soil water status and weather conditions.
- Maintain irrigation systems regularly.
- Where necessary, register water use with the Department of Water Affairs.
- Record actual water use to compare against registered use.
- Implement water-harvesting and water-recycling techniques where possible.
- Use drought-resistant crop and livestock varieties.

How now brown cow?

Originally cows grazed on grasslands that were not suitable for crops, converting inedible grass into high-value protein. Today this simple truth has been forgotten and 75% of South Africa's cattle spend a third of their lives in feedlots, fed by grains grown on the country's scarce arable land. Not only does this practice produce meat with an unhealthy fatty acid profile, it is also a major water issue. Compared to naturally fed beef, it takes about 65 times the quantity of surface water to produce feedlot-finished beef in South Africa if the feed crops are irrigated – 860 litres for every 500 g grain-fed steak (see data in Appendix). A sustainable solution is to reduce our daily consumption of red meat and to source natural, range-fed meat.

Thousands of South Africa's species and a third of the country's ecosystems are under threat, together with the critical free services they provide to farmers. Without action, this will accelerate and massively impact on agricultural productivity in future.

BIODIVERSITY & ECOSYSTEMS



Source data: Endangered Wildlife Trust, 2004; IUCN Red List, 2010; Raimondo et al., 2009.

Setting the scene

Agricultural ecosystems

Ecosystems provide essential agricultural services, such as the increased provision and purification of water; protection against natural hazards; pollination and grazing; increased soil fertility, and regulation of the world's climate. Over the past 50 years, human activity has altered ecosystems faster and more extensively than ever before. Land transformation has left 34% of South Africa's ecosystems threatened. Of these, 21 ecosystems (5%) are critically endangered.

Ecosystems, natural and agricultural, are made up of numerous species that contribute to their proper functioning. Human activities cause habitat loss and fragmentation, resulting in the loss of species and ultimately in the decline of ecosystem functions. Almost a third of the Earth's plants and animals have been lost since 1970 and current extinction rates are approximately 100 times higher than the natural rate indicated by the fossil record.

The Little Karoo and its dwindling ecosystem services

A recent study by Reyers et al. (2009) shows that ecosystem services in the semi-arid Little Karoo are in decline. It is one of the most degraded areas in the Western Cape, with 52% of the area degraded through overgrazing. Of particular concern is that there has been an 18% decline in water-flow regulation and a 44% decline in erosion control – ecosystem services that underpin the region's agricultural economy.

These ecosystem declines raise concerns about the region's long-term productivity and its resilience to floods, droughts or market shifts. Creating a sustainable Little Karoo will require improvements in the health of its ecosystems. This, in turn, will require large-scale conservation and restoration activities targeted at areas of importance to water flow and erosion control. But due to the slow rate of recovery in arid and semi-arid ecosystems this will take time.

Pesticide problems

In the 1980s, rice fields in Indonesia were plagued with pesticide-resistant brown plant hoppers. Frequent applications of broad-spectrum pesticides had devastated the hoppers' natural predators and over 2 million hectares of rice were lost. Resistant rice strains were introduced allowing yields to temporarily recover, but the hoppers were soon back and, by 1985, 70% of Java's rice was threatened with destruction. After much research it was found that the hopper was a pest because of, not in spite of, pesticide applications. A national integrated pest management programme was established to move farmers toward the protection of the hoppers' natural enemies. Pesticide subsidies were removed and 57 of the most widely used pesticides banned. Pesticide use dropped by 90%, farm profitability climbed, and production increased. The Food and Agriculture Organization (FAO), one of the agencies responsible for the Green Revolution package, summarised it well: 'pesticides were always bundled together with other inputs, but conclusive studies showing their contributions to production were not made' (Cooper, 1991).

Pesticides, herbicides and GMOs

Poor farm management further reduces species diversity and ecosystem functioning. The use of pesticides, for example, can have a devastating effect on biodiversity. It is estimated that less than 0,1% of sprayed pesticide reaches the target pest; the rest ends up in the environment and may persist for many generations (Pimental & Levitan, 1986). Pesticides are known to kill amphipods and other species that are important in the food chain for fish and higher animals such as birds of prey (and humans). The impact of pesticides on beneficial species can have a negative effect on farm productivity. For example, it was estimated in 1991 that honey bee poisonings and reduced pollination due to pesticides cost the US $150 million annually (Pimentel et al., 1991).

Many pest predators are also susceptible to pesticides and develop resistance far more slowly than do pests. Thus, spraying for one pest can result in outbreaks of other pests as natural predator populations are devastated. This is called a secondary pest outbreak. Twenty-four of the 25 pests causing at least $1 million worth of crop damage in California in 1970 were secondary pests, and this situation remains largely unchanged (Cooper, 1991).

Despite an increase in the use and strength of pesticides since 1950, the percentage of crops lost to pests has stayed roughly the same. This is because pests have a short generation time, coupled with an incredible ability to mutate, allowing new generations of pesticide-resistant pests. Stronger and more frequent applications of pesticides are then required to suppress the pest population. This cycle is often called the pesticide treadmill, as growers spray as fast as they can and still lose ground.

Emerging farmers in South Africa are being encouraged to engage in high-input agricultural production in order to obtain commercial status. Since existing practices in commercial agriculture rely heavily on pesticides, emerging farmers are pressured to adopt or increase their use of pesticides (Rother et al., 2008). Many of the pesticides registered for use in South Africa have been banned in many other countries due to their toxic effects on humans and wildlife. The well-being of farmers, workers and the environment is at risk.

Pesticides were always bundled together with other inputs, but conclusive studies showing their contributions to production were not made.

Food and Agriculture Organization (FAO)

The use of herbicides can also lead to a decline in species, particularly amphibians and soil micro-organisms. The advent of genetically modified herbicide-resistant crops has exacerbated the problem by allowing farmers to spray indiscriminately. Monsanto's Roundup herbicide, sprayed on millions of acres of crops and weeds across the US, has been found to be extremely toxic to amphibians. A recent study revealed that applying the recommended manufacturer's dose of Roundup unexpectedly caused an up to 71% decline in tadpoles (Relyea, 2005).

The march of monoculture

The use of limited monoculture species has led to a loss in the diversity of agricultural species. Over the last 50 years, 75% of global agricultural crops have been lost. About 20% of the world's breeds of cattle, goats, pigs, horses and poultry are also currently at risk of extinction, which means their features (such as resistance to disease or adaptation to climatic extremes) will be lost forever. Indigenous African food crops, such as millet and sorghum, have lost their status. Concerted efforts need to be made to ensure that these hardy crops are not lost to agriculture forever. A fatal element in the runaway loss of our genetic wealth is the fact that it is not evident to the public when one looks at the bread shelves or the meat counter. And the disappearance of domestic varieties of fruit and vegetables is hidden behind exotic imports.

Managing the potential of GMO

Genetically modified crops (GMO) have been shown to increase both yield and crop quality, but can potentially pose a threat to the environment. The genetically engineered material can be transferred to other related crops and wild plants. Once released, it is impossible to clean up any unforeseen consequences. The crops themselves may also escape from the agricultural environment to become superweeds. Creeping bentgrass, which was genetically engineered in the US to resist the herbicide Roundup on golf courses, is now growing in the wild, posing a huge threat. This is the first example of agricultural biotechnology escaping from the farm environment. In 2003, the International Centre for Technology Assessment filed a lawsuit seeking to halt development of genetically engineered bentgrass.

Modified maize

South Africa is the only country in the world to allow genetic modification of its staple crop, maize. The country has also commercialised GM cotton and soya beans, and field trials are being conducted for sugar cane. In 2008, white GM maize totalled 1,04 million ha, an increase of 48% over 2007, representing a market share of 62%.

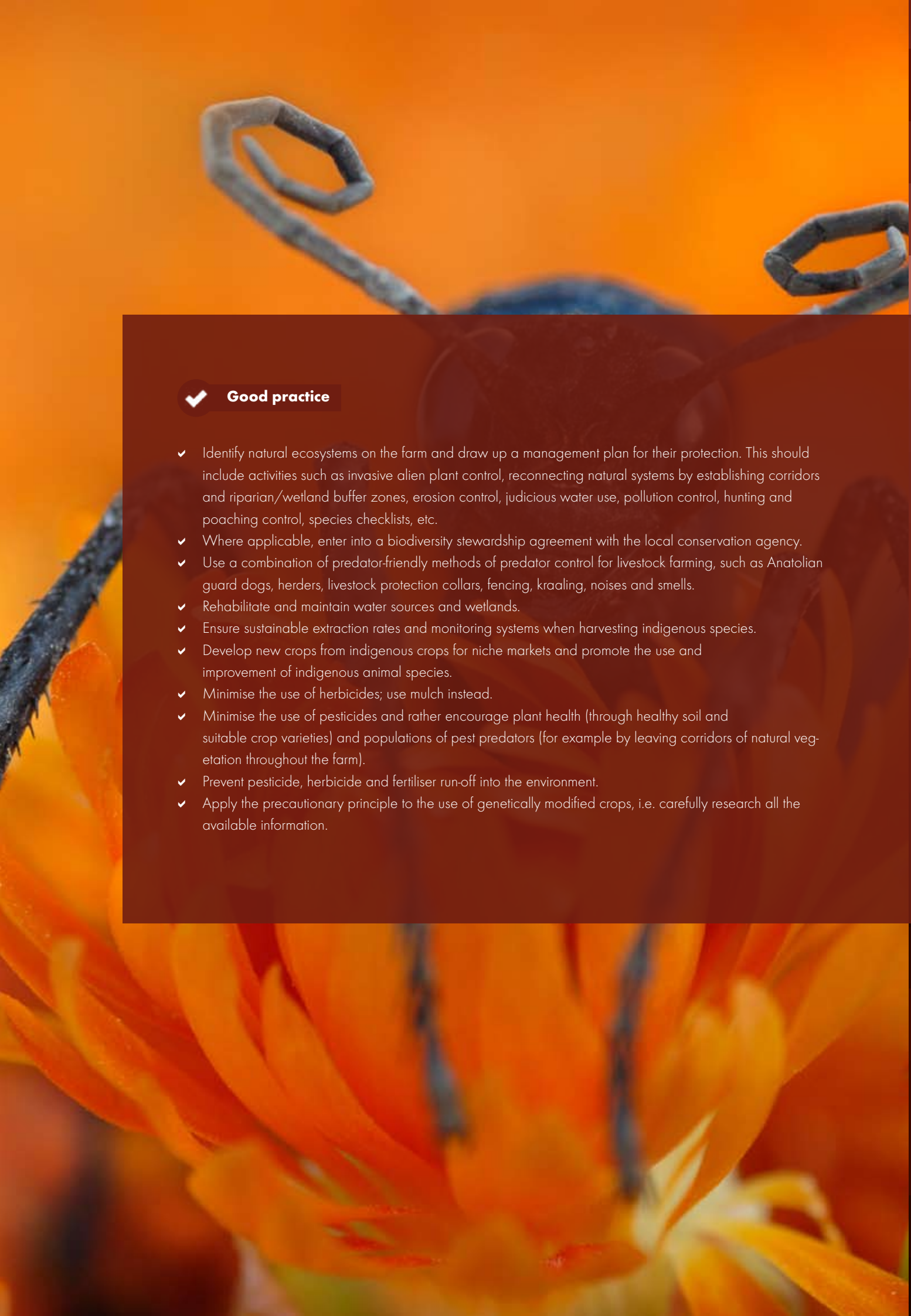
However, traders say that South Africa's GM status has made it more difficult to shift its maize surplus (which is partly a result of better yields under GM). The EU, for example, currently does not accept GM products.

Three varieties of Monsanto's genetically modified maize failed to produce crops during the 2008–09 growing season, leaving up to 200 000 hectares of fields barren of cobs and causing crop losses across several provinces in South Africa. Affected farmers were compensated.

With every species and gene lost, we are limiting our options for future success, particularly in adapting to climate change. The wild relatives of crops (species that are genetically related to those in cultivation) and their genes are used to boost the nutritional value, disease resistance and productivity of our food crops. This genetic diversity is at risk in the wild. More than one in 20 of Poaceae species (related to crops such as wheat, maize, barley and millet) are threatened with extinction. In 2007 the wild apricot *Armeniaca vulgaris*, the origin of all cultivated apricots, was classified as Endangered on the IUCN Red List.

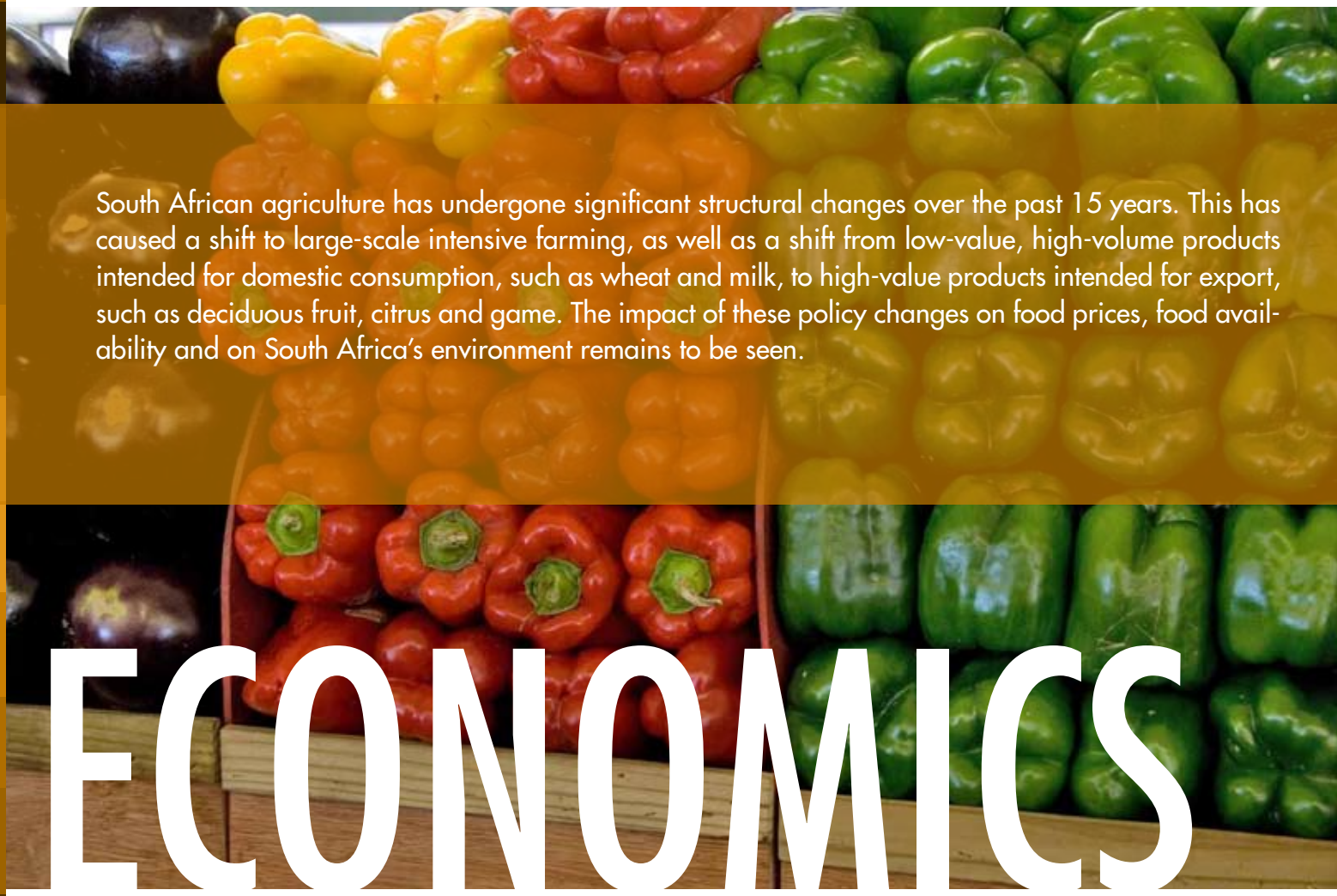
Turning disservices into opportunities

Honey badgers are renowned destroyers of beehives and have typically been exterminated for their activities. In 2002, beekeeping organisations, conservation agencies and NGOs, together with retailers and the public, worked together to develop and promote badger-friendly honey production methods. By developing cheap and effective protection measures, educating and incentivising the public, and creating a 'Badger-friendly' labelling system for honey, this conflict has been turned into a notable gain for all.



Good practice

- Identify natural ecosystems on the farm and draw up a management plan for their protection. This should include activities such as invasive alien plant control, reconnecting natural systems by establishing corridors and riparian/wetland buffer zones, erosion control, judicious water use, pollution control, hunting and poaching control, species checklists, etc.
- Where applicable, enter into a biodiversity stewardship agreement with the local conservation agency.
- Use a combination of predator-friendly methods of predator control for livestock farming, such as Anatolian guard dogs, herders, livestock protection collars, fencing, kraaling, noises and smells.
- Rehabilitate and maintain water sources and wetlands.
- Ensure sustainable extraction rates and monitoring systems when harvesting indigenous species.
- Develop new crops from indigenous crops for niche markets and promote the use and improvement of indigenous animal species.
- Minimise the use of herbicides; use mulch instead.
- Minimise the use of pesticides and rather encourage plant health (through healthy soil and suitable crop varieties) and populations of pest predators (for example by leaving corridors of natural vegetation throughout the farm).
- Prevent pesticide, herbicide and fertiliser run-off into the environment.
- Apply the precautionary principle to the use of genetically modified crops, i.e. carefully research all the available information.



South African agriculture has undergone significant structural changes over the past 15 years. This has caused a shift to large-scale intensive farming, as well as a shift from low-value, high-volume products intended for domestic consumption, such as wheat and milk, to high-value products intended for export, such as deciduous fruit, citrus and game. The impact of these policy changes on food prices, food availability and on South Africa's environment remains to be seen.

ECONOMICS

Setting the scene

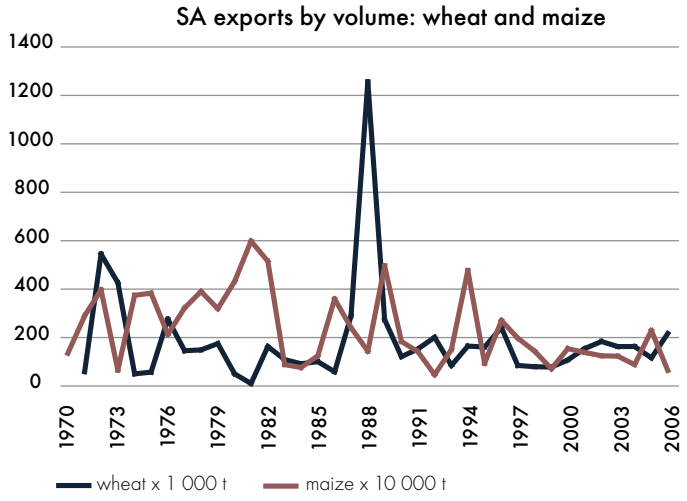
Dual agricultural economy

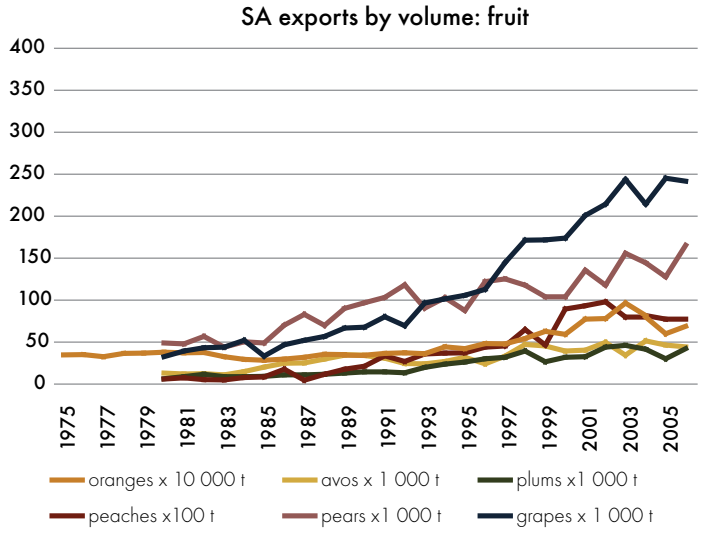
South Africa has a dual agricultural economy, with both well-developed commercial farming and smaller-scale communal farming (located in the former homeland areas). Agriculture contributes a relatively small share of the total GDP, but is important in providing employment and earning foreign exchange. The commercial agricultural sector has grown by approximately 14% per year since 1970, while the total economy has grown by 14,5% over the same period, resulting in a decline of agriculture's share of the GDP to 2,5% in 2008. However, there are strong backward and forward linkages into the economy, so that the sector is estimated to actually contribute about 14% of the GDP.

Over the last 15 years, South Africa has undergone immense social and economic changes, with fundamental structural reforms resulting in an open, market-oriented economy. Some of these changes were intended, while others are the result of the country's integration into the global economy following the end of apartheid-era sanctions. The changes in policy were intended to remove the socialist control of agriculture prevalent under the Nationalist Government, improve the lot of farm labourers, and redress land inequalities.

Closing agricultural marketing boards, phasing out certain import and export controls and introducing certain import tariffs all converted a stagnant and state-controlled sector into a vibrant market economy. Dismantling state support to farmers combined with low import tariffs did, however, leave many South African farmers unable to compete in certain areas, such as wheat and milk, against farmers from developed countries who receive generous state subsidies and dump their products in South Africa. On the other hand, government-led initiatives to increase irrigated farmland has enabled other farmers to successfully grow high-value export crops such as deciduous fruit, grapes and citrus. The volume of agricultural exports increased dramatically, and the rand value of exports increased from 5% of agricultural production in 1988 to 51% in 2008 (SA Yearbook 2008/9). The net result has been a decrease in the area under production for staple low-value crops such as wheat and maize, and a dramatic increase in the export of high-value crops.

The Western Cape is the only province whose citrus exports are allowed into the US due to appropriate sanitary standards, and has become the largest exporter of fresh oranges to the US (almost 50% of US imports).





Source data: Agricultural Statistics, 2008

Smaller farmers in South Africa cannot compete successfully with subsidised produce from overseas that is dumped in South Africa at below production cost. For example, between 2006 and 2008 there was a 263% increase in imported wheat, and South Africa is set to import 1,6 million tons of wheat in the 2010–11 year. Local wheat plantings have fallen to less than a third of the annual area sown in the 1970s and 1980s and production cannot meet local consumption. Farmers are requesting subsidies and asking for increased import tariffs, which will increase the cost of staples such as bread.

In 2008, South Africa's shift from low-value basic food crops to high-value export crops made the country a net importer of food in terms of volume for the first time. While this may be regarded as a negative by those who believe that national food security requires national production to meet demand, it is clearly a positive in terms of generating foreign exchange and profits for local farmers. Impact on the natural environment is mixed. Increased water usage for irrigation in certain areas as well as increased carbon outputs through import and export transport are both negative, particularly in the face of climate change. But at the same time the large-scale conversion of wheat monocultures, which require large quantities of pesticides and fertiliser, and dairy pastures to fallow land, game farms and smaller higher-value crops represents a net benefit to the environment.

Land reform

An important share of public financial resources has been devoted to land reform and agricultural support programmes for disadvantaged farming communities. New programmes were introduced in 2005 to support the development of market-oriented family farms emerging from the land reform process, mainly through investment grants and provision of micro-credit and retail financial services in rural areas. The Land Reform Programme has doubtless reduced social tensions in certain areas and has redressed previous wrongs, but progress has been slow and projects have shown a 90% failure rate, reducing agricultural output in certain areas. Uncertainty around land tenure has also proved to be a disincentive for white farmers to farm responsibly (MEGA Report, 2009). A key challenge is to develop a sound understanding of the sociology of emerging agriculture to determine how to better support sustainable land reform initiatives.

South Africa is game

Game ranching is the fastest-growing branch of agriculture in South Africa, with the majority of game ranches found in Limpopo, the Northern Cape and the Eastern Cape. The total area covered by these privately owned ranches now exceeds that of all national parks and provincial nature reserves put together. In terms of game ranching, game is considered to be an agricultural product as defined in the Marketing of Agricultural Products Act of 1996.

Increasing input costs

Intensive farming practices are dependent on water, fuel, feed, synthetic fertilisers, pesticides, herbicides and, increasingly, on genetically modified (GM) seeds. Currently, farm feeds are the biggest expenditure item, followed by fuel and fertilisers. Retail prices of these commodities are linked to the oil price and to the rand/dollar exchange rate, both of which are out of the farmer's control. A move towards farm-produced organic fertilisers and improved soil fertility would reduce input costs and the vulnerability of farmers to international price fluctuations.

Increased fuel prices impact on the running of farm machinery as well as the transport of agricultural produce. In 1985, 80% of grain produce was transported by rail. Now, due to inadequate rail services, only 30% is hauled by rail. The bulk is transported by road and transport is therefore strongly linked to the fuel price. The price of electricity is also rising and in October 2009, AgriSA released figures suggesting that Eskom's proposed electricity price hike will cost agriculture R600 million.

Global demand for fertiliser in 2008 outstripped supply. This, together with the high price of raw materials used in fertiliser production, the rising oil price and increased shipping costs, created unheard of international prices for fertilisers. A weakened rand against the US dollar further drove up the prices of imported fertilisers such as potassium and nitrogen. Local fertiliser production is also subject to international fluctuations and is under the control of a few large corporate companies. In 2009, Sasol was fined R250 million for collusion in the fertiliser industry and came under attack from trade unions and farmers' representative bodies for its impact on food prices.

Only the biggest survive

The Census of Commercial Agriculture 2008 reflects a 31% decline in the number of farmers since 1993, resulting in the industry being left with fewer than 40 000 farms. The maize, wheat and dairy sectors have been the hardest hit. Although the number of units has dropped during this time, gross farm income (GFI) has increased by more than 300%. With expenses growing by a relatively low 285%, net farm income (NFI) grew by a staggering 410% over this period. Because of this growth, the net farm income per farm unit has increased significantly to five times more than what it was in 1993. This was mainly due to economies of scale that kicked in as the units became fewer but bigger.

Many of the smaller and more marginal farmers on the other hand went out of business as their input costs grew faster than their revenues. These farmers were also often reliant on subsidies and soft funding from institutions such as the Land Bank, and faced a situation where government support was phased out at the same time as the markets opened to allow competition from cheap imports.

Not so sweet

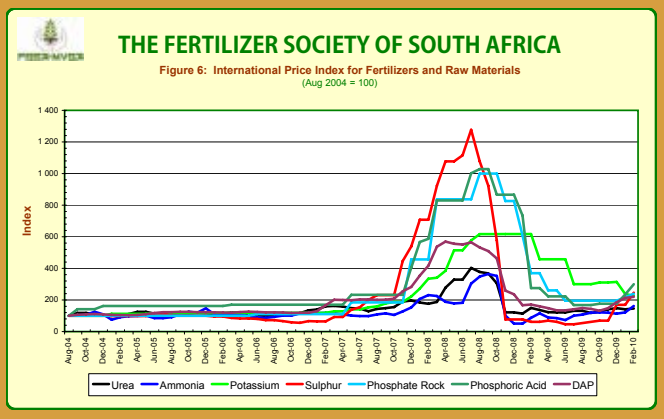
Small sugar cane growers are finding it increasingly difficult to farm profitably due to rising input costs and a lack of rainfall, resulting in many abandoning cane production. According to the SA Cane Growers' Association, cane production from small-scale growers has more than halved in the Umfolozi and Pongola regions over the past eight years. World sugar prices on the other hand have surged to a 28-year high, but small farmers are not seeing the benefits. The decline in volumes from small farmers is a vicious cycle as contractors who haul cane to mills increase their prices due to the lower volume of cane. Fertiliser prices are also higher for smaller farmers buying in small quantities. The cost of transport for a small grower buying a few bags could be R10 extra a bag, but for a big farmer placing a large order the transport cost might only be an extra R1 a bag. The cost of transporting the fertiliser could even exceed the base cost of the fertiliser.

In a bid to revitalise the sector, the sugar industry launched the R22-million-a-year Supplementary Payment Fund in 2006, which helps bolster the revenue stream for small growers. This initiative encourages growers to restructure their farming initiatives to benefit from economies of scale through consolidated farming projects.

Peak Phosphorus

Phosphate fertiliser is essential to intensive agriculture. The product is synthesised from mined rock phosphate, a non-renewable resource that takes 10–15 million years to form. Recent evidence suggests that global supplies of rock phosphate are dwindling and are likely to be depleted within the century (Rosmarin, 2004). There is no substitute for phosphate in agriculture. Experts disagree on how much phosphate is left and how quickly it will be exhausted, but argue that a shortage is coming and that it will leave the world's future food supply hanging in the balance.

Phosphate reserves are geographically concentrated, and are largely under the control of Morocco (45%), China (21%), the US (7%) and South Africa (5%) (Jasinski, 2006). Europe and India are totally dependent on imports. China, who ranks first in the consumption of chemical fertilisers, recently imposed a 135% export tariff on rock phosphate to secure domestic supply, which has halted most exports. South Africa, on the other hand, exports most of its supply. Phospate mining in the country is wholly controlled by Foskor, a subsidiary of the Industrial Development Corporation (IDC), which is expanding production to increase output by 14% by 2011. Coromandel International, one of India's leading fertiliser companies, has a large stake in Foskor and takes the lion's share of Foskor's phosphate exports.



The international price index for fertilisers and raw materials
Source: FSSA fertiliser production data of South Africa. Accessed at www.fssa.org.za on 26 March 2010.

Biofuels compete

The fast-emerging South African biofuel industry has the potential to shake up the agricultural sector. In 2007, the South African government accepted the Biofuel Strategy which makes provision for 2% of annual fuel needs to be supplied by biofuels within the next five years. The crops proposed for the production of biofuels are sugar cane and sugar beet for bioethanol and sunflower, canola and soya beans for biodiesel. It is estimated that 1,4% of arable land will be required to meet this biofuels target. The intention is to use underutilised arable land in the former homelands for biofuel crops, thus providing opportunities to the rural poor by creating a market for their produce.

Rainbow Nation Renewable Fuels (majority-owned by an Australian biofuels group) is currently constructing a R1,5 billion soybean processing facility at Coega, the industrial development zone near Port Elizabeth in the Eastern Cape. The factory will be the largest of its kind in Africa and will consume one million tons of soybeans annually. The company is currently working with local farmers to significantly expand their local supplier base of soybeans.

It remains to be seen whether promoting the use of arable land for non-food production will be a bane or a blessing for South Africa, but if not managed sustainably, there is concern about its effect on food prices, food availability and the environment.

Food prices

Until recently, the real price of food has been fairly stable or has declined, benefiting both the national and household economies. The situation has now changed: food prices are increasing rapidly due to increased transport, electricity and fertiliser costs. Rising prices are a bigger burden for the poor, who spend about 33% of their income on food, as opposed to the more affluent shoppers, who spend about 2% of their income on food. In addition, rural consumers (who are the majority of South Africa's poor) pay more for selected food items. They also have to travel to town to buy food.

Food security is not only about food availability and prices, it is also an unemployment issue. The government needs to create jobs to ensure that people can buy food for the table. Agriculture's contribution to employment in South Africa has dropped by 75% between 1993 and 2005, to employ only 628 000 farm workers (Agricultural Statistics, 2008). The Department of Agriculture's Medium Term Strategic Framework emphasises agriculture as a focus area for job creation.

Who is picking up the real cost?

As South Africa moves towards larger and more intensive farms, the real costs of agricultural production are not being fully calculated in the cost of production. The negative impacts of intensive farming methods on the environment are not being reflected in the input costs. These impacts include pollution of ground- and surface water, loss of biodiversity, spread of genetically modified organisms, loss of soil fertility, erosion, transport costs and climate change, to name a few. It is the individual taxpayer and tomorrow's generations that will pay the real price of these inputs through reduced options.

Good practice

- The agronomic, livestock, veld and forage resources and mechanisation practices of the farm are integrated with the climate, soils, water and topography to maintain or enhance an optimum and sustained economic return for the farmer.

Widespread unemployment and poverty, crime and a high prevalence of HIV/Aids are everyday realities in South Africa. Many of these issues play out at farm level. Addressing them and meeting the needs of people are essential to securing a sustainable farming future. The health of people on and off the farm should be protected as a basic human right.

SOCIAL CONSIDERATIONS

Setting the scene

Health risks

South Africa's constitution guarantees all citizens the right to an environment that is not harmful to their health. Sadly, South Africa's deteriorating agricultural environment is posing an increasing threat to people's well-being.

An example is provided by a study in South Africa's maize production area which found atrazine in about 20% of both surface and groundwater samples (Pick et al., 1992). This toxic endocrine disrupting chemical is a pesticide and herbicide residue that has been found to affect sexual maturation during prenatal growth and in children. Research shows that exposure to even $^{1}/_{30}$th of the regulatory dose of atrazine changes male frogs into sterile hermaphrodites (Hayes et al., 2002).

Pesticides and herbicides have also been linked to various forms of cancer, particularly in children. By 1997, eight of the 26 pesticides classified by the International Agency for Research on Cancer to have sufficient evidence to be considered carcinogenic were still registered for use on crops in the US (Zahm & Ward, 1998) and in South Africa.

In addition, the possible cancer hazards from pesticide residues left on and in food have also been hotly debated. But what is not under debate is the fact that people carry pesticide toxins in their bodies. Children are more vulnerable to these chemicals as their livers lack the enzymes required to denature some toxins (Curl et al., 2003). Researchers found that children fed predominantly organic produce had only one-sixth the level of pesticide by-products in their urine compared to children who ate conventionally farmed foods (Curl et al., 2003).

Farming is the most consistent occupational risk factor for prostate cancer.

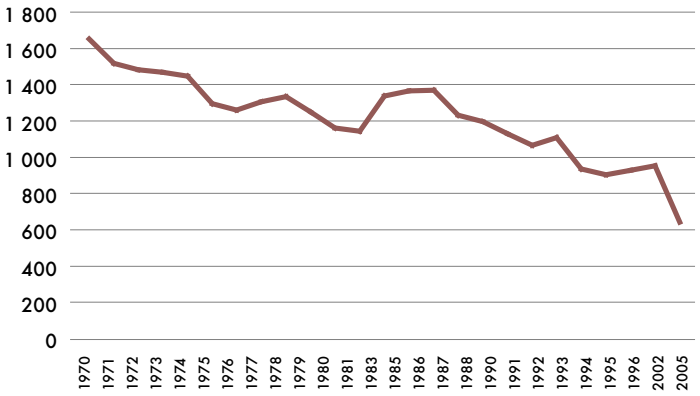
Dr Michael Alavanja, USA National Cancer Institute

Pesticides are not the only potentially harmful residues found in food produced on poorly managed intensive farms. The intensive livestock industry, for example, uses both hormones and antibiotics in the production of meat. Hormones are used to increase lean meat production and improve the efficiency of conversion of feed energy to meat. The EU has banned the import of meat containing artificial beef hormones, while the US and Canada have fought the ban. Feedlot animals also require routine doses of antibiotics to resist bacterial infections. The effect of antibiotic residues in meat on human health is also under debate.

The composition of livestock feed has also come under the spotlight with mad cow disease (bovine spongiform encephalopathy), the discovery of dioxin in chicken and eggs and pharmaceutical waste in pork.

'Grass-fed' beef is better for your health than grain-fed beef. It is not only lower in saturated fats, it contains up to six times more of the good Omega 3 fatty acids that our modern diets lack. South African lamb and mutton are also good sources of Omega 3 fatty acids, as most are reared on natural veld. Choosing grass-fed meat also keeps livestock on the land, rather than in large feedlots. This creates jobs in rural areas, reduces pressure on South Africa's maize supplies, uses less water and, if stocked at appropriate rates, is good for the country's grazing lands.

Total number of SA farm workers



Source data: Agricultural Statistics, 2008

Poverty

As a labour-intensive and rural industry, agriculture has an important role to play in job creation and poverty alleviation in South Africa. Sadly, employment is on the decline in the commercial farming sector, as farms have become larger and more mechanised. According to the 2008 agricultural statistics, the total number of farm employees has dropped from 1,6 million in 1971 to 628 000 in 2005. Given the population increase over that time, agriculture's contribution to employment dropped from 8,3% to 1,3% in relative terms.

Employment has also shifted from permanent employment to irregular, temporary employment, leaving farm workers and their households vulnerable and insecure. Introducing a minimum wage for farm workers as well as implementing a system of worker rights was intended to improve the lot of agricultural workers, but has met with mixed success and arguably proved a failure. The Department of Agriculture's Medium Term Strategic Framework emphasises agriculture as a focus area for job creation. To achieve this goal, labour-intensive sustainable production systems should be encouraged.

Farm murders

Farming in South Africa is one of the most dangerous professions in the world. The murder rate is about eight times higher than the reported national average and has increased by 25% since 2005. The independent South African Human Rights Commission quantifies the number of farm murders at about 2 500 to date, while farmers' organisations state the figure to be closer to 3 000.

Good practice

Ensure the health of those on and off the farm:

- Reduce the use of pesticides and eliminate or minimise exposure to these products.
- Areas where children are most exposed, such as parks, schools and sports grounds, must be kept pesticide free.
- People who apply pesticides should follow application directions and wear appropriate personal protective equipment (gloves, masks, etc.).
- Prioritise human health when there is doubt about the safety of a product.
- Encourage emerging farmers to become sustainable farmers rather than reliant on pesticides, herbicides and mechanisation.

Job creation:

- Where practical, encourage farming methods that rely on labour-intensive practices such as hand weeding and harvesting, composting agricultural waste and tending livestock for manure.

Over the past 50 years we have created a system that is economically and ecologically unsustainable. The result is that we are depleting our natural resources – rivers, arable land and species – faster than at any other time in history. Fortunately, solutions are taking shape and there are signs that future growth will happen in more efficient and responsible ways.

CONCLUSION
THE LIVING FARMS OF THE FUTURE

- The government is exploring and implementing legislative tools like tax incentives and ploughing restrictions.
- Retailers and manufacturers are greening their product ranges through certification and standards. Certification is an effective tool, particularly when a more holistic approach is adopted as in the Woolworths Farming for the Future guidelines for fresh-produce suppliers.
- For every risk that agriculture provides to biodiversity, it also offers an opportunity. While agricultural activities can threaten habitats, pollute water and consume resources, they can also – when operations are sustainably managed – provide new habitats, help protect watersheds and improve soil health (WWF, Agriculture and Biodiversity Initiative, 2008).
- Both the forestry sector and sugar cane growers have produced sustainability guidelines. Other initiatives include the Potato and Biodiversity Initiative, the Right Rooibos Project, the Biodiversity and Wine Initiative, Badger-friendly Honey, and sustainably harvested wild flowers under the Flower Valley Conservation Trust.
- WWF, under the GreenChoice project with Conservation International, set about developing – through a transparent, multi-stakeholder process – a harmonised master document for well-managed farms. The process included the inputs of consultants and experts and has taken a year to complete. This master document, called the **Living Farms Reference** outlines basic sustainability principles and includes brief descriptions of the methodologies and practices currently associated with sustainable agriculture in South Africa.
- The **Living Farms Reference** has already been customised for implementation in specific agricultural sectors. These sector-specific guide documents are voluntary, credible mechanisms for reducing negative farming impacts. They can also be used as a market access and marketing mechanism for producers as well as a policy instrument. And finally – in this age of growing environmental anxiety – they can empower retailers and consumers to make environmentally aware decisions.

Future engagements will need to take place throughout the agricultural value chain in order to ensure that all food products are produced in a way that is affordable, healthy and sustainable. Every collaborative effort to mainstream sustainable agriculture between industry, the conservation community and consumers points to a more optimistic future – a future where we appreciate the value of managing our natural resources, creating renewable flows and ensuring that monoculture does not destroy our heritage and, ultimately, our well-being.

WWF South Africa's Vision

All citizens of South Africa value, respect and defend the integrity of the natural ecosystems that underpin the sustainable development of our country and the well-being of our people.

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APPENDIX

Body weight on arrival in feedlot	230	kg
Final feed-lotted body weight	380	kg
Average body weight in feedlot	305	kg
Daily feed requirement in feedlot (2,7% body weight/day)	8,24	kg
Days spent in feedlot	100	days
Total feed consumed in feedlot	823,5	kg
Maize quantity (at 75%)	617,6	kg
Meat content of final carcass (60%)	228	kg
kg maize consumed per kg meat produced	2,7	kg
Water productivity of maize	1,6	kg/m^3
Water used to produce 1 kg irrigated maize	0,63	m^3
Water used to produce 2,71 kg maize	1,69	m^3
Drinking water/day	20	ℓ
Average of cows	305	days
Total water drunk (by 228 kg meat)	6 100	ℓ
Drinking water per kg feedlot beef	26,75	ℓ
Drinking water per kg feedlot beef	0,03	m^3
Total water used for kg of feedlot finished beef	1,72	m^3
Total water drunk by grassland beef (same as feedlot)	6 100	m^3
Total water for kg range-fed beef (same as feedlot)	0,03	m^3
Water for 500 g steak feedlot-finished beef	0,86	m^3
Water for 500g steak feedlot-finished beef	860	ℓ

Source data: SA feedlots and Crop Water Productivity for maize data reported by FAO

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