The GreenChoice Reference for Well-Managed Farms

Complied by Dr. J.S.B. Scotcher
jscotcher@forestlore.co.za

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EXECUTIVE SUMMARY

Over the centuries, South Africa has established a proud heritage of farming. Today's farmers ensure that the country's growing population is self-sufficient in virtually all major agricultural products, while producing more than half of southern Africa's maize requirements and exporting many agricultural products to the world. But times are changing. Farmers are under increasing pressure to intensify their agricultural outputs to meet rising food demands and are faced with looming threats of a changing climate. The population of South Africa was 48 million in 2009, and is growing at about 2% per year. If this trend persists, by the year 2035, there will be nearly 82 million people living in South Africa, all dependent on the same level of natural resources yet aiming for a better quality of life.

Some farmers have responded by expanding their area under cultivation and increasing their use of pesticides, herbicides, fertilizers and water. Uncontrolled, these activities can lead to, among other things, soil erosion, water pollution, water scarcity, declining soil health, ecosystem degradation, species extinction and climate change. In South Africa, annual soil loss through erosion is estimated at 400 million tonnes; surface and ground water resources are already almost fully utilized; water is often so polluted that it cannot even be used for irrigation; ecosystems and the services they provide are being degraded or used at unsustainable levels; and a recent assessment found that almost 10% of the country's birds and frogs, 20% of its mammals and 13% of its plants are threatened with extinction.

In recognition of these threats (and of the threat of climate change), there is a move both legislatively and in general opinion towards promoting sustainability in farming practices. In addition, there is an increasing appreciation of both the local and global value of species and ecosystems. Healthy ecosystems support the tourism industry and provide critical goods and services such as increased water quality and availability, flood and erosion control, pollination, grazing, nutrient cycling, natural hazard protection and soil fertility. Conserving South Africa's species and ecosystems is critical to accommodating the basic needs of its people, while preserving the resources that will enable its future generations and ecosystems to thrive.

The goal of sustainable agriculture is to minimize any adverse impacts of farming on the environment, to demonstrate good stewardship of natural resources and to enhance social well-being, while providing a sustained level of production and profit. A number of international initiatives have recently emerged that promote sustainable production or use and locally, various sectors (such as forestry, sugarcane and mohair) have produced guidelines with economic, social and environmental criteria that promote sustainable production or use. While these and other initiatives and guidelines exist, and while many South African farmers have a feel for sustainable farm management and good land practice, the Worldwide Fund for Nature in South Africa (WWF-SA) and Conservation International (CI) identified the need for a single document that brings together current knowledge on sustainable farm management in South Africa.

In response, the GreenChoice Alliance (a WWF and CI–led partnership) has produced the generic, WWF-funded, *Reference for Well-Managed Farms*. The Reference was developed

through an extensive review of existing national and international sustainability guidelines and certification systems, of South African land management legislation, and through a series of multi-stakeholder workshops. It outlines basic sustainability principles that can be applied across different farms and includes brief descriptions of the methodologies and practices currently associated with sustainable agriculture in South Africa. The Reference is not intended as a farmer friendly document but was developed as a master document that could be customized for specific agricultural sectors.

To achieve future food security and environmental protection in the face of current agricultural challenges we need to work across the whole agricultural supply chain. The GreenChoice Alliance presents the *Reference for Well-Managed farms* in the hope that it will provide a starting point for greater collaboration between governments, farmers, consumers and industry; leading to the adoption of good and efficient farm management principles for the benefit of South Africans today and in the future.

TABLE OF CONTENTS

BACKGROUND

Modern farming systems have delivered tremendous gains in agricultural productivity and efficiency and over the past 50 years global food production has exceeded population growth (FAO, 2002). The World Bank estimates that between 70% and 90% of the recent increases in food production are the result of improved productivity (due mainly to the introduction of chemical fertilisers, pesticides and improved crop varieties) rather than greater acreage under cultivation. But farmers are under increasing pressure to further intensify their agricultural outputs to meet rising food demands. The United Nations predicts that food production must rise 50% by 2030 and the FAO projects the need to increase 70% by 2050 to meet demands.

Some farmers have responded by increasing their use of pesticides, herbicides, fertilizers and water, and by expanding their area under cultivation. Uncontrolled, these activities can lead to, among other things, soil erosion, water pollution, water scarcity, declining soil health, ecosystem degradation and species extinction. Together, these processes degrade farmland, reducing its productivity and increasing its vulnerability to climate change. This document provides an overview of these current and future threats to agricultural productivity and food security, and looks at the recent move towards promoting sustainability in agricultural practices.

While various sustainable farming initiatives and guidelines have emerged both internationally and locally, the GreenChoice Alliance identified the need for a single document that brings together current knowledge on sustainable farm management in South Africa. In response, WWF funded the GreenChoice Alliance to produce the generic *Reference for Well-managed Farms*. The guideline outlines basic sustainability principles that can be applied across different farms and includes descriptions of the methodologies and practices currently associated with sustainable agriculture in South Africa. The process for developing the Reference is described here, and the Reference itself is presented in the following section.

Agricultural Challenges

The Food Equation

In the late 18th century Thomas Malthus forecast that population growth rate would, over the centuries, outstrip the world's food supply; forcing a return to subsistence level conditions. Two hundred years later, the theories of Malthus are again under the spotlight as world population continues to grow. Predictions are that the global population will reach 9.1 billion by 2050, with sub-Saharan Africa growing the fastest. The population of South Africa is growing at almost 2% per year and the 48 million in 2009 is expected to grow to 82 million by the year 2035. Food production must more than double to feed the expanding world population and production needs to increase using the same or fewer natural resources.

Population growth will occur wholly in urban areas, which by 2050 will swell by about 3 billion people as the rural population contracts. In 2007, for the first time in history, the urban population exceeded the rural one, with people moving to the cities in search of better-paying jobs. The challenge will be for the shrinking rural population to feed the increasing urban one, as well as themselves. In addition, urbanization (together with projected rises in the GDPs of developing countries) is causing the world's middle class to burgeon, with an expected three-fold increase in the number of middle-income consumers by 2030 (and in South Africa, post-apartheid reforms have seen the country's black middle

class increase 30% from 2001-2004). Increased wealth goes hand in hand with a shift from staple grain crops to a more diverse diet of meat, dairy, fish, eggs, pulses, vegetables and fruits - all of which require more land to produce through a disproportionate demand for crops used as animal feed.

Did you know?
Relatively wealthy consumers account for by far the greatest per-capita share of consumption expenditure and environmental footprint. It is estimated that three planets would be required were everyone to adopt the consumption patterns and lifestyles of the average citizen from the United Kingdom; five planets, were they to live like the average North American.

Economic Considerations

South Africa has an essentially dual agricultural economy, with both well-developed commercial farming and more subsistence-based (often communal) farming located in the previous 'homeland' areas. Despite its relatively small share of the total GDP, agriculture is an important sector in the South African economy. It remains a significant provider of employment, especially in the rural areas, and a major earner of foreign exchange. The primary agricultural sector has grown by an average of approximately 13.9 % per annum since 1970, while the total economy has grown by 14.5 % per annum over the same period, resulting in a decline of agriculture's share of the GDP from 7.1 % in 1965 to 3.3% in 2008.

Agriculture's prominent indirect role in the economy is a function of backward and forward linkages to other sectors. Purchases of goods such as fertilisers, chemicals and implements form backward linkages with the manufacturing sector, while forward linkages are established through the supply of raw materials to the manufacturing industry. In 2008 expenditure on agricultural input and services amounted to R69,862 million, which represents an increase of 21,5 % from R57,486 million in 2007. Expenditure on farm feeds, fuel and fertilisers increased by 8%, 51% and 19 %, respectively. Prices for fertilisers showed an increase of 70,6 %, while prices paid by farmers for fuel increased by 14,1 %.

Over the last 20 years, South Africa has undergone immense social and economic changes, with fundamental reforms implemented to create a more open and market-oriented economy. The overall results of the implemented policy reforms to date have been positive, with a stronger and stable macro economy, better integration into the global trading system, and some progress in redressing past injustices. The main agricultural policy reforms include:

- liberalising agricultural trade and deregulating the marketing of agricultural products;
- implementing land reform policies and programmes;
- abolishing certain tax concessions favouring the sector;
- reducing budgetary expenditure on the sector and reducing subsidies; and
- introducing a minimum wage for farm workers.

The Marketing of Agricultural Products Act of 1996 dramatically changed agricultural marketing in the country by closing agricultural marketing boards, phasing out certain import and export controls, eliminating subsidies, and introducing import tariffs to protect South African farming from unfair international competition. Since the deregulation of markets in the mid 1990s, domestic market interventions are limited to the sugar cane/sugar market where a price pooling system is maintained by the South Africa Sugar Association, which is the only sugar exporter.

Phasing out controls and closing marketing boards has led to a shortage of essential services formerly provided by the boards and cooperatives, such as storage, grading, deliveries, value adding, information dissemination and research. As a result, specialised marketing support institutions such as

the South African Futures Exchange (Safex) and the Agricultural Futures Market of the JSE were established to provide much-needed price risk management mechanisms.

An important share of public financial resources has been devoted to land reform. Under the programme, grants are given to the black disadvantaged population to acquire land or for other forms of on-farm participation. Beneficiaries can access a range of grants depending on the amount of their own contribution in labour and/or cash. 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 is financially costly and budget limits have become a constraint to further progress.

People deserve the best standard of living that is sustainable. Improving livelihoods requires the generation of wealth by economic activity and the provision of income to rural communities. This can be done by increasing the value of agricultural produce throughout the value chain. Sustainable economies do however need to be competitive in the global market. Products that are too expensive, and without a market, are not sustainable, even if they are socially and environmentally sound.

Social Issues

An underlying principle for virtually all government policy is to bring the previously excluded black community into the mainstream economy through job creation and entrepreneurship. South African agricultural policy reforms that address past apartheid government injustices include land reform, a minimum wage for farm workers, agricultural support programmes to disadvantaged farming communities and a broad based programme of economic empowerment of the black population. An important share of public financial resources has been devoted to the Land Reform Programme, which consists of three main components: restitution of land unjustly taken from people and communities; land redistribution; and land tenure reform. On the other hand, uncertainty around land tenure has proved to be a disincentive for white farmers to farm responsibly (de Villiers *et al*. 2009).

While addressing unequal land access is one of the greatest issues facing South Africa's new government, there are also many other challenges facing South African society. Widespread unemployment and poverty, a large unskilled work force excluded from the formal economy, weak social and educational systems, a significant level of crime and a high prevalence of HIV/AIDS are everyday realities.

Many of these issues play out at a farm level and addressing and meeting the needs of people is essential to securing a sustainable farming future. The health of people on the farm should be protected (especially when dealing with poisons) and they need access to medical care, secure and suitable housing and food, and to generally aim for as high a standard of living as possible. Sustainable farming should aim to foster healthy populations with the greatest chances of realizing their development potential through promoting equality, education and participation in local communities.

Environmental Challenges

According to the Millennium Ecosystem Assessment, two-thirds of the Earth's ecosystem services are in decline. The resources we depend on for much of the world's food supply are finite, declining, and in some cases, disappearing. Fresh water is becoming scarcer, land is degraded and ecosystems are in decline. Farming practices need to focus on managing natural resources wisely and conserving biodiversity and ecosystem services if agricultural production is to increase in the face of increasing demands, climate change and limited resources.

Did you know?
Humanity's ecological footprint (a measure of the pressure on Earth from human consumption of natural resources) has increased to 125% of global carrying capacity and could rise to 170% by 2040. Food and drink have the highest levels of ecological impact per dollar spent, followed by household equipment and housing. In its *One Planet Business* report, the WWF describes food to have the biggest ecological footprint because of great impacts at both the production and consumption stages.

Water

Farmers needs fresh water, and lots of it. Agriculture is by far the most significant user of water worldwide (over 90% in some developing countries), and it is predicted that famers need to double their use of water by 2050 if they are to meet growing food demands. Today, agriculture is mostly rain-fed, with only about 20% of cultivated land irrigated (accounting for 40% of global food production). Increased irrigation is required to boost agricultural productivity (especially if climate change leads to increasingly unreliable rainfall), but fresh water is becoming scarcer and competition from growing industrial and domestic use is expected to significantly limit irrigation potential and agricultural production in the 21st century.

Most of South Africa's farmland is rain-fed, with only 7% of the country's cultivated land under irrigation. South Africa's rainfall is characteristically erratic and highly variable between years and a system of storage dams and inter-basin transfers are used to provide a reliable bulk water supply for the country. Water withdrawal in South Africa has tripled over the last fifty years and the country's surface and ground water resources are already almost fully utilized (by 2025 the country will be classified as a water scarce country). More than 50% of the country's water resources are already directed to agricultural purposes. This, together with the additional burden of water pollution and growing industrial and domestic water use, means that massively increased irrigation is unlikely to be a solution to increased agricultural production in South Africa. More sustainable water use is essential if agriculture is to survive and flourish into the 21st century.

Did you know?
Agriculture is the largest single non-point source of water pollutants in South Africa. Poorly managed farms allow pesticides, herbicides, poisons, nutrients (from fertilisers and manure) and sediments to drain into groundwater, rivers, lakes and coastal zones. Pesticides from every chemical class have been detected in groundwater and are widespread in the nation's surface waters. In many areas water is not only un-potable but is so polluted that it cannot be used for irrigation.

Less water, declining water quality, and growing water demand are the biggest threats to the future of South African farming.

Land, Soil and Nutrients

Land degradation (the reduction in land productivity resulting from poor land management) affects an estimated 24% of the world's agricultural lands and 65% of agricultural land in Africa. Exposure of topsoil to erosion, over-grazing, soil compaction, over-ploughing and irrigation with salty water have been the major contributors to land degradation. A quarter of the world's population depends directly on land that is being degraded, posing a major challenge to meeting increasing food needs. It is estimated that crop yields in Africa could be cut by half within 40 years if the degradation of cultivated lands continue at present rates.

Land degradation is among the most critical environmental issues facing South Africa. Land in 25% of South Africa's magisterial districts is classified as severely degraded and annual soil loss through erosion is estimated at 400 million tonnes. About 2% of Southern African soils are also crusted and compacted from overstocking and overgrazing, leading to a reduction in water infiltration and available soil water. As much as 91% of South Africa is defined as arid or semi-arid, and it is in these areas that land degradation (compacted by climate change) can lead to desertification and the irreversible loss of productive land.

Areas of severe degradation (and those predicted to be most vulnerable to climate change, Gbetibouo and Ringler 2009) correspond closely with the distribution of the apartheid-era homelands, specifically in Limpopo, KwaZulu-Natal and the Eastern Cape, while the most degraded commercial farming areas are located in the Western and Northern Cape Provinces. Although the communal areas are in greatest need of government support to combat land degradation, it is the commercial farming areas that currently contribute most to South Africa's food security.

Biodiversity and Ecosystems

Agriculture has only recently depended on external inputs, such as fertilisers and pesticides, instead of natural ecosystems and biodiversity for its productivity. Natural ecosystems provide essential services such as increased water quality and availability, flood and erosion control, pollination services, grazing, nutrient cycling, natural hazard protection and soil fertility. Agricultural productivity also depends on numerous species, such as soil micro-organisms, pollinators, predators of agricultural pests and the genetic diversity of the crops and livestock. Over the past 50 years, human activity has altered ecosystems faster and more extensively than ever before. The main findings of the UN Millennium Ecosystem Assessment (a four-year, international, scientific appraisal of the conditions and trends in the Earth's ecosystems completed in 2005) are that two-thirds of critical ecosystem services are being degraded or used at unsustainable levels, and that this will accelerate into the future, massively impacting agricultural productivity.

Land transformation is the major driver of ecosystem and biodiversity loss. Almost 30% of the Earth's terrestrial area has been converted to urban areas or cropland, leading to habitat loss and fragmentation, with resulting species extinctions. Land transformation has left 34% of South Africa's terrestrial ecosystems (and their associated ecosystem processes and services) threatened. Of these, 21 ecosystems (5%) are critically endangered (14 in the fynbos, 5 forest ecosystems, 1 is in the grasslands and 1 wetland vegetation type). While some of the first protected areas in the world were established in South Africa in the late 1800s, the approach to conservation has generally been *ad hoc* and most protected areas are located in landscapes of low economic potential. South Africa's protected area network is thus not designed to conserve a representative sample of biodiversity, particularly in the face of climate change, so it is not surprising that nearly half of the country's terrestrial ecosystems have no or extremely low levels of formal protection.

The little Karoo – A case of dwindling ecosystem services

A recent study by Reyers et al. (2009) shows that ecosystem services in the semi-arid Little Karoo are in decline. Very little (<10%) outright transformation of natural habitat has taken place, however 52% of the region is degraded through overgrazing, making the Little Karoo one of the most degraded areas in the Western Cape. 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. The situation mirrors semi-arid regions around the world, which house the most vulnerable people, ecosystems, and ecosystem services.

These ecosystem declines raise concerns about the region's long-term productivity and its resilience to floods, drought 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 which, due to the slow rate of recovery in arid and semi-arid systems, will take time.

Almost a third of the Earth's plants and animals have been lost since 1970 and current extinction rates are approximately one hundred times higher than the fossil record. A recent South African assessment found that almost 10% of the country's birds and frogs, 20% of its mammals and 13% of its plants are threatened with extinction. Crop cultivation is one of the leading causes of extinction for South African plants. The latest IUCN Red List of Threatened Species contains 40 species listed as Extinct or Extinct in the Wild, with another 76 listed as Critically Endangered – and 43 of these are listed due to crop expansion. The Western Cape, home to the highest known concentration of plant species in the world (three times more than the Amazon rainforest), has become a leading site for species extinctions globally. Today, less than 20% of the Cape landscape is pristine, and these areas exist as disconnected fragments that cannot maintain the ecological processes required for species survival.

With every species and gene lost, we are limiting our options for future success, particularly in adapting to climate change. Crop wild relatives (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 the Poaceae species (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 Red List.

The use of limited monoculture species has led to a loss in the biodiversity of agricultural species. Over the last 50 years, 75% of the crop genetic base of agricultural crops has been lost. About 20% of the world's breeds of cattle, goats, pigs, horses and poultry are also currently at risk of extinction. At least one livestock breed a month has become extinct over the past seven years, with their features (such as resistance to disease or adaptation to climatic extremes) lost forever. Indigenous African food crops such as millet and sorghum have lost their status and concerted efforts need to be made to ensure that these hardy crops are not lost to agriculture forever.

A business-as-usual scenario will lead to serious consequences by 2050, when 11% of the natural areas remaining in 2000 could be lost, predominantly as a result of conversion for agriculture, a change from low-impact farming to intensive use, urbanization and uncontrolled alien plant infestations. The associated loss of species and ecosystems will not only affect agricultural productivity, but also local, regional, or global productivity through the loss of services such as climate regulation, air quality and water availability.

Did you know?
As 80% of South Africa's land is under agriculture (69% for grazing), the maintenance of ecosystem health lies in the hands of South Africa's farmers. For example, the last 10% of critically endangered Renosterveld vegetation exists as fragments scattered amoung the vast wheat fields of the Western Cape, and it is up to these farmers to restore habitat connectivity and ecosystem functioning.

Biodiversity is the term commonly used to capture nature's richness. Biodiversity underpins the functioning of ecosystems, enabling them to provide services such as water cycling and purification, pollination, increased soil fertility and climate regulation.

Climate Change

According to the Intergovernmental Panel on Climate Change, the Earth is expected to warm by up to 4°C by the end of the century, accompanied by changes in rainfall and an increase in extreme weather events. Outcomes depend on future greenhouse gas (GHG) emissions. Agriculture significantly contributes to the problem, emitting an estimated 14% of total GHG emissions, and over 30% if deforestation for agriculture is included. Developing countries are the source of 74% of agricultural emissions. From 1990 to 2005, emissions from agriculture in developing countries increased 32% and are expected to continue to rise, driven by population increases and changes in diet.

Several studies conclude that in the near term (to 2050) relatively limited changes in temperatures and precipitation are expected to limit major impacts on global agricultural production. It was thought that climate change might even have a positive impact in some areas due to carbon dioxide fertilization effects. However, it is now well-known that carbon is not the limiting element for plants, with mineral nutrient limitation and other factors limiting a positive plant growth response to elevated CO_2 (e.g. Díaz *et al*. 1993). After 2050, large global decreases in agricultural production are projected, with global agricultural output decreasing between 6% and 16% by 2080 (assuming a 4.4°C temperature increase, a 2.9% decrease in precipitation, and depending on the effects of CO_2 fertilization).

Globally, southern Africa and south Asia are expected to be hardest hit in both the near and longer term. Global warming in Africa is likely to be above the global average and records show that South Africa has been getting hotter over the past four decades, with the highest increases in the most arid parts of the country. Predictions for South Africa are for further temperature increases in the range of 2.3°C to 3.9°C by 2050, a 2% to 30% drop in rainfall (depending on region), shifts in seasonality, and an increase in extreme weather events such as storms, floods, droughts and high winds. Most predictions indicate a drying in the western two-thirds of the country and a wetting along the east coast, where topography plays a significant role in the formation of rainfall. The Western Cape, a province that is already facing water scarcity, is predicted to face a shorter rainfall season, however it is the KwaZulu Natal, Limpopo and Eastern Cape provinces that have the least ability to adapt to climate change and may be the worst hit (Gbetibouo and Ringler 2009).

Did you know?
Agriculture's link to climate change is just beginning to be appreciated. Modern farming contributes over 30% of global greenhouse gas emissions. Carbon dioxide is emitted in huge quantities when forest or grassland is converted to agriculture and again when soil is ploughed. Nitrous oxide (which is 300 times more potent than carbon dioxide) is emitted by nitrogen fertilisers, which inefficiently release much of their nitrogen into the atmosphere. And livestock produce both nitrous oxide and methane, making themselves responsible for more GHGs than from transportation.

In general, climate change is expected to be harmful to farming in South Africa, as agriculture in the country is dependent on climatic variables (as seen during the 1994-95 droughts where the maize harvest fell 42% in one year). The country's rain-fed croplands and rangelands are the most vulnerable to climatic changes, with irrigated farms cushioned against rainfall variability by having a substitute for rainwater. The SA Department of Environmental Affairs and Tourism estimates that changes in climate will cause maize production (which constitutes about 70% of grain production) to drop by between 10–20% over the next 50 years, affecting South Africa and the sub-region (as South Africa produces more than half of the sub-region's maize). The country's rangelands are at risk of declining productivity and desertification due to increased aridity. Speciality crops grown in specific environmentally favourable areas, such as apple farming in the Western Cape, are also at risk. In addition to reduced water

availability, increased alien species invasions and pathogens populations are expected to severely impact agricultural productivity (Vitousek et al. 1997).

However, both gains and losses are expected, specific to each farming system and each province. For example, earlier rainfall in the summer farming regions would be beneficial to rain-fed agriculture, while later rainfall would be harmful. Early winter rainfall would also be beneficial for the winter farming regions. If farmers, scientists and policy makers are able to identify where the gains and losses are, and direct the appropriate adaptation strategies to these areas, the expected overall negative effect may be reduced, and it is even possible that the agriculture sector in South Africa may reap some benefits from climate change.

Did you know?
Apple farmers around Grabouw and Elgin in the Western Cape, who need cold winters for optimal production, are already struggling to produce sufficient export-quality fruit. Rising temperatures mean insufficient chill units for proper fruit set (Farmers Weekly 12.06.07). According to Dr Guy Midgley, head of the climate-change unit at the SA National Biodiversity Institute, "If you just have a couple of days that go above a critical temperature, you get sunburn in these export apples."

Climate change is also predicted to impact South Africa's biodiversity and ecosystems. The area considered climatically suitable for South Africa's seven biomes could shrink 40% by 2050, to be replaced by unknown vegetation cover. Much of the area currently occupied by grasslands, for example, could shrink and become increasingly susceptible to invasion by savanna species, expanding the extent of the savanna biome. Some 44% of plant and 80% of animal species will alter their existing ranges, with the majority of range shifts taking place in an easterly direction, a pattern in keeping with the predictions of significant increases in aridity in the western parts of the country. These ecosystem changes and likely species losses will reduce the provision of ecosystem services and possibly also increase negative environmental impacts, such as alien plant infestations, fires, and insect pests.

The challenge is for South African agriculture to adapt fast enough to a changing climate, and to shift production practices to reduce its carbon footprint. Activities align well with sustainable land management practices and include using improved crop varieties, more efficient use of water, reduced stocking rates, wetland and catchment restoration, adopting precision fertilizer management, using composted manures rather than synthetic fertilisers and reducing tillage.

Biofuels – a bane or blessing to South African farmers?

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 5 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 underutilized 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 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 to South Africa, but if not managed sustainability, there is concern about its affect on the environment, loss of ecosystem services, and how South Africa is going to feed its growing population.

A Sustainable Solution

While total global food production is higher than ever, per capita yields are decreasing (Funk and Brown 2009), and environmental damage is extensive. As the cost of modern agriculture takes its toll, there is increasing recognition that species and ecosystems are critical to accommodating the basic needs of the world's population, now and into the future. These realizations have led a move towards promoting the concept of sustainability in farming practices. This concept centres on the need to build farm productivity and profitability in a way that allows ecological processes to continue and conserves natural and human resources on the farm– ensuring that the agricultural sector can meet world food demands, enhance rural livelihoods and stimulate economic growth.

The organic farming movement does to some extent address the issue of sustainable food production, as its basic principle is to promote the exclusive use of natural agricultural resources (Badgley *et al*. 2006). However, organic farming often falls short of the requirements for addressing the social and economic aspects of farming, as well as the conservation and management of natural on-farm biodiversity and ecosystems.

What is sustainability?

The phrase 'sustainable development' originated in German forest management during the 19th century, but was popularized in the 1980's following the World Commission on Environment and Development and its report of 1987, *Our Common Future* (known as the Brundtland report). The well-used Brundtland definition of sustainable development is:

"*Economic activity that meets the needs of the present without compromising the ability of future generations to meet their own needs*."

Interestingly, the sustainability of a system can be determined only after the fact. Thus, definitions of sustainability are actually predictions of what set of conditions will lead to a sustainable system. It is therefore particularly important to adopt a precautionary approach to development – i.e. not to take unnecessary risks that could decrease the chances of sustainability and not to hope for technological solutions when things go wrong.

In South African legislation, sustainable development means "the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (National Environmental Management Act 107 of 1998). The definition of sustainable in relation to the use of a biological resource means:
"the use of such resource in a way and at a rate that -

a) would not lead to long-term decline;
b) would not disrupt the ecological integrity of the ecosystem in which it occurs; and
c) would ensure its continued use to meet the needs and aspirations of present and future generations of people."

While the Conservation of Agricultural Resources Act 43 of 1983 does not define sustainable development, sustainable use or sustainable, the Draft Sustainable Utilisation and Protection of Agricultural Resources Bill (SUPAR) has proposed the following definitions:

- "sustainable utilisation" means the utilization and protection of natural agricultural production in an environmentally sound manner, without compromising the ability of future generations to meet their own needs.
- "sustainable" in relation to use of natural agricultural resources, means the use of such resource in a way and at a rate that
    a) would not lead to its long-term decline;
    b) would not disrupt the ecological integrity of the ecosystem in which it occurs; and
    c) would ensure its continued use to meet the needs and aspirations of present and future generations of people.

The image most commonly used to describe sustainable development is that of three pillars, representing economic growth, social development and environmental protection. As sustainable development is historically a product of the environmental discussion, the focus has long been on strengthening the environmental pillar, perceived as the weakest of the three. The challenge for the future will be to consider all three aspects of sustainability as a whole, rather than focusing on a specific pillar. This requires partnerships between the three sectors: international organizations and government agencies responsible for environmental protection, social welfare, and economic development; NGOs working toward environmental and development goals; and the private sector (which in recent years become active in strengthening pillars other than the economic one).

Sustainable development means the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations (South African National Environmental Management Act 107 of 1998).

Existing Sustainability Guidelines

A number of initiatives have emerged internationally and locally that promote sustainability best practices in agriculture. A few prominent examples are:

- The Rainforest Alliance who, through the Sustainable Agriculture Network, has produced the Sustainable Agriculture Standard (2008) that integrates "sustainable production of crops and livestock into local and regional strategies that favour biodiversity conservation and safeguard social and environmental well-being".
- Scientific Certification Systems who has established a comprehensive framework and common set of environmental, social and quality requirements by which to demonstrate that an agricultural product has been produced and handled in a sustainable manner, from soil preparation and seed planting through production, harvest, post-harvest handling and distribution for sale (SCS-001 Sustainable Agriculture Practice Standard For Food, Fibre and Biofuel Crop Producers and Agricultural Product Handlers and Processes: Draft Standard for Trial Use, April 13 2007).
- The United National Conference on Trade and Development (UNCTAD) Biotrade Initiative (United Nations, 2007) who has developed a set of principles and criteria related to the collection or production, transformation, and commercialisation of goods and services derived from native biodiversity (genetic resources, species and ecosystems) according to criteria of environmental, social and economic sustainability.
- The Round Table on Responsible Soy Association (RTRS) who is currently developing a set of Principles, Criteria and Indicators to be applied to all types of soy production. Each soy

producing country will be encouraged to make a national interpretation of the guidelines which, once endorsed by the RTRS, will become the basis for certification in that country.

- The Forest Stewardship Council (FSC), who is an independent, non-governmental organisation established to promote the responsible management of the world's forests (see www.fsc.org). Products carrying the FSC label are independently certified to assure consumers that they come from forests that are managed to meet the social, economic and ecological needs of present and future generations.

In the local context both the plantation forestry growers and sugarcane growers have developed initiatives that promote sustainable production. Under the auspices of Forestry South Africa, a series of publications, culminating in the publication of "Environmental Guidelines for Commercial Forestry Plantations in South Africa" have emerged (Forestry South Africa, 2002). The forestry guidelines deal with the environmental aspects of soil preparation, planting, harvesting and transport of the crop, as well as the well-being and health of workers. More recently, 80% of plantations in South Africa have progressed to independent certification of their operations according to the standards of the internationally based Forest Stewardship Council.

The Noodsberg Canegrowers embarked on a process to develop and implement an environmental management system in the absence of any industry-developed system in South Africa. The process was initiated in 1998 and resulted in the publication in March 2002 of the *Noodsberg Canegrowers Environmental Management Guidelines for Sugarcane*. In 2004, the WWF/Mondi Wetlands Project formed a partnership with Noodsberg Canegrowers to develop a Sustainable Sugar Initiative which provides a practical and acceptable environmental management system for sugarcane growers. This partnership resulted in the development of what became known as the *Sustainable Sugarcane Farm Management System*, or SuSFarMS (2008), which is based on three principles, underpinned by a number of criteria and indicators, with performance against these indicators assessed according to verifiers. The verifiers are legal requirements, better/best management practises, or a combination of both.

Other initiatives that have been launched include the Biodiversity and Potato Initiative in the Western Cape Sandveld, the Biodiversity and Rooibos Initiative, the Biodiversity and Wine Initiative, Badger-Friendly Honey, and sustainably harvested wild flowers under the auspices of the Flower Valley Conservation Trust (FVCT).

The GreenChoice Reference for Well-Managed Farms

While various local and international sustainability initiatives and guidelines exist, and while many South African farmers have a good feel for sustainable farm management and good land practice, the GreenChoice Alliance identified the need for a single document that brings together current knowledge on sustainable farm management in South Africa. In response, WWF funded the GreenChoice Alliance to produce the generic *Reference for Well-Managed Farms*. This guideline outlines basic sustainability principles that can be applied across different farms and includes descriptions of the methodologies and practices currently associated with sustainable agriculture in South Africa.

The objective is that, over time, the GreenChoice Alliance partners would develop sector-specific sustainable farm management systems that meet their needs, using the Reference as a guideline. The set of principles, criteria and indicators laid out in the Reference, and the supportive text, thus offers an approach towards the development of sector-specific sustainable farm management practices. The Reference includes legal requirements as well as generic best management practices around which sector-specific verifiers can be established.

The Reference is thus not intended as a farmer friendly document but was developed as a master document that could be customized for specific agricultural sectors, using what is appropriate from the guideline for each sector and adapting any sector best practice guidelines within the criteria or indicators. In some instances, it may be necessary to develop a separate criterion or indicator to cater for a particular set of circumstances. The aim would be that a simple and easy to use guide, assisted by the development of a check sheet or audit check-list, would provide a farmer with a practical tool that can be used to check his/her performance against the principles, criteria and indicators.

GreenChoice

The GreenChoice Alliance was launched in May 2008, co-hosted by WWF-SA and Conservation International South Africa. Founding partners include the Botanical Society of South Africa, the Cape Leopard Trust, the Endangered Wildlife Trust, the Flower Valley Conservation Trust, the Landmark Foundation, the Wilderness Foundation, Cape Action for People and the Environment (CAPE), Cape Nature and the South African National Biodiversity institute (SANBI). The aim of this national alliance is to upscale sustainable agriculture and fisheries production in South Africa by driving best practice across supply chains.

Developing the Reference

The approach adopted in developing the *Reference for Well-Managed Farms* is the 'Principles and Criteria' concept used in the forestry industry and the recently published Sustainable Sugarcane Farm Management System (SuSFarMS). The principles used in the Reference are the same as those agreed upon through the extensive stakeholder consultation process to develop SuSFarMS. The criteria for the Reference have however been modified from those in SuSFarMS to reflect the fact that the *Reference for Well-Managed Farms* is a generic document, as opposed to the sector specific SuSFarMS. The criteria also incorporate suggestions from stakeholders in the series of workshops convened to develop the Reference.

The *Reference for Well-Managed Farms* has also taken cognisance of all legislation related to farmers achieving a financially stable, socially acceptable and biological productive farm while minimising risk and protecting the natural resources on which their farming operation depends. An outline of the relevant legislation is provided below.

The first *Reference for Well-Managed Farms* stakeholder meeting was convened by GreenChoice and WWF in December 2008. A draft of the Reference was discussed at length, and arising from the stakeholder discussions and inputs, the Reference was refined. The refined Reference was presented at two workshops in March 2009. Further stakeholder input at these workshops allowed for additional improvements and the further amended Reference was presented at a workshop on 28 August 2009. The final *Reference for Well-Managed Farms* reflects the outcome of this workshop.

Legal Requirements

Compliance with national, provincial and local legislation is a minimum requirement in achieving a financially stable, socially acceptable and biological productive farm that minimises risk to the natural environment. The *Reference for Well-Managed Farms* takes into account all relevant South African legislation affecting farmers.

<u>Agricultural legislation</u>

In South Africa, the legislation governing agriculture is contained in the somewhat dated Conservation of Agricultural Resources Act 43 of 1983. The objective of this Act, commonly known as CARA, is to provide for the conservation of natural agricultural resources of the Republic by the: "maintenance of the production potential of land; combating and prevention of erosion and the weakening or destruction of water sources; and by the protection of the vegetation and the combating of weeds."

Recent developments in agricultural policy and legislation have seen the publication of the Government's White Paper on Agriculture (1995), the 1998 Agricultural Policy in South Africa, the 2002 Strategic Plan for South African Agriculture as well as the 2003 version of the Sustainable Utilisation and Protection of Agricultural Resources (SUPAR) Bill. These publications, culminating in the draft SUPAR Bill, have taken a significant step forwards and have expanded the horizons of CARA. In particular, there is recognition of the closely related economic, social and ecological challenges facing agriculture, which the 1998 Agricultural Policy succinctly emphasis as the need to:

- protect the natural resource base;
- prevent the degradation of soil and water;
- conserve biodiversity;
- contribute to the economic and social well-being of all;
- ensure a safe and high-quality supply of agricultural products; and
- safeguard the livelihood and well-being of agricultural workers and their families.

There have been a number of initiatives within the Department of Agriculture that are worth mentioning. Firstly, there is the LandCare concept which is defined as a community-based land management programme. LandCare offers practical assistance to effect land conservation activities that are identified, implemented and monitored mainly by the farming community. It is designed to achieve biological productivity, economic viability, social acceptability, minimisation of risk and protection of natural resources.

Secondly, there is a Draft: Policy for the Sustainable Management of Veld (Range) and Forage Resources in South Africa[1] which gives an introduction to veld and forage resources utilisation in the country. The policy has a number of objectives which comfortably align with the development of the *Reference for Well-Managed Farms*. In particular to:

- provide a framework and guidelines that promote and facilitate the sustainable use of South Africa's veld and forage resources for animal production; and
- provide a framework and guidelines for effective veld and forage monitoring and improvement with the capacity to support compliance to the relevant legislation/regulations regarding the sustainable use of these resources.

Thirdly, there is the National Livestock Development Strategy (DoA, 2007) which was developed to enhance equitable access to and participation in agriculture, to improve global competitiveness and to ensure sustainable resource management. Arising from this strategy was a review of the impact of planned and partially implemented interventions on red meat research, development and marketing in South Africa – The Livestock Development Strategy (LDS) and its Potential Impact on the Red Meat Marketing and Development in South Africa (DoA 2008 (a)). The review argues that the sustainable use of veld and forage resources is the most critical success factor, as most of the red meat (cattle, sheep, goats, wildlife and ostriches) produced in South Africa starts with this resource.

The Department of Agriculture has also recognised the role that wildlife ranching plays as a sustainable alternative to more conventional livestock farming systems (DoA, 2008 (b)). The DoA recently published a comprehensive reference book that includes lists of species, production guidelines and

[1] Published in GN 873 in GG 28994 of 7 July 2006.

service providers to facilitate the development of wildlife ranching as a formally recognised activity in South Africa (DoA, 2008). The publication is far reaching in that not only does it provide practical guidance (such as the calculation of grazing capacity and browse capacity for game species), but also the role of DoA in the development of a sustainable wildlife ranching sector in South Africa.

From these developments, it is obvious that there is increasing focus on the sustainable use of both the agricultural and natural resources of South Africa, while recognising the important role that economic viability and social well-being plays in the need for a vibrant agricultural sector.

Biodiversity Conservation Legislation

The National Environmental Management Act 107 of 1998 (NEMA) is the overarching legislation that governs environmental management in South Africa (elements of the Environmental Conservation Act 73 of 1989 which remain in force will ultimately be repealed). NEMA identifies various principles which serve as the general framework within which environmental management and implementation plans must be formulated. Importantly, the Act requires that, *inter alia*:

- environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably; and
- development must be socially, environmentally and economically sustainable.

Importantly, the Act requires that:

"every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing, or recurring, or, in so far as such harm to the environment is authorised by law, or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment."

There is thus a clear requirement that even if a landowner is authorised by law to, for example, break virgin ground for new crops, they must take steps to minimise or rectify any degradation (or pollution) of the environment. By inference, the adoption of best management practices would be regarded by authorities as the means of minimising degradation of the environment. It is suggested that the *Reference for Well-Managed Farms*, or an adaptation of the system to a specific form of agricultural use (e.g. stock farming, wildlife ranching, crop production) would be seen as contributing towards the landowner's duty of care to minimise the impact of farming operations on the environment.

Within the framework of NEMA, the NEM: Biodiversity Act 10 of 2004 (NEM:BA) was promulgated to, *inter alia*:

- provide for the management and conservation of biological diversity; and
- provide for the use of indigenous biological resources in a sustainable manner.

As a follow-up to the publication of NEM:BA, South Africa's National Spatial Biodiversity Assessment (NSBA) was published in 2005. The assessment is wide-ranging, and provides a national context for assessments at the regional scale, and points to broad priority areas where further investigation is warranted. Three key strategies for conserving South Africa's biodiversity have emerged from the NSBA:

- linking biodiversity and socio-economic development in priority areas. This involves working with production sectors, private and communal land-owners to conserve biodiversity. This

would include the implementation of sector-specific wise-practice guidelines to minimize loss of natural habitat and species in threatened ecosystems, and to protect ecosystem functioning.

- Focusing emergency action on threatened ecosystems to prevent further loss of ecosystem functioning. Threatened ecosystems are often found in the midst of production landscapes and are often fragmented or degraded. Minimising loss of habitat in threatened ecosystems can be achieved by, for example, promoting stewardship among private and communal land-owners, and by using regulations in terms of NEM:BA.

- Expansion of the formal protected network. This expansion allows for private or communal land to be declared a formal protected area and allows for co-management of such a protected area status (with perhaps an associated rates exclusion in terms of the Municipal Property Rates Act).

Progress in achieving conservation of biodiversity in production landscapes has been made through a number of initiatives. In the first instance, the National Biodiversity Strategy and Action Plan (NBSAP, 2006) sets out a framework and a plan for, among other things, the conservation and sustainable use of South Africa's biological diversity. The overriding goal is to "Conserve and manage terrestrial and aquatic biodiversity to ensure sustainable and equitable benefits to the people of South Africa, now and in the future". The NBSAP has a number of strategic objectives. Of particular relevance to the farming sector and to the *Reference for Well-Managed Farms* are the following Strategic Objectives. Each is supported by a number of Outcomes and Activities, which for brevity have not been included here.

Strategic Objective 1: *An enabling policy and legislative framework integrates biodiversity management objectives in the economy*.

Strategic Objective 3: *Integrated terrestrial and aquatic management minimises the impacts of threatening processes on biodiversity, enhances ecosystem services and improves social and economic security.*

Strategic Objective 4: *Human development and well-being is enhanced through the sustainable use of biological resources and equitable sharing of benefits.*

Strategic Objective 5: *A network of conservation areas conserves a representative sample of biodiversity and maintains key ecological process across the landscape and seascape*.

There is thus a convergence of views in both the agricultural sector and biodiversity sector that there is a place for both transformed and untransformed land in achieving both biological and agricultural sustainable systems. This emphasizes again the possible use of a generic sustainable farm management system that brings the two sectors together, while contributing to the landscape level maintenance of ecological functions, and to the social well-being and economic viability of individual farming operations.

Structuring the Reference (P C & I)

The *Reference for Well-Managed farms* is structured around principles and criteria. Following each principle and its supporting criteria, is an indicator which is an essential aspect of a criterion that can be used to demonstrate or indicate compliance with the criterion. The principles, criteria and indicators have been written in a form that is typical of an auditing system.

P, C and I Definitions

In order to understand the meaning of principles, criteria, indicators and verifiers at a conceptual level, the following definitions have been modified from the successful forest certification initiative (after Center of International Forestry Research, 1999).

A principle: A fundamental truth or law as the basis of reasoning or action.

Principles provide the primary framework for managing farms in a sustainable manner and embody conventional wisdom. An example of a principle would be: *Natural assets are conserved, ecosystem services and ecological processes are maintained and agricultural and biodiversity resources are sustainably used.*

A criterion: A principle or a standard that a thing is judged by.

Criteria are "second order" principles that add meaning to a principle without itself being a direct measure of performance. Criteria are the intermediate points to which the information provided by indicators can be integrated and where an assessment crystallizes. An example of a criterion, using the above example of a principle would be: *Biodiversity assets and threatened ecosystems are conserved.*

An indicator: Any variable or component of the farming enterprise used to infer the status of a particular criterion.

Indicators should convey a single, meaningful message. An example of an indicator, using the criterion above, would be: *Threatened and protected species as provided in legislation are protected*.

A verifier: Data or information that enhances the specificity or ease of assessment of an indicator.

Verifiers or guidelines provide specific details that would indicate or reflect a desired condition of an indicator. They add meaning, precision and often site-specificity to an indicator, and may define a performance threshold or target. Examples of verifiers, using the indicator above, would be:

- *Protected tree species on the farm as listed annually in terms of the requirements of the National Forest Act 84 of 1998, remain protected.*
- *Nationally threatened or protected species on the farm, as identified in terms of the National Environmental Biodiversity Act, remain protected.*

Potential for sector-specific verifiers

Following each indicator is text that provides information that could be used to develop verifiers or standards specific to a particular farm product.[2] For example, an indicator such as the prevention of veld and forest fires would be as follows:

Indicator 3.3.6: *Veld and forest fires are prevented*

[2] Because there are points of view that consider that the term 'standard' should only be used in cases where whatever is being judged can be measured, the term 'verifier' has been used (implying that the indicator can either be measured or its presence simply verified).

For a landowner to be able to ensure that this happens, and, perhaps in due course for an independent auditor to be able to determine that veld and forest fires are indeed prevented, the following verifier would be applicable:

Verifier 3.3.6.1: *Farmers comply with the National Veld and Forest Fire Act 32 of 1998.*

But this in itself may not be particularly helpful to the landowner, or even to the auditor for that matter, so the value of the verifier to the user could be enhanced further by outlining some of the most important legal requirements or best management practices. Thus:

- Farmers prepare and maintain a firebreak on his/her side of the boundary between his/her land and the adjoining land;
- farmers have the necessary equipment and personnel to fight fires, or they are members of a fire protection association; and
- farmers are aware of the annual restrictions on the burning of fire breaks and rubbish.

While this example is generic to all landowners, specific agricultural crops or livestock types would need to consider current acceptable best management practices and include these as their specific verifier. For example, in the sugarcane industry, conservation terraces are important structures on sloping land to minimize soil loss. Thus, the indicator would be

Indicator 3.3.1: *Soil quality is maintained or, where necessary, improved*.

Again, for a landowner to be able to ensure that this happens, and, perhaps in due course for an independent auditor to be able to determine that soil quality is indeed maintained, the following verifier would be applicable:

Verifier 3.3.1: *Conservation terraces are in place to minimize soil erosion.*

Again, this in itself may not be particularly helpful to the landowner or auditor so the value of the verifier to the user could be enhanced further by outlining some of the most important legal requirements or best management practices. Thus:

- All land over 3% slope is protected by conservation terraces;
- panel widths do not exceed specifications for slopes;
- highly erodible soils are protected by conservation terraces on slopes over 1,5%;
- moderately erodible soils are protected by conservation terraces on slopes over 3%; and
- broad-based terraces are constructed on slopes of up to 12% and if planted over to cane, are aligned parallel with the contour.

Useful questions that can be asked of a verifier or guideline are:

- Will complying with the verifier achieve good farm management?
- Does the verifier make sense?
- Is it fair to all farms (small through large)?
- Does the verifier work consistently well in all parts of the country?
- Can an auditor use it to reach a clear decision, and will all auditors reach the same decision?
- Do farmers agree that it is operational?

While the wording in the principles and criteria should remain unchanged, or, if changed, should reflect the same intention, the indicators and verifiers adopted for each sector (e.g. grain, malt, barley, wine, rooibos, ostrich, livestock, wildlife ranching) could change to reflect that sector. Changes are more likely to be found in the environmental principle and to a lesser extent in the social and economic

sector. However, it is only by rolling out the generic farm management system into specific sectors that the extent of change necessary will become evident.

THE REFERENCE FOR WELL-MANAGED FARMS

THE ECONOMIC PRINCIPLE

1. Economically viable farm production is maintained or enhanced.

Criterion

1.1 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.

Indicator

1.1.1 A written land-use plan that promotes sustainable farm production exists.

A land-use plan is an elementary planning tool for each landowner and assists him/her in identifying management priorities based on the inherent characteristics of the land. Different parts of the land usually require different types of management and these must be integrated into a working plan that, while striving for economic returns, protects the environment.

Typically, a land use plan would include a map and, depending on the scale of the operation, the map could be supported by text that could range from a simple one page document to a complex management plan. A land use plan, to be really effective, should include the following information (the level of detail will be dependent on the scale of the operation and the type of farming practiced):

- Soils (type, series, depth, erodibility, organic content etc)
- Natural vegetation (classified into various types, depending on detail required for effective land management)
- Water sources (wetlands, dams, rivers, streams, boreholes)
- Rainfall, temperature, altitude – important for determining suitable crop, livestock and wildlife stocking rates/carrying capacity
- Climate change predictions and downscaled climate change maps (where available)
- Arable land
- Crop types (in ha)
- Grazing camps (in ha)
- Infrastructure (roads, quarries, causeways, bridges, housing, sheds, workshops)
- Waste disposal (rubbish dumps, or a note to the effect that waste is disposed of to a registered waste disposal site)
- Distance to markets (road, rail).

Indicator

1.1.2 Profitability or viability of the farming operation is planned on an annual basis.

Landowners are concerned about their future profits and thus the sustainability of their operations. Analysis of the past provides a useful insight into the farm's financial viability and potential future financial performance (Hartley, Firer and Ford, 1990).

Structured financial planning is the key success of any business venture – and farming is a business. A well-run farm should have a clearly defined goal, which should be categorised into a series of operating plans which lay down the steps to achieve those objectives. Basic steps that a landowner should consider in the financial plan would include (after Hartley, *et al*, 1990):

- the level of capital expenditure in the following year(s)
- the sales forecast for existing crop, livestock, wildlife or tourism (or products derived from them), and for new crops, livestock, wildlife or tourism ventures
- use of a proforma income statement to forecast the level of profit anticipated
- forecast the probable level of assets in the farm's balance sheet at the end of each planning period, and hence estimate the funding requirements of the farm
- assess the proportion of the required funds that will be generated internally, and what proportion, if any, will have to be financed from outside sources
- ensure that the effects of seasonal requirements (fertilisers, herbicides, tourism structure maintenance) are taken into account in the plan
- note cost of natural disasters such as flooding or droughts
- provide adjustments to the inputs to the plan in the light of the financial sustainability of the farm
- establish and maintain controls to ensure that the financial plan is carried out effectively.

Indicator

1.1.3 Production potential or grazing capacity of the land is maintained or enhanced.

In order to ensure an economically viable farming unit, it is necessary to plan and then record against that plan what was actually achieved. For example, area of land under crops and their yield should be recorded annually, while livestock yields (animal units/ha or kg/meat/animal/ha) are an indication of appropriate stocking rates and grazing management. Costs of maintaining or enhancing the production potential of the land should also be recorded (e.g. use of fertilisers, biocides and their type, rate and frequency of application) and this use interpreted in relation to crop yields over time. In the livestock industry, the objective should be to produce all feed requirements from farm-grown forages, with minimum supplementation at the least possible cost – this entails matching fodder supply with fodder demand (Klug, van Heerden and Lishman, 1999). In the wildlife ranching industry, the production potential could consider a number of options such as maintenance of the optimum carrying capacity of the land to enhance wildlife production which could be for tourism, hunting, etc.

Should a farmer practice organic agriculture (the environmentally, socially and economically sound production of food and fibres in the absence of synthetic fertilisers and pesticides, genetically modified organisms and pharmaceuticals) then reference to IFOAM (The International Federation of Organic Agriculture Movements – www.ifoam.org) and the input costs should be maintained as a measure of the economic sustainability of organic agriculture.

Indicator

1.1.4 Payment for ecosystems services is implemented where possible through a biodiversity management agreement.

Society derives many essential services from natural ecosystems such as increased water availability, soil fertility, protection from natural hazards and climate regulation.
Payment for Ecosystem Services (PES) is a relatively new concept where beneficiaries of environmental services make payments or provide other non-financial goods, such as market access, land security, public services, infrastructure and capacity building to those who secure the provision of such services (Leimona and Lee, 2008). Current PES tools include direct public payments (gathered in the form of a tax and distributed to priority service areas such as water catchments) and direct private payments (e.g. purchases on the carbon market). The services promoted through PES primarily focus on climate regulation (carbon) and water provision, although PES is increasingly being used as a tool to achieve biodiversity conservation and to maintain landscape beauty as national assets. While the environmental and broad societal benefits are the primary objectives of PES schemes, implementation experience has shown that PES provides important income for poor land users to improve their livelihoods and is a useful vehicle for national income redistribution. PES is likely to work if there is:

1. effective supply and demand for the PES mechanism
2. supportive national and international conditions
3. support by credible intermediary organisations.

In South Africa, the Income Tax Act 58 of 1962 as amended by the Revenue Laws Amendment Act 60 of 2008 (section 37C) has implemented a PES-type system by allowing for income tax deductions in respect of environmental conservation and maintenance. Expenditure incurred by a taxpayer to conserve or maintain land is deemed to be expenditure in the production of income and for purposes of a trade carried out by the taxpayer, if –

- the conservation and maintenance is carried out in terms of a biodiversity management agreement that has a duration of at least five years;
- the agreement is entered into by the taxpayer in terms of section 44 of NEM:BA; and
- land utilised by the taxpayer for the purposes of carrying out pastoral, agricultural or other farming operations consists or includes or is in the immediate proximity of the land that is the subject of the biodiversity management agreement.

In addition, if the above conditions are met, expenditure in respect of certain activities (e.g. eradication of alien plants) to conserve and maintain land owned by the taxpayer may be deemed as expenditure incurred in the carrying out of pastoral, agricultural or other farming operations.

To meet the biodiversity management agreement criterion for tax deductions, Section 44 of NEM:BA indicates that the Minister may enter into a biodiversity management agreement with an organisation (or person or organ of state) regarding the implementation of a biodiversity management plan. This Reference for Well-Managed farms could be tested or adapted to form the foundation of a farm biodiversity management plan, while WWF-SA or other reputable NGOs or conservation agencies could be the organisation with whom the Minister enters into an agreement. This would satisfy two of the minimum requirements identified by Leimona and Lee (2008) for PES to work, viz:

- national government support; and
- support by a credible organisation.

If this were to happen and proved successful, then the third requirement for a workable PES would also be met, viz:

- effective supply and demand.

There are further fiscal incentives for protected areas, which is a higher level of agreement than a biodiversity management agreement. If a farmer wishes to proclaim his land or a portion of his land as a nature reserve, special nature reserve, national park or protected environment then he/she will be eligible for these incentives.

In addition to the tax relief incentives, there is potential for a national land fund with a true PES component that focuses on food, water and climate security. This fund could pay for sustainable land management activities carried out on land under a biodiversity management agreement. While PES is still a new concept, there may be possibilities of exploring this concept through these guidelines, and piloting its implementation accordingly.

Lastly, the international and local carbon markets offer potential for farmers to receive payment for reducing the greenhouse gas emissions of their operations and thereby contributing to conserving the climate stabilising ecosystem service. Ways in which farmers can reduce their emissions are outlined under Indicator 1.1.6., with most activities falling under the REDD (Reduced Emissions from Deforestation and Degradation) category. One of the key issues associated with establishing financing mechanisms for mitigation is the establishment of systems to measure, report and verify mitigation actions and outcomes. It should also be noted that engaging with the international carbon market is costly and requires a large-scale operation, but there are emerging opportunities to engage with the local 'voluntary' carbon market.

Indicator

1.1.5 The effects of climate change on current farming practices are recognised and, where possible, are adapted to cope with predicted climate change impacts.

South African farmers will need to adjust to new environmental conditions such as higher temperatures, reduced rainfall, increased flooding and other extreme weather events. Farmers need to take note of current and predicted climatic changes and their potential impacts on their farming activities, and to implement adaptation strategies to increase their resilience and reduce their vulnerability to climatic changes.

Adaptation measures that landowners could consider in their long-term plans are:

- the more efficient use of water on the farm (e.g. improving irrigation efficiency, rainwater tanks, water reuse and intercropping to maximize uptake of water and crop productivity);
- wetland and catchment/riparian restoration to increase water quantity and quality;
- removal of alien plant infestations to increase water flow;
- reducing stocking rates to reduce grazing pressure on rangelands;
- planting drought resistant crops;
- building soil health (see Indicator 3.3.1 for a detailed account);
- avoiding bare fallows to prevent erosion and soil water loss; and

These adaptation measures fit comfortably with sustainable farm management practices as they ensure the wise use of agricultural resources and the restoration and protection of ecosystem health. These practices also contribute to reducing the farm's greenhouse gas emissions and thus assist in mitigating climate change itself.

Indicator

1.1.6 The need for climate change mitigation and energy efficiency is recognised and, where possible, implemented.

South Africa is responsible for about 1 % of the global warming effect, placing it in the top ten contributing countries in the world (Energy Research Centre, 2007). The per capita emission rate is just under 10 tons of CO_2e per year, which is above the global average of 7 tons of CO2e. The largest emissions source is associated with energy supply and consumption (78%), with smaller contributions from industrial processes (14%), agriculture (5%) and waste (2%) (UNFCC study, DEAT 2009). These figures do not however include emissions or sinks caused by land use change for agriculture and forestry activities, which increase the agricultural contribution significantly.

Increasing Energy Efficiency

The nation needs to alter the way it produces and consumes energy. Government has identified this need through the publication in 1998 of the White Paper on Energy Policy, the recently promulgated National Energy Act of 2008, and the 2005 National Energy Efficiency Strategy[3]. These, coupled with the DEAT commissioned Long Term Mitigation Scenario completed in 2007, identifies the opportunity for immediate low-cost and no-cost interventions, as well as higher-cost measures with short payback periods. The Strategy sets a national long-term target for energy efficiency improvement of 12% by 2015. Energy efficiency improvements will include economic and legislative means, efficiency labels and performance standards, energy management activities and energy audits, as well as the promotion of efficient practices.

To become energy efficient and cut energy costs, use Eskom's guide to energy saving for useful hints (www.eskomdsm.co.za). There is also a section for agricultural customers (www.eskomdsm.co.za/?q=Agricultural_Saving_tips) which provides useful tips for farmers. These include:

- replacement of old electric motors by new generation high-efficiency motors;
- matching irrigation pipes and nozzle sizes (small diameter pipes operate at higher friction levels and more electricity is required to increase rate of water delivery to overcome this friction);
- the proper maintenance of nozzles and pipes (reduces water losses - leaking pipes means more water and thus more electricity use);
- use of cell phone and computer technology to schedule irrigation (can save up to 30% energy use);
- reduction of cold-rooms energy usage by:
- opening doors only when necessary,
- not overfilling cold-rooms (overfilled rooms have a lower cooling efficiency and thus more energy is used to reach the storage temperature), and
- ensuring well ventilated condensers for best performance, and regular cleaning of coils and filters;
- saving power in the dairy parlour by rinsing the milking machines with cold water directly after milking and ensuring a complete washing cycle takes place outside Eskom's peak hours;
- reducing the energy costs of animal housing by installing proper roof insulation; and

[3] With a new version published on 26 June 2009, GG No. 32342.

- investigating the use of alternative energy sources, such as solar (through solar energy and photovoltaics) or the use of biogas installations to generate heat and electricity (the use of wind and water also offers possibilities, but would be very site specific).

Other useful websites for guides to energy efficiency include SA Fruit and Wine Industry carbon calculator, which provides categories for reductions in energy usage (http://www.climatefruitandwine.co.za/), the Energy Saving Trust (www.energysavingtrust.org.uk/housingbuildings/calculators/bestpracticehouse/) and the Carbon Trust (www.carbontrust.co.uk/energy/startsaving).

Direct Reductions in Greenhouse Gas Emissions

To mitigate the greenhouse gas emissions (GHG) from their operations, farmers need to first establish their current emissions (carbon dioxide, methane and nitrous oxide), and then investigate cost-effective ways to reduce their emissions over time in a quantifiable way.

While there are a number of carbon calculators that give an indication of personal GHG footprints (see WWF-SA's 'My CO_2 Print' at www.wwf.org.za and the Climate Action Partnership's personal carbon footprint calculator at www.cap.org.za), GHG emissions calculators at the farm level are still emerging. The fruit and wine industry have developed a GHG calculator that could be used as a starting point (http://www.climatefruitandwine.co.za/). The calculator allows you to audit various sectors within your farm unit which contribute to GHG emissions, but is sector specific. In the United Kingdom, there is an organisation called Farming Futures (www.farmingfutures.org.uk) which provides a carbon calculator for land managers called CALM (Carbon Accounting for Land Managers, see www.calm.cla.org.uk). Yet for an accurate assessment of their greenhouse gas emissions, farmers need to contract a site specific audit of their farm.

Once a farm assessment is complete, farmers can identify where it is possible to reduce emissions or improve carbon sequestration (natural carbon capture sequestration, which is 89% of the technical mitigation potential of agriculture) on their farm. Nearly all of the agricultural mitigation options are the same as those proposed for sustainable land management and adaptation to climate change, and are discussed in detail under Principle 3. Suggested climate change mitigation activities include:

Methane emission reductions through:

- feeding livestock an optimal 'low-gas' diet; and
- installing an anaerobic digestion plant to reduce methane emissions (and also offset carbon emissions when linked to electricity and heat generation).

Nitrous oxide emission reductions though:

- optimising nitrogen fertiliser efficiency through correct timing and quantity of applications (precision management);
- applying nitrogen fertiliser on damp days to increase absorption and reduce evaporation; and
- including nitrogen fixing crops as organic fertiliser in rotations and as cover crops (e.g. legumes, rye, cocksfoot).

Carbon dioxide emission reductions through:

- maintaining areas of natural vegetation or plantations (legally established) to sequester (absorb) CO_2 ;

- reducing fire frequency and intensity;
- using minimum tillage (reduced ploughing increases soil carbon and also reduces the CO_2 emissions associated with ploughing);
- building organic matter in soils by adding compost and mulch;
- reducing soil erosion and building organic matter by leaving crop residues on the land in winter;
- Improving grazing management by controlling the intensity and timing of grazing (e.g. stocking rate and rotational grazing); and
- restoring degraded lands (e.g. re-vegetation and applying nutrient amendments and organic substrates) to increase CO_2 capture and reduce further carbon loss.

There are also many practices that one can undertake on the farm to increase the efficiency of fossil fuel-burning machinery, such as diesel engines, generators and pumps.

A key consideration to reducing on-farm GHG emissions is the costs of achieving these climate change mitigation benefits. This is critical in determining which synergies to pursue and which trade-offs can be effectively minimized. It is indicated that most sustainable land use practices should generate higher benefits than costs over time, but there are often large initial investments required to make the changes, which is a main barrier to implementing many of these practices.

THE SOCIAL PRINCIPLE

2. The rights and well-being of employees and the local community are upheld and promoted, product hygiene practices are in place and there is no evidence of cruelty to animals by landowners and employees.

For all labour related legislation, farmers are encouraged to view the Department of Labour's website (www.labour.gov.za) which contains all relevant legislation, as well as key information related to a specific subject, annual leave, basic guides of key topics within labour legislation, forms and sample documents. It is an excellent website, and user friendly.

The question of the applicability of the guidelines to contractors is not debatable. In situations where farmers use contractors, it is understood that the guidelines will be applied as if the contractors were farm workers, but acknowledging the limitations placed on landowner by the labour laws .

CRITERION

2.1 The right to fair labour practice is upheld.

Indicator

2.1.1. Employers shall demonstrate awareness and compliance with relevant legislated fair labour practice conditions.

The Basic Conditions of Employment Act 75 of 1999 was promulgated to advance economic development and social justice by giving effect to the right to fair labour practices conferred by the Constitution through the establishment and enforcement of basic conditions of employment

and by regulating the variation of basic conditions of employment. The Act also gives effect to obligations incurred by the Republic as a member state of the International Labour Organisation (ILO). The latter is an important inclusion, since internationally, compliance with the ILO obligations is a requirement to be able to demonstrate fair labour practices.

The Act does *not* apply to senior managerial employees, sales staff, employees who work less than 24 hours a month for an employer, to work which is required to be done without delay and which cannot be performed by employees during the ordinary hours of work. All employees earning in excess of R149,736.00 per annum be excluded from certain sections of this Act (e.g. ordinary hours of work, overtime, meal intervals, daily and weekly rest period, night work and public holidays)[4]. This amount is likely to be recalculated annually via the Government Gazette.

Section 26(1) requires that no employer may require or permit a pregnant employee or an employee who is nursing her child to perform work that is hazardous to her health or that of her child. The Code of Good Practice on the Protection of Employees during Pregnancy and after the Birth of a Child[5] defines how employers can protect the health of pregnant and breast-feeding employees and identifies various physical, ergonomic, chemical and biological hazards (expanded further in four appropriate schedules) and aspects of pregnancy that may affect work.

The sectoral sector prescribes the minimum wages applicable to a farm worker (section 2 – 8) but as these are updated regularly (see above), it is important that farmers are in possession of the latest prescribed minimum wages. Written particulars of employment are required such as details of employer name, name and occupation of the farm worker, description of the work for which the farm worker is employed, the place of work, date of employment, leave particulars and period of notice (section 9). Hours of work are prescribed in section 10 – 20 and include emergency work on Sundays, night work, meal intervals, rest period and public holidays. The kind of leave to which a farm worker is entitled includes annual leave, sick leave, family responsibility leave and maternity leave (sections 21 – 25).

Procedures for termination of employment are contained in sections 26 – 35 and include payment instead of notice, payment on termination, severance pay and certificate of service. The Sectoral Determination includes a section (section 25) on the prohibition of child and forced labour (also contained in the Basic Conditions of Service Act 75 of 1997 (sections 43 – 48). No person may employ a child in farming who is under 15 years of age and all forced labour is prohibited.

In establishing verifiers/standards, the Sectoral Determination for farm workers (a copy of which is legally required to be available in the workplace at all times) would form the basic requirement, with cross-references to the various Codes of Practice and other supporting sections of the Basic Conditions of Employment Act.

Indicator

2.1.2 Employers can provide evidence of contributions to employee unemployment benefits.

The Unemployment Insurance Contributions Act 4 of 2002 applies to all employers and employees other than where an employee is employed for less than 24 hours per month, or if an

[4] Published under GN R300 in GG30872 of 14 March 2008.
[5] Published under GN R1441 in GG 19453 of 13 November 1998.

employee receives remuneration under a learnership agreement registered in terms of the Skills Development Act 97 of 1998.

It is the duty of every employer and employee to whom the act applies to contribute to the Unemployment Insurance Fund on a monthly basis. The amount of contribution payable on a monthly basis is 1% of the remuneration paid[6]. Farmers should be aware that this is likely to be revised on a regular basis and must therefore be up to date with the relevant requirements at all times.

Indicator

2.1.3 Employers are aware of the requirements for compensation for disablement or death resulting from occupational activities.

If an employee meets with an accident resulting in his/her disablement or death, the employee or the dependents of the employee are entitled to certain benefits provided for in the Compensation for Occupational Injuries and Diseases Act 130 of 1993. For the benefits to be provided, the employer has certain obligations such as:

- Employers have registered with the Compensation Commissioner (appointed in terms of section 2 of the Act) as prescribed in terms of section 80 of the Act;
- Employers have a record of all employees in terms of wages, time worked, payment for piece work, overtime and any other prescribed particulars, and such records are maintained for a period of four years (section 81 of the Act);
- Employers have annually (from 1 March to the last day of February of the following year) furnished the commissioner with a return showing the amount of earnings for that year (section 82); and
- Employers have the assessment determined by the commissioner within the period prescribed by the Act (section 83).

Note: The Compensation for Occupation Injuries and Diseases Act 130 of 1993 replaces the Workman's Compensation Act 30 of 1941 (as amended).

Claims for compensation need to follow the procedures outlined in the Act (sections 38 – 44). Note that a right to benefits in terms of the Act shall lapse if the accident is not brought to the attention of the commissioner or of the employer as the case may be within 12 months of the date of the accident.

If an employee has contracted an occupational disease or that employee has contracted a disease other than an occupational disease and such disease has arisen out of and in the course of his employment, then that employee shall be entitled to the compensation provided for in this Act (section 65). A right to benefits of the Act shall lapse if any disease referred to in section 65(1) is not brought to the attention of the commissioner or the employer within 12 months from the commencement of that disease. Schedule 3 of the Act identifies both the disease and the work environment where it is presumed that such disease arose out of and in the course of his employment.

While much of the Act deals with administration by the Commissioner, landowners must be aware of their obligations (Chapter 9) as briefly summarised above.

[6] Published under Section 6(1)(a) of the Act or as specified in the GG 17976 Notice 860 Regulation 8301 of 2 September 2005.

CRITERION

2.2 A working environment that is safe and without risk to the health of employees is provided and maintained.

Indicator

2.2.1 Employers shall demonstrate awareness and compliance with relevant conditions for the health and safety of persons at work.

The Occupational Health and Safety Act 85 of 1993 (OHSA) is designed, among other things, to provide for the health and safety of persons at work. A copy of the OHSA should be present at each farming operation and employers must be familiar with those sections of the Act that are of relevance to their particular farming activities.

General duties of employers to their employees (section 8(1)) require that every employer must provide and maintain as far as is reasonably practicable, a working environment that is safe and without risk to the health of his/her employees. These duties include (section 8(2)):

- taking steps as may be reasonably practical to eliminate or mitigate any hazard or potential hazard to the safety or health of employees, before resorting to personal protective equipment;
- providing information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of employees; and
- ensuring that work is performed and that the plant or machinery is used under the general supervision of a person trained to understand the hazards associated with it and who have the authority to ensure that precautionary measures taken by the employer are implemented.

Employers also have a duty to inform (section 13), as far as is reasonably practicable, every employee regarding the hazards of his health and safety attached to any work he/she has to handle and any plant or machinery he/she has to use, as well as the precautionary measures which should be taken with respect to those hazards. Note also that under NEMA 107 of 1998 section 2(4)(i) that workers have the right to refuse work that is harmful to human health or the environment and to be informed of dangers, and that such right must be respected and protected.

Importantly, the OHSA does not place the onus entirely on the employer. The employee also has to take responsibility for his/her actions, as outlined in section 14. Thus, employees at work must take reasonable care for the health and safety of himself/herself and of other persons who may be affected by his/her acts or omissions, carry out lawful orders, report any unsafe situations and report any incident which may affect health or which has caused an injury.

In addition to the OHSA, landowners need to be aware of regulations pertaining to the safe transport of workers on the farm itself, and in the transport of workers on public roads (National Road Traffic Regulations 93/19965 Regulation 247). Thus, persons may only be transported in a goods vehicle if the portion of the vehicle is enclosed to a height of at least 350mm above the surface on which a person is seated, and at least 900mm above the surface on which a person is standing. People may also not be transported in a goods vehicle compartment unless they are

separated from the goods by a partition. Any person driving a vehicle for the transport of people must have a valid driver's licence, be proficient in the driving of that particular vehicle and be medically fit. This applies to drivers operating on both public and private roads.

There may be issues associated with food safety on a particular farm, and because of the importance that this aspect plays, particularly in the export market, a criterion that deals with food safety and hygiene practices has been included in the guidelines (see 2.7)

The OHSA allows for the Minister to make regulations which are necessary in the interest of health and safety of persons at work or in connection with the use of plant or machinery (section 43). Such regulations have been published, and employers must be aware and take steps to ensure compliance with the appropriate regulations. The following list is an example of appropriate regulations.

General Safety Regulations[7]
Deals with personal safety equipment and facilities; intoxication; first aid, emergency equipment and procedures; use and storage of flammable liquids; stacking of articles; welding, flame cutting, soldering and similar operations; use of ladders; and use of ramps.

Environmental Regulations[8]
Deals with thermal requirements (e.g. minimum outdoor temperature); refrigerated environment; lighting; provision of windows in relation to the size of the building; ventilation; housekeeping (i.e. sufficient clear and unobstructed space at every machine in an indoor workplace); precautions against flooding; and fire precautions in the workplace (e.g. evacuation).

Driven Machinery Regulations[9]
Deals with revolving machinery; circular saw; band saws and band knives; wood planing, wood moulding and mortising machines; sanding machines; grinding machines; shears, guillotines and presses; rolls and calendars; air compressors; transportation plants; goods hoists; and lifting machines and lifting tackle.

General Machinery Regulations[10]
Deals with supervision of machinery; safeguarding of machinery; operation of machinery; working on moving or electrically live machinery; and devices to start and stop machinery.

Electrical Machinery Regulations[11]
Deals with safety equipment, work on disconnected electrical machinery; electric fences, use of portable electric tools and electric light and other aspects mostly applicable to electrical suppliers and not farmers.

Electrical Installation Regulations[12]

[7] Published under GN R1031 in GG 10252 of 30 May 1986 and last amended by GN R1010 in GG 25027 of 18 July 2003.
[8] Published under GN R2281 in GG 10988 of 16 October 1987 and last amended by R307 in GG 24967 of 7 March 2003.
[9] Published under GN R295 in GG 11152 of 26 February 1988.
[10] Published under GN R1521 in GG 11443 of 5 August 1988.
[11] Published under GN R1593 in GG 11458 of 12 August 1988 and amended by GN R 1185 in GG 12497 of 1 June 1990.

Deals with the regulations for the installation of electricity supply and is applicable to farmers in the sense that they need to have a certificate of compliance in respect of any installations, subject to certain conditions.

Regulations for Hazardous Chemical Substances[13]

These regulations apply to an employer who carries out work at a workplace which may expose any person to the intake of a Hazardous Chemical Substance (HCS) at that workplace. Exposure of employees to substances hazardous to health should be prevented or, where this is not reasonably practicable, adequately controlled. Farmers need to check the names/substances of any chemical products on the farm against the list of substances in the tables to identify whether an HCS is kept on the farm. If so, action as identified in the Regulations must be taken to prevent exposure of employees to the identified HCS.

Major Hazard Installation Regulations[14]

Applies to employers who have on their premises a major hazard installation or a quantity of substances which may pose a risk that could affect the health and safety of employees and the public. The Regulations are unlikely to be of relevance to farmers, as they mostly apply to large processing plants.

Asbestos Regulations[15]

These Regulations apply to every employer who carries out work at a workplace that may expose any person to asbestos dust at that workplace. No employer or self-employed person shall require or permit any person to work in an environment in which he/she would be exposed to asbestos in excess of the prescribed occupational exposure limit. While the regulations might only seem to apply to work in an asbestos environment, regulation 14 does require the employer or employee to take reasonable steps to ensure that the location of asbestos in the workplace, buildings, plant or premises is located where that asbestos is likely to release asbestos dust that could impact on health or pollute the environment and to make a written inventory of the location of the asbestos. Precautions are also prescribed when erecting, altering, renovating, repairing, dismantling or adding asbestos cement roof sheeting, wall panelling, gutters, facia boards and related products to a building (regulation 15).

The correct procedure for disposal of asbestos waste is contained in regulation 20. Specifically the disposal of asbestos waste which can cause exposure must be disposed of on sites specifically designated for this purpose in terms of the Environment Conservation Act 73 of 1989 and the National Environmental Management Act 107 of 1998.

Noise-Induced Hearing Loss Regulations[16]

These regulations apply to an employer who carries out work that may expose any person at the workplace to a noise at or above the noise-rating limit of 85dBA where the noise-rating limit of 85dBA is exceeded. Regulation 9 requires that the workplace, or the

[12] Published under GN R2920 in GG 14350 of 23 October 1992 and amended by GN R962 in GG 15747 of 20 May 1994.
[13] Published under GN R1179 in GG 16596 of 25 August 1995 and amended by GN R930 in GG 25130 of 25 June 2003.
[14] Published under GN R692 in GG 22506 of 30 July 2001.
[15] Published under GN R155 in GG 23108 of 10 February 2002.
[16] Published in GN R307 in GG 24967 on 7 March 2003.

affected area of the workplace, is zoned as a noise zone and clearly demarcated as such. The required hearing protective equipment (regulation 12) must be worn in a noise zone. Control of noise exposure (regulation 10) is required as far as is reasonably practicable, to reduce noise or implement noise control measures.

While these measures may not apply to all farmers, there are likely to be processing plants or machinery on farms which exceed the 85dBA noise-rating limit and to which these regulations would apply. Thus, assessment of potential noise exposure must be carried out at least once every two years (regulation 7), and noise monitoring must take place on a system of medical surveillance for all employees exposed to noise at or above the noise–rating limit.

General Administrative Regulations (GAR)

These regulations are a "catch all" for regulations under the OHSA. Farmers need to be aware of the GAR as failure to comply shall be guilty of an offence and liable to a fine and/or imprisonment. They include:

- access to premises by an inspector
- the requirement that a copy of the OHSA and relevant regulations are readily available at the workplace where an employer has five or more persons in his employ
- the availability of a suitable place for health and safety committees to meet and the maintenance of records of committee meetings for three years
- procedure for negotiations and consultations with registered trade unions of that workplace before designation of health and safety representatives, or, in the absence of a registered trade union, procedures for consultation with employee representatives in that workplace before the designation of health and safety representatives
- reporting of incidents and occupational diseases and procedures associated with such incidents and diseases
- recording and investigation of all incidents, for which records must be kept for a period of at least three years
- procedures for the calling of witnesses at an enquiry.

Construction Regulations[17]

These Regulations apply to any persons involved in construction work. While most of the regulations apply to contractors, there are client (farmer) responsibilities in terms of regulation 4, largely around health and safety specifications. Farmers who undertake construction work on their farms through the appointment of a contractor, need to be aware of their client responsibilities.

Facilities Regulations[18]

The regulations focus on the workplace, defined in OSHA as "any premises or place where a person performs work in the course of his employment". While a farm working environment is probably different to the intention of these regulations, farmers should be aware of the sanitation regulations (regulation 2) and drinking water regulations (regulation 7) in particular.

It is recognised that farming practices vary enormously in terms of their size, scope and level of technical operations. Despite this, all landowners, whatever their size and use of technical skills, should ensure that the safe working conditions for workers are in place, that there is a sufficient

[17] Published under GN R1010 in GG 25207 of 8 July 2003.
[18] Published under GN R924 in GG 26636 of 13 August 2005 and by GN R1045 in GG 21753 of 10 September 2004.

supply of drinking water, that workers are issued with and use personal protective equipment and clothing and access to first aid facilities. The International Labour Organisation has published a number of documents related to safety and health viz. safety in the use of chemicals at work (Geneva, ILO, 1993), safety and health in the use of agrochemicals: A guide (Geneva, ILO, 1991), and safety and health in agriculture (Geneva, ILO, 1990), which should be used in the development of agricultural sector specific standards (www.ilo.org).

CRITERION

2.3 The right for security of tenure of labour tenants and farm occupiers is upheld.

Indicator

2.3.1 The rights of labour tenants and farm occupiers to reside on land and to acquire land where appropriate is documented.

The Land Reform (Labour Tenants) Act 3 of 1996 was introduced to provide for security of tenure of labour tenants and those persons occupying or using land as a result of their association with labour tenants. The Act also provides for the acquisition of land and rights to land by labour tenants. Labour tenants have a legal right with his/her family members to occupy and use that part of the land that they were using or occupying on 2 June 1995. The right of a labour tenant in this regard may only be terminated in accordance with the provisions of this Act (section 2). In addition, labour tenants may only be evicted in terms of an order of the Court issued under this Act (section 5).

Subject to the provisions of the Act, labour tenants also have the right to acquire land (section 16). The owner of affected land or any person whose rights are affected are entitled to compensation as prescribed by the Constitution for the acquisition by the applicant of land or a right in land (section 21).

Shortly after the promulgation of this Act the Extension of Security of Tenure Act 62 of 1997 (ESTA) came into effect. It was introduced to regulate the conditions of residence and circumstances under which the right of persons to reside on land may be terminated or evicted and to facilitate long-term security of land tenure. The Act applies to occupiers defined as a person residing on land which belongs to another person, and who has on 4 February 1997 or thereafter had consent or another right in law to do so. It excludes a labour tenant in terms of the Land Reform (Labour Tenants) Act 3 of 1996.

The ESTA makes it possible, through State assistance, to facilitate the planning of both on-site and off-site developments for occupiers. It provides for rights and duties of both the occupier and the owner and lays down the legal responsibilities in terms of termination of rights of residence (section 8), limitations on eviction (section 9) and restoration of residence and use of land by persons who have been evicted contrary to the provisions of the Act (section 14). Farmers who are affected must comply with the requirements of these two Acts and uphold the rights of affected people, while recognising their own rights for compensation.

CRITERION

2.4 The development of farm labour skills is promoted.

Indicator

2.4.1 Contribution to the development of skills for farm workers should be demonstrated.

The Skills Development Act 97 of 1998 was introduced to, among other things:

- develop the skills of the South African workforce;
- improve the quality of life of workers, their prospects of work and labour mobility
- improve productivity in the workplace and the competitiveness of employers
- promote self-employment
- encourage employers to provide employees with the opportunities to acquire new skills and
- improve the employment prospects of persons previously disadvantaged by unfair discrimination and redress these disadvantages through training and education.

The purposes of the Act are achieved through the establishment of an institutional and financial framework comprising, *inter alia*, a skills development financing scheme as provided for in the Skills Development Levies Act 9 of 1999. This Act requires every employer to pay a skills development levy at a rate of 1% of the leviable amount (the total amount of remuneration paid by an employer to his employee during any one month) (section 3(4)). Section 3(5) details amounts (e.g. pension) that are excluded from the remuneration on which the 1% levy is payable. The levy is also not payable by an employer during any month where there are reasonable grounds for believing the amount of remuneration paid or payable by that employer to all its employees during the following 12 month period is less than R500,000.00.

Employers liable to pay the levy must apply to the Commissioner for the South African Revenue Service to be registered as an employer for the purposes of the levy and indicate the jurisdiction of the SETA (Sector Education and Training Authority) within which the employer must be classified. For farmers, this is likely to be the Agricultural Sector Education and Training Authority (AGRISETA) in the vast majority of applications.

CRITERION

2.5 Contribution towards the local economy can be demonstrated.

Indicator

2.5.1 Employers can demonstrate participation in actions that strengthen the local economy.

Where possible, landowners should make a demonstrable effort to contribute towards the establishment of a sustainable local economy. One of the ways to achieve this is by adopting a policy of preferential employment of residents from the local community or from labour tenants on the farm.

There is also growing evidence that agricultural growth and efficient management of natural resources are dependent on the political, legal and administrative capabilities of rural

communities to determine their own future and to protect their natural resources and other economic interests. In the absence of this power, the result is an abuse of common property resources, disenfranchisement of rural people, especially women, and the weakening or breakdown of rural institutions (Rukini, 2004).

Farmers should promote a process of pro-active consultations with local communities, either independently, or through a local forum. The objective could be to establish both community needs and aspirations, and to work towards a commonly agreed goal for the mutual benefit of all participating parties. Farmers should, however, take care not to raise expectations beyond what they or others can reasonably be expected to provide.

CRITERION

2.6 Landowners provide accommodation and related basic services to farm workers and tenure residents.

Indicator

2.6.1 Accommodation for farm workers and tenure residents is structurally sound and there is provision of potable water and adequate waste management facilities.

The South African Constitution states that everyone has the right to adequate housing (Section 26) and that the state must take reasonable legislative and other action to achieve the realisation of this right. In addition, no-one may be evicted from their home, or have their home demolished, without an order of the court made after considering all the relevant legislation. The government is obliged to realise this right, however landowners have not only a legal responsibility, but a moral responsibility, to ensure that farm workers and farm residents have access to adequate housing. In the South African context, two types of housing can be distinguished, namely accommodation provided and traditional housing (Lewis, MacFarlane, Howard and Germishuizen, 2009).

For accommodation provided by the landowner, it is suggested that landowners familiarise themselves with the National Building Regulations and Building Standards Act 103 of 1977 which provides technical information and specifications on buildings and their construction. The construction of any buildings will require authorisation from the local authority and must comply with the requirements of SANS 10400. In brief, buildings must be structurally safe, roofs must be durable, structure and roof must be waterproof, allowance should be made for cooking areas, personal, clothing, waste disposal and sanitation facilities. Lighting and ventilation must be adequate (minimum of one window per room), sanitation must be appropriately designed and installed and meet the requirements of SANS 10400 while refuse disposal must consist of adequate containers. Storm water management must be appropriate for the site while fire protection (adequate equipment) must be available with approval from the local municipality for any fire installations.

When it comes to Traditional housing, the UN Committee on Economic, Social and Cultural Rights have noted that culturally adequate housing must appropriately express a cultural identity (from Lewis et al 2009). Landowners should attempt to ensure that traditional accommodation is structurally sound, that there is provision of potable water, and that adequate waste management or disposal facilities are available. Of particular relevance to South African landowners is that traditional accommodation on a farm may house people not necessarily

employed on the farm, but elsewhere employed or even unemployed. Such people may have tenure rights.

CRITERION

2.7 Product safety and hygiene standards are controlled.

Indicator

2.7.1 Food safety and hygiene practices are in place.

Many landowners produce products for the export market, particularly Europe, and have been exposed to the GlobalGAP (previously EurepGAP) certification requirements. GlobalGAP arose in response to the growing concerns of consumers regarding product safety, environmental and labour standards and has harmonised various standards into a common certification system that is now recognised as the top international 'good agricultural practice' standard (www.globalgap.org). This criterion is based on the GlobalGAP concept, focussing almost exclusively on their standard 'hygiene practices in the workplace' that ensure the safety of workers and the hygiene requirements related to both workers and the product. The criterion aims to ensure that farmers who are not involved in the GlobalGAP certification standards reach these basic hygiene principles.

In general terms, landowners whose farming activities involve the handling of food products need to consider the following basic controls in a documented hygiene procedure:

- training of workers in hygiene procedures appropriate to the product(s)
- implementation of hygiene instructions for the handling of products
- maintenance and cleaning of tools, containers and vehicles involved in the harvesting and transport of produce
- access to clean hand-washing equipment and toilets for workers in the vicinity of their work
- the use of containers exclusively for the produce
- the protection of packed produce from contamination
- clean storage facilities on the farm and temperature and humidity controls (where applicable) maintained and documented
- smoking, eating and drinking areas clearly designated and segregated from products
- workers provided with clothing/outer garments that protect products from contamination
- cleaning agents approved for application in the food industry
- all entry points to buildings suitably protected to prevent, whenever possible, the entry by rodents and birds
- baits used for the control of rodents located in a manner that non-target species are excluded
- rodenticides used only as a last resort (see 3.1.4)
- water used for washing of products must be clean and tested regularly for its suitability
- any biocides, waxes and plant protection products used for post-harvest protection of the harvested crop must be registered and applied correctly and adequate records of their use maintained.

CRITERION

2.8 Prevention of cruelty to animals is actively promoted.

Indicator

2.8.1 There is no cruelty to animals by any landowner in the execution of farming practices.

The Animal Protection Act 71 of 1962, the Protection of Animals Amendment Act No.7 of 1991 and the Animal Matters Amendment Act No.42 of 1993 consolidate laws relating to the prevention of cruelty to animals. The Acts provide protection not only for the protection of domestic animals (dogs, cats, horses, cattle, sheep etc), but also any wild animal in captivity or under the control of a person. The Landowners' responsibilities in terms of the applicability of the Act are clearly defined and include:

- overloading
- tethering any animal unnecessarily which may cause unnecessary suffering
- unnecessarily starving or denying access to food or water
- exposure to poisons except for the destruction of vermin or marauding domestic animals
- negligently or deliberately keeping an animal in dirty conditions, failure to render veterinary treatment, or failure to destroy seriously injured animals (where to prolong life would be cruel)
- attaching to any animal any equipment or vehicle which causes injury and thus suffering
- driving or using any animal which is diseased or injured and thus unfit for work
- laying any trap for the purposes of capturing or destroying any animal, wild animal or wild bird which is not proven to be necessary for the protection of property or for the prevention of the spread of disease
- having laid such trap, failing to inspect and clear it at least once a day
- without reasonable cause, abandoning an animal in circumstances likely to cause suffering to the animal
- negligence by an owner of an animal that causes injury to another person
- possession of animals for the purposes of fighting another animal.

ENVIRONMENTAL PRINCIPLE

3. Natural resources and biodiversity are conserved, critical ecosystem services and ecological processes are maintained and agricultural resources are sustainably used.

CRITERION

3.1 Biodiversity assets and threatened ecosystems are conserved.

This criterion focuses on the protection of threatened species as provided for in legislation, the control of alien and invasive species that pose potential threats to biodiversity, the implementation of best management practises to protect threatened or critical ecosystems, their services and processes, and the prevention or minimisation of pollution and degradation of the environment.

Indicator

3.1.1 Threatened and protected species as defined in legislation are protected.

Legislation that provides for the protection of threatened species is present at both the national and provincial level, with national legislation normally overriding provincial legislation. At the national level, there are two important Acts that provide species protection, namely the National Forest Act 84 of 1998 (NFA) and the National Environmental Management: Biodiversity Act 10 of 2004 (NEM:BA).

The NFA provides for the protection of certain indigenous tree species (listed annually) and all indigenous trees in forests (sections 7 – 16) unless authorised by DWAF to the contrary. No person may cut, disturb, damage or destroy any protected tree or any indigenous tree in a natural forest except under a licence or in terms of an exemption.

The NEM:BA prohibits (or requires a special permit) any activity which may impact on threatened or protected species or ecosystems. Farmers would thus need a permit to carry out a restricted activity (e.g. hunting) involving listed threatened or protected species. The Minister has published further regulations to the NEM:BA permit system for hunting, providing for the protection of wild populations of listed critically endangered, endangered, vulnerable and protected species effective from 1 June 2007.[19]

Critically endangered species are at extremely high risk of extinction in the wild, and include:

- riverine rabbit
- wattled crane
- blue swallow
- Egyptian vulture
- Cape parrot
- various cycad species
- others that face an extremely high risk of extinction in the wild in the immediate future.

Endangered species face a high risk of extinction in the wild in the near future, although they are not critically endangered, and include:

- geometric tortoise
- blue and grey crowned crane
- saddle-billed stork
- bearded, white-backed, Cape, hooded and lappet-faced vulture
- black rhinoceros
- mountain zebra
- oribi
- tsessebe
- African wild dog
- two species of golden mole
- various cycads and other plants

Vulnerable species are species that face a risk of extinction in the wild in the medium-term future, although they are not a critically endangered species or endangered species, and include:

- white-headed vulture

[19] Published under the GG No 29657 R150, 151 and 152 of 23 February 2007.

- tawny, martial and southern banded snake eagle
- kori and Ludwigs bustard
- blue korhaan
- bald ibis
- grass owl
- bateleur
- samango monkey
- pangolin
- lion
- cheetah
- leopard
- suni
- blue duiker
- roan antelope
- bontebok
- various lilies and cycads

Protected species are species of high conservation value or national importance that require national protection, and include:

- southern ground hornbill
- African marsh harrier
- Denham's bustard
- Cape clawless otter and spotted-necked otter
- hedgehog
- spotted and brown hyaena
- black footed cat
- honey badger
- reedbuck
- Cape fox
- White rhino
- Black wildebeest
- Sharpe's grysbok
- African elephant
- various cycads, orchids and euphorbias
- African rock python

Landowners should also be aware of protection given to species at the provincial level. For example, the KwaZulu Natal Nature Conservation Management Amendment Act 5 and 7 of 1999 and the Mpumalanga Nature Conservation Act 10 of 1999 provide for the protection of certain animals and plants, although they do not prevent farmers destroying provincially listed specially protected plants and animals as far as it is necessary to do so for any *bona fide* farming purpose.

Landowners should determine whether any listed species occur on their farms or in the area, and through consultation with other farmers in the area and the local conservation services, determine whether there is any management activity that can be agreed upon that will assist in the protection of these species.

The National Biodiversity Stewardship Programme (previously the Natural Heritage Site Programme) assists farmers with priority species and ecosystems to protect and manage their significant natural resources. As part of a biodiversity stewardship agreement with the farmer,

local conservation agencies or NGOs will draw up management plans for the protection of species and ecosystems on the land.

Indicator

3.1.2 Ethical and non-lethal control of damage causing animals is practiced.

Despite the regulations published under NEM:BA which permit under certain circumstances the use of lethal control measures for listed threatened or protected damage-causing species, there is a strong thrust towards non-lethal, holistic, ecologically acceptable and ethical management of predators on livestock farms driven by the Landmark Foundation, the Endangered Wildlife Trust, the Cheetah Conservation Trust and others.

The Landmark Foundation has prepared a Code of Practice for agricultural producers for the management of predators. The use of lethal methods (leg-hold traps/gin traps, indiscriminate poison traps or indiscriminate use of hunting dogs) is not permitted in terms of this Code of Practice unless all non-lethal measures have been extensively investigated. Non-lethal measures include livestock guarding dogs (Anatolian shepherds), alpacas, herdsmen, donkeys, smart technology collars, livestock protection collars, fencing, noises, lights, smells and herding techniques. No single method will be 100% effective in reducing or preventing predation on livestock, but a combination or use of alternative methods should result in improved predator control.

The use of "guardians" is a method that involves livestock being guarded against predators. The Anatolian shepherd dog is one of the most successful livestock guarding dogs, having been used for approximately 6000 years in Turkey (Smuts, 2008). This breed is being used in Southern Africa by several organisations (e.g. the Cheetah Conservation Fund, Conservation International and Cheetah Outreach) and is ideally suited to areas experiencing problems with leopards, cheetahs, caracals and jackal. However, being large dogs, they need a high quality diet, especially in the first 18 months, and this may be expensive, but also needs to be evaluated against the financial implications of the potential stock losses.

Alpacas and donkeys are also effective as both have a strong herding instinct and, in pairs or small numbers, will tend to gravitate towards the herd or flock of livestock and remain with them. Both are very alert and will often attack predators.

Livestock protection collars provide a physical barrier to the neck of livestock and the various types in use (the King Collar, the Dead Stop collar and the Bell Collar) have all reported consistently high reductions in predator losses (80% - 100%). The Veldwagter is a "smart technology collar" which uses cellular telephone and GSM network technology. They work by a motion-sensing device whereby excessive movement of the collared individual in the herd (e.g. when fleeing a predator), will activate a SMS to the farmer.

Finally, fences still remain a useful deterrent to predator losses, remaining the first line of defence which, when used with herding techniques, can dramatically reduce predatory losses to livestock. As with any piece of farming equipment, fences need maintenance and this may often be neglected. Herding techniques include lambing camps (preferably near homesteads), kraaling of livestock at night and ensuring that the veld is in good condition by maintaining an appropriate stocking rate which means that natural prey for predators (rodents, lizards, small game, ground birds) is abundant.

For further information on livestock protection, see www.landmarkfoundation.org.za as well as the Endangered Wildlife Trust's human-wildlife conflict manual (www.ewt.org.za) entitled *Predators and Farmers* (Hodgkinson, Davies-Mostert, Komen and Snow, 2007). Both the Landmark Foundation and EWT publications are invaluable and should be on the bookshelf of every landowner faced with damage-causing animal problems.

The NEM:BA regulations (R152 in GG No. 29657) deal in detail with the permit system for the control of listed threatened or protected damage-causing species. Landowners who are faced with crop damage or livestock loss from damage causing animals must be aware of the regulations and comply strictly with the conditions contained in the permit. While any person may, in terms of section 88(1) of the Biodiversity Act, apply for a permit, the actual process is dependent on a number of requirements, the detail of which is beyond the scope of a generic document. In brief, when considering a permit application, the issuing authority must take into account:

- all applicable legal requirements;
- whether the species is listed in terms of section 56 of the Biodiversity Act as a critically endangered species, an endangered species, a vulnerable species or a protected species; and
- whether the restricted activity (e.g. hunting) is prohibited, e.g. regulation 26 prohibits certain methods of hunting of a listed species - such as by means of poison, traps, snares, dogs and various forms of firearms.

When it comes to damage-causing animals, the provincial department responsible for the conservation of biodiversity in a province must determine whether a listed species can be regarded as a damage causing animal (regulation 14(1)). In the case of damage causing animals originating from a protected area, the regulations provide for various control options (regulation 14(2)) that must be exercised by the relevant authority. However, regulation 14(1) does not prevent a landowner from killing a damage-causing listed species in self-defence where human life is threatened.

The regulations also prohibit activities involving listed large predators (lion, cheetah, leopard, spotted hyaena and brown hyaena) and both species of rhino (regulation 24). Of relevance to farmers would be the prohibitions of the hunting of damage causing listed large predators (e.g. causing damage to domestic livestock) by making use of a gin trap. As noted above, the Regulations prevent the authorisation of the hunting of listed species by means of poison, traps, snares, dogs and various types of firearms unless it is for the management of damage causing animals in accordance with regulation 14. It would this appear that the legislation does not permit a farmer to hunt a damage causing listed species using poison, traps, snares etc. This can only be undertaken by the relevant authority, namely the provincial department or the management authority of a protected area.

Landowners must also be aware of protection given to species at the provincial level. For example, the KwaZulu Natal Nature Conservation Management Amendment Act 5 and 7 of 1999 and the Mpumalanga Nature Conservation Act 10 of 1999 provide for protection of certain animals and plants.

Indicator

3.1.3 Damage-causing rodents are managed through appropriate control measures.

Of the approximately 75 indigenous rodent species, about 25% can be considered agricultural pests. In the agricultural context, field crops can be damaged by porcupines, springhares, cane-rats, giant rats, multi-mammate mice and gerbils. There are a number of control methods outlined by Willan (1992), but most importantly is the planning of a pest control programme. This should hinge on:

- measures that are effective in pest control
- affordable control
- avoidance of ecological damage or, where this is not possible, minimisation of such damage.

General recommendations for rodent pest control include biological control (for long term protection) and artificial control (when the need arises and only after a full analysis of the actual pest problem has been carried out). These controls include:

- encouragement of predator activity (protection from disturbance or hunting, set asides of natural vegetation, use of neutered cats, management of veld adjoining crop lands)
- ensuring good field crop harvesting to minimise rodent population growth
- modifying habitat surrounding vulnerable fields to reduce cover for smaller rodents which will help keep the population densities low and
- not routinely using rodenticides, as the poisons are a danger to predators of the rodents.

Should it be absolutely necessary to use poisons, the following points should be considered:

- toxicity trials mainly employ laboratory animals and the results may not accurately reflect the tolerances of indigenous species
- impact on non-target animals
- the likelihood of resistance developing when used repeatedly at the same locality
- rodenticides are effective only in the short term.

Farmers faced with significant rodent damage problems should be familiar with the general biology of the species and with the climatic and population indicators of population growth and outbreaks. If in doubt professional advice should be sought. See also Willan (1992).

Indicator

3.1.4 Threatened ecosystems are protected.

The National Spatial Biodiversity Assessment, led by the South African National Biodiversity Institute, has assessed the status of South Africa's terrestrial ecosystems and the irreversible loss of natural habitat based on the 1996 National Land Cover data. The results show that 34% of ecosystems are threatened, as follows:

- 21 are critically endangered - being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation;
- 58 are endangered - being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems;
- 70 are vulnerable - being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and
- 298 are least threatened – being still largely intact.

Chapter 4 of the NEM: Biodiversity Act 10 of 2004 deals with threatened ecosystems and species. One of the key provisions in this Chapter allows the Minister or an MEC to list threatened and protected ecosystems, although the ecosystems are yet to be listed.

The National Water Act 36 of 1998 focuses specifically on water resources (rivers and wetlands) and, in terms of this legislation, certain restrictions in terms of water use pertain to wetlands in particular, and certain listed catchment areas or rivers[20].

Farmers may also visit their local municipality for information on priority ecosystems as, according to the Local Government Municipal Systems Act 32 of 2000, they are required to protect ecosystems by the adoption of a land-use plan within an integrated development plan (IDP).

Although no legally binding protection is in place in terms of listed threatened ecosystems, farmers are encouraged to implement management plans to protect all natural ecosystems on their land. The National Biodiversity Stewardship Programme provides the opportunity to secure ecosystem conservation through partnerships between the owners and users of land, conservation authorities and other parties (such as conservation NGOs). The programme provides the means to conserve ecosystems and biodiversity on both communal land and private land while promoting livelihoods through the sustainable management of the natural resources.

The stewardship programme works with landowners to draw up agreements of varying degrees of legal commitment and resulting benefits to the landowner. The site can become a conservation area (a decision that is not legally binding and of no specific duration), a landowner can enter into a legally binding stewardship agreement, or the property can be contracted into a nature reserve (a legally binding long-term contract). All options are entered into voluntarily and the landowner retains the property title deed. As part of the agreement, the nature conservation agency draws up a sustainable land management plan tailored to suit the specific needs of the owner and the property. At the contractual levels of agreement, the agency undertakes all legal work and provides extension services. At the highest level, the agency approaches the Minister of Environmental Affairs on behalf of the landowner for official declaration of the site as a nature reserve in terms of section 23 of the National Environmental Management: Protected Areas Act, and offers substantial assistance with rates and tax exemptions, habitat management and marketing. The Nature Reserves attract compulsory zero based rates in terms of the Local Government Municipal Property Rates Act.

Regardless of whether a farmer enters into a biodiversity stewardship agreement, they are encouraged to establish in which ecosystem they fall and to take proactive steps in implementing best management practises for the natural ecosystems in their care.
Some of the practises that could be put into effect include the following:

- All natural and cultural assets, untransformed land as well as transformed (planted) land should be included in a farm management plan, appropriate to the scale of the operation (size and complexity).
- Natural ecosystems (including water resources) should be identified and mapped.
- Management planning should include the entire farm and provide for operations such as invasive plant control, controlled burning (firebreaks and block burns), litter management, road construction and maintenance, fencing, poaching control, hunting, game counts, species check lists, etc. Again, the level of management and data collection should be appropriate to the scale of the operation (size and complexity).

[20] See GN 398 and 399 of 26 March 2004

- Where crops are planted in or close to the edge of water sources and wetlands (or even in wetlands), farmers should undertake to consider the removal of such crops over a period of time.
- Rehabilitation of degraded areas using local grass species if possible should be undertaken. Alternatively, commercially available species such as Eragrositis curvula varieties should be considered. The importance of creating a vegetation cover on the soil should be a priority.
- In the case of the harvesting of indigenous flora, sustainable extraction rates and monitoring systems should be carried out and be appropriate to the size and complexity of the farm.
- Livestock ranching and game farming offer significant opportunities for maintaining biodiversity integrity. However, much depends on the grazing systems or stocking rates applied and O'Connor and Kuyler (2005) found that, at least in the Grassland Biome, high intensity systems and continuous sheep grazing are undesirable for maintaining biodiversity integrity. This aspect is dealt with in more detail in 3.3.3.

CRITERION

3.2 Critical ecosystem services and processes are maintained and protected.

Ecosystems provide goods (such as wildlife, forage, biomass fuels, pharmaceuticals, and agricultural resources), as well as services such as the:

- mitigation of floods, droughts and water table fluctuations
- generation and protection of soils and their fertility
- pollination of crops
- nutrient recycling
- erosion control
- control of agricultural pests
- sand movement and dune replacement.

The maintenance of these services is essential for sustainable agricultural productivity.

Indicator

3.2.1 Critical ecosystem services and processes are identified and plans for their maintenance and protection are included in the land use or management plan.

In the interests of sustainable agricultural production, landowners should endeavour to identify, protect and maintain as many of the critical ecosystem services and processes on their land as is possible. Degraded ecosystems should, where possible, be rehabilitated to a condition as close to a functional service or process as possible. Special areas of conservation significance (e.g. wetlands, rivers and other ecosystem specific features) should be prioritised by the farmer in his/her efforts to conserve ecosystem functioning.

Biological services

Farmers are encouraged to maintain areas of natural vegetation on their land for the biological services they provide, from the control of pest outbreaks to the provision of pollinators and the capture and the storage of atmospheric carbon dioxide.

There is evidence from the SA Sugar Research Institute that predation of sugarcane pests and diseases is promoted by the inclusion of natural habitats on the farm that provide refuge for the natural enemies of the pests and diseases. With regard to pollination services, a significant number of plants (agricultural and indigenous) are dependent on pollination by insects, birds and mammals. These pollinating agents in turn rely on the presence of natural habitats distributed in the landscape. There exists a broad concept of what is required to initiate activities that conserve and sustainably manage pollinators within agro-ecosystems (Eardley, Roth, Clarke, Buchmann and Gemmil, 2006) namely:

- conserving and restoring habitat
- growing flowering plants preferred by pollinators
- promoting mixed farming systems
- establishing nectar corridors for migratory pollinators
- providing habitats alongside cropland for pollinators nests and food
- encouraging integrated pest management
- discouraging the use of agro-chemicals.

The removal of natural ecosystems is one of the major causes of CO_2 emissions and climate change. Farmers should maintain natural veld to avoid CO_2 release, and should restore degraded lands, thereby increasing the capture of CO_2 as the lands return to their high carbon state.

The maintenance of soil health is one of the most important ecosystem services provided to agriculture. This service is provided by the soil agro-ecosystem, which is made up of micro-organisms, earthworms, insects and a variety of other microscopic and minute life forms. Farmers need to actively manage the soil to encourage diversity in this agro-ecosystem through, for example, building soil organic matter, reducing tillage, and reducing or omitting the use of pesticides, herbicides and large applications of synthetic fertilizers (see Indicator 3.3.1 for a more detailed account).

Physical services

Intact ecosystems provide valuable services in controlling and regulating the physical environment. Natural vegetation stabilizes soils and reduces erosion (Scholes and Walker, 1993), they provide wind breaks, stabilize sands, protect against natural hazards and increase water availability and quality.

Trees and woody shrubs with deep tap roots maintain water tables at certain levels where removal of a critical number of deep-rooted plants in an ecosystem results in a raised water table and concentration of salts in the upper soil layers (Brinkman,1980). This is evident in the large-scale salinization of the Australian wheatbelt (www.science.org.au/nova/032/032key.htm). As such, areas should not be cleared of vegetation and left bare to erode, and caution should be exercised when considering clearing woodlands for crops.

Intact vegetation, particularly wetlands and riparian areas (provided they are functional i.e. have not been drained or degraded) are able to reduce flood damage, filter water and encourage the deposition of suspended sediments, increase water availability and capture nutrients. Farmers should identify wetlands and riparian areas on their land (using the DWAF Guideline Document: A Practical field guide procedure for identification and delineation of wetlands and riparian areas) and include these details in the land use plan, implementing a sustainable management plan where necessary and appropriate to the scale of the operation. Degraded wetland and riparian areas should receive priority for rehabilitation but will require an EIA in terms of NEMA

as amended. Plans for a cost-effective rehabilitation programme should have objectives and an action plan with a time frame.

The Conservation of Agricultural Resources Act has regulations pertaining to the use of wetlands (see 3.3). The Department of Water Affairs, through the National Water Act, does not normally permit the use of water from wetlands. Farmers who have crops in, or close to the edge of, wetlands compromise the integrity of the wetlands and should consider the removal of these crops over a period of time. Such removal may have a positive impact on river flows and water availability. Kotze (2004) has developed a document for the WWF Mondi Wetlands Project that, while aimed at the forestry industry, is of relevance to all landowners who have wetlands on their farms. The guidelines address burning as well as the sustainable utilisation of wetlands for craft production.

Farmers are encouraged to provide a system of contiguous natural habitats, both on their farms and at the landscape level. What this means is that farmers on adjoining properties, and beyond, should liaise over the provision of natural habitats that, where possible, are contiguous with each adjoining farm. Rivers provide an ideal "corridor" as they often run through various farms and a natural vegetation buffer alongside rivers should be the aim of every farmer.

Indicator

3.2.2 Invasive alien plants posing threats to biodiversity and ecosystem services are controlled.

Invasive alien plants pose a significant threat to the ecological functioning of natural systems and to the productive use of land. The Conservation of Agricultural Resources Act 43 of 1993 has, as one of its objectives, the control of weeds, and a comprehensive list has been published which separates the weeds into three categories in terms of their impact and control requirements.

In brief, certain species of plants are declared weeds, and others as invader plants. Declared weeds are what is known as *Category 1* plants and may not occur on any land or inland water surface, and must be controlled as specified in the regulations (Regulation 15E) - this includes mechanical, chemical and biological control as well as the mandatory requirements for follow-up operations. Examples of Category 1 plants are Mauritius thorn, pom-pom weed, ink-berry, triffid weed, camphor tree, lantana, oleander, various prickly pear species, hakea species, American bramble, sesbania and bugweed.

Category 2 plants may also not occur on any land or inland water surface other than what is known as a demarcated area. The area in which Category 2 plants are permitted may be demarcated by the executive officer of the Department of Agricultural Affairs, but subject to certain conditions. As Category 2 also contains most of the commercial tree species, the regulations also permit land for which a water use licence for a stream flow reduction activity (i.e. afforestation) has been issued in terms of the National Water Act, deemed to be a demarcated area. No land user may allow Category 2 plants to occur within 30m of the 1:50 year floodline of a water resource (river, stream, spring, lake dam or wetland (unless authorised in terms of the National Water Act 36 of 1998). Examples of Category 2 plants are black wattle, blackwood, silver wattle, eucalyptus, pine, poplar, castor-oil plant and weeping willow.

Category 3 plants are not permitted to occur on any land or water surface, but as they are the most benign of the three categories, plants in existence at the time of the commencement of the regulations (30 March 2001) are not required to be removed. However, if they occur within 30m

of the 1:50 year floodline of a river, stream, lake, spring, dam or wetland, then they must be removed. No Category 3 plants may not be established, propagated, sold or acquired after 30 March 2001. Examples of Category 3 plants are loquat, jacaranda, various species of privets, syringa, firethorns, cassia, tipu tree and others.

In addition to the requirements of the Conservation of Agricultural Resources Act, the National Environmental Management: Biodiversity Act 10 of 2004 also has relevance. Section 70 of NEM:BA allows the Minister to identify alien and invasive plants that pose potential threats to biodiversity. A draft list was published for public comment in April 2009. The implications of the regulations, and the long list of alien and invasive species, have the potential for major impacts on all landowners (state, private and communal land). As the publication is only a draft, it will not be considered further.

However, landowners need to be aware of their legal obligations to remove alien and invasive species, and ensure such removal is adequately planned and financed and that follow-up operations occur.

Indicator

3.2.3 The negative impacts of fire are minimised.

Many of South Africa's ecosystems are fire dependent, and management or use of fire is necessary to promote both biodiversity and reduce the fuel load and thus fire hazard. Fire can also be used to control alien invasive plants as well as indigenous invasive plants and to improve the quality of grazing, since recently burnt grassland has a higher crude protein content than grassland that has not been burnt for some time.

Much of the eastern half of South Africa is characterised by fire/climax grasslands or savannah that owe their very nature to their long history of association with fires. The sour grasslands in particular require regular top-growth removal by fire, since adequate removal by grazing alone is difficult in these grasslands. There are normally four major objectives for using fire in veld management (Tainton, 1981, 1999):

- to burn off unpalatable growth that remains from the previous season and which if left unburnt, will result in a moribund grassland;
- to stimulate growth at the end of the dry season;
- to destroy parasites such as ticks; and
- to control the encroachment of undesirable plants (both woody and forbs) – this is usually only successful in a limited number of applications, usually where grazing pressure is very light.

While these are largely agricultural reasons, fire also plays a significant role in maintaining ecosystem functioning. For example, most grassland species (both plants and animals) are well adapted to a frequent fire regime, which, in the absence of fire, may be reduced in number and behaviour (e.g. not flowering). The regular application of fire in grasslands therefore serves both the agricultural requirements a farmer may have, as well as maintaining ecosystem functioning.

In savannah, the application of fire is dependent on the nature of both the grass and the tree layers. In sour mixed bushveld areas, the objectives for burning would be largely to remove unpalatable grasses, as well as to control bush. In sweet savannah, fire is not usually as effective in reducing bush as the rainfall is usually erratic and there may not be a sufficient accumulation of grass fuel (due to the higher stocking rates of herbivores) to provide for regular fires.

As a general rule of thumb, fire in grasslands should be applied every two to three years, although in ungrazed grassland, annual fires can also be used (e.g. to reduce fire hazard, block winter burns as a fire protection mechanism, etc.). If bush control is required, a less frequent fire regime, which allows for the accumulation of sufficient fuel to have an impact on the bush, should be applied. Head fires (with the wind) are more effective against bush encroachment than a back burn (against the wind), but can pose increased risks for the farmer and the neighbours. There are practical ways of resolving this, such as starting with a back-burn and then initiating a head fire that will burn towards the back-burn.

The fynbos biome is also fire dependent and is used largely to maintain biodiversity and reduce the fuel load. By maintaining fynbos biodiversity, the management of the wild flower picking industry is maintained, alien invasive species are controlled and water yield in the catchments can be improved. The interval between fires in the fynbos is not as frequent as in the grasslands or savannah, and depending on the objectives of the land owner, can vary between 8 and 20 years. Again, the intensity of grazing in the fynbos will determine the frequency of the fires – the higher the grazing pressure, the less the fuel load and the less effective is the fire.

Fire intensity is dependent on fuel load, fuel moisture, relative humidity, wind speed and the nature of the ecosystem (volatile oils tend to increase the fire intensity). Fuel-load itself is dependent on the stocking rate, and a heavy stocking rate can this negate the effectiveness of fire.

Certain native plant communities such as natural forests are usually sensitive to fires. Adequate protective measures should be taken in this regard to minimise damage to forest margins. This could be done by minimising the fuel load adjacent to forests through the regular application of fires and/or initiating fires at the forest margin, and burning away from the forest. This is not always practicable on a large scale – if at all – and thus more regular burning tends to have the desired effect of reducing fire damage to forest margins because of the lower fuel load.

The National Veld and Forest Fire Act 32 of 1998 is aimed at preventing and combating veld fires through a system of prohibitions on burning veld under certain conditions, the preparation and maintenance of annual fire-breaks and the formation of fire protection associations. Every landowner on whose land a veld fire may start or burn or spread is required to prepare and maintain a firebreak on his/her land and the adjoining land. These are legal requirements concerning mutual agreement in the preparation of fire-breaks (section 12), the requirements of the breaks themselves (section 13) and a farmer's readiness for fire-fighting (section 17) i.e. adequate fire fighting equipment and facilities with accessible water points.

Farmers should be aware of the fire characteristics and ecosystem requirements in their area and devise a plan (that should also include neighbouring farms) that meets legal, safety and practical requirements. Landowners should join the local fire protection association which apart from providing an early warning fire management system (the fire index rating), also provides insurance against claims for fire damage.

Indicator

3.2.4 The negative impacts of authorised listed or scheduled activities are minimised.

Various activities have been identified under the Environment Conservation Act 73 of 1989 (ECA) and under NEMA (section 24) as having the potential to impact significantly on the environment.

The former Act was replaced by NEMA on 1 July 2006, but farmers who have had authorisation under ECA still need to comply with the conditions set out in the Record of Decision.

Both Acts require the assessment of the potential impacts of a scheduled or listed activity, prior to that activity commencing or being implemented. The activity may only proceed if authorised to do so, or if an exemption (section 28A of NEMA) has been approved. Activities that would affect farmers under the ECA include:

- the construction or upgrading of dams, levees and weirs on or after 2 March 1998;
- the change of land-use from agricultural or undetermined use to any other land-use on or after 1 April 1998; or
- the change of land-use from agricultural or zoned undetermined use or an equivalent zoning, to any other land-use on or after 10 May 2002;
- the change of land-use from grazing to any other form of agricultural use (on or after 1 April 1998); and
- the cultivation or any other use of virgin ground (on or after 10 May 2002). Virgin ground means land which has at no time during the preceding 10 years been cultivated.

Activities that would affect a farmer under the NEMA (as from 1 July 2006) are, amoung others:

- the construction of facilities or infrastructure, including associated structure/infrastructure for the concentration of animals for the purposes of commercial production in densities that exceed:
  - 20 square meters per head of cattle and more than 500 head of cattle per facility per year;
  - eight square meters per sheep and more than 1000 sheep per facility per year;
  - eight square meters per pig and more than 250 pigs per facility per year excluding piglets that are not yet weaned;
  - 30 square meters per crocodile at any level of production, excluding crocodiles younger than 6 months;
  - three square meters per head of poultry and more than 250 poultry per facility at any time, excluding chicks younger than 20 days;
  - three square meters per rabbit and more than 250 rabbits per facility at any one time;
  - 100 square meters per ostrich and more than 50 ostriches per facility per year or 2500 square meters per breeding pair.
- agri-industrial purposes, outside areas with an existing land-use zoning for industrial purposes, that cover an area of 1000m² or more.
- any purpose in the one in ten year flood-line of a river or stream or within 32 metres from the bank of a river or stream where the flood-line is unknown (including canals, channels, bridges, dams and weirs).
- off-stream storage of water, including dams and reservoirs with a capacity of 50000m³ or more.
- dredging, excavation, infilling, removal or moving of soil, sand or rock exceeding 5m³ from a river, tidal lagoon, tidal river, lake, in-stream dam, floodplain or wetland.
- transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered ecosystem listed in terms of Section 52 of NEM:BA.
- subdivisions of portions of land 9 hectares or larger into portions of 5 hectares or less.

Farmers need to ensure that any of their farming activities that fell into the ECA activities between March 1998 and July 2006, or post July 2006, are duly authorised and that the

conditions attached to their authorisation or record of decision are being or have been, complied with.

The regulations of July 2006 are currently being revised through a consultation process, and new or amended regulations appeared in early 2009 for public comment. The list of activities shows a genuine attempt by the competent authority to fast track the unseemly slow rate of the authorisation process. For example, whereas previously transformation or removal of indigenous vegetation of 3ha or more required a basic assessment, this figure has been increased to 20ha, with an upper limit of 100ha, where after a full EIA is required. This applies to land for agricultural purposes or afforestation. The regulations have not been finalised at the time of writing (September 2009).

Indicator

3.2.5 Significant pollution and degradation of the environment is prevented, contained, minimised or remedied.

Section 28 of NEMA requires that every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring or, even if such harm is authorised by law (e.g. water use licence for storm water run-off) or cannot reasonably be avoided or stopped, to minimise and rectify the pollution or degradation of the environment.

The very widely embracing requirement essentially imposes an obligation on landowners to take measures to cease or minimise harm to the environment resulting from farming activities. Focus has been placed on the following measures, although there may be others which are dependent on the farming enterprise:

Soil and water pollution can be avoided by the application of best management activities at the following sites on a farm:

- Organic fertiliser stockpiles:
  - should not be placed near natural water sources or near groundwater where water can be contaminated; and
  - should be protected from wind dispersal and the breeding of insects and pests (there should be no standing water at the stockpile).
- Farm workshops:
  - wash-bay facilities should be provided for cleaning tractors and equipment, and all run-off should be directed into a protected sump to minimise contamination of ground water or water courses;
  - old engine oil should be emptied into containers and recycled; and
  - all equipment and power supply points should comply with relevant health and safety requirements.
- Farm land:
  - Servicing of vehicles in-field should not occur anywhere near a waterway or water course; oil and diesel should be drained into containers and removed, together with discarded spares.

Indicator

3.2.6 The generation of waste is avoided or minimised or, where this cannot be achieved, waste is reduced, re-used, recycled, recovered and, finally, safely disposed of.

The National Environmental Management: Waste Act 59 of 2008 was promulgated on 10 March 2009, and came into effect on 1 July 2009. It effectively reforms all other waste legislation and has as its main objectives, to:

- protect health, well-being and the environment by providing reasonable measures for:-
- avoiding and minimising the generation of waste
- reducing, re-using, recycling and recovering waste
- treating and safely disposing of waste.

The definition of waste is:
"…. any substance, whether or not that substance can be reduced, re-used, recycled and recovered –

a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of
b) which the generator has no further use of for the purposes of production
c) that must be treated or disposed of or
d) that is identified as a waste by the Minister by notice in the Gazette

and includes waste generated by the mining, medical or other sector, but –

i. a by-product is not considered wast and
ii. any portion of waste, once re-used, recycled and recovered, ceases to be waste."

While the Act and the regulations that arise will take some time to come into effect, landowners should begin to practice the general duty in respect of waste management contained in section 16 of the Act which is based on:

- waste avoidance or minimisation;
- waste reduction, re-use, recycling and recovery;
- waste disposal;
- management of waste so that it does not endanger health or the environment or cause a nuisance through odour or visual impacts;
- preventing any employee from contravening the Act; and
- prevention of waste from being used for an unwanted purpose.

The Act requires that any person that stores waste (such as a waste pit on a farm) must ensure that adequate measures are taken to prevent leaking; that waste cannot be blown away and nuisances such as odour, visual impacts and breeding of vectors do not arise (section 21). No person may dispose of waste at an unauthorised site, but this does not apply to waste generated as a result of normal household activities and where the municipality does not render a waste collection service. This would apply to many farmers who will have a waste disposal site (pit) on their land. Despite this, landowners must adopt to most environmentally feasible option for the management of waste (section 26). Littering is also prohibited in terms of section 27 of the Act.

As a best management practise, farm waste should be avoided or recycled or disposed of in accordance with the relevant legislation:

- recycling of glass, tins, paper, organic kitchen waste and oil should be promoted and adequately identified containers should be provided by farmers to manage the programme;

- empty chemical containers should be returned to the supplier, and not given to staff to serve as, for example, water containers; and
- cognisance should be taken of any provincial or local by-laws on waste management e.g. in KZN there exists legislation (Prevention of Environmental Pollution Ordinance 21 of 1981) that prevents littering, subject to certain conditions.

Farmers therefore need to be aware of their legal requirements in terms of the prevention of pollution by waste, and to implement a waste management plan that addresses waste avoidance, minimisation, recycling, re-use and disposal.

CRITERION

3.3 Natural agricultural resources (soil, water and vegetation) are protected and/or sustainably used.

The focus of this criterion is on the need for agricultural practises to protect natural resources and prevent degradation of soil, water and vegetation. The Conservation of Agricultural Resources Act 43 of 1983 (CARA) is the major legislation that gives effect to this need. It is applicable to all forms of agriculture, and is therefore couched in fairly general terms. The Act allows the Minister to publish certain regulations that provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land, by the combating and prevention of erosion and the destruction of the water resources, and by the protection of the vegetation and the combating of weeds and invader plants. Regulations have been published that put forward some very specific requirements.[21]

Aside from the legislation, the Agricultural Research Council (ARC) has recently adopted the concept of conservation agriculture. The ARC Institute for Soil, Climate and Water (ISCW), together with the ARC African Pollinator Initiative (API) and the Plant Protection Research Institute (PPRI), have initiated a programme to investigate Conservation Agriculture's key principles that, under different crops, contribute to soil health, restore agro-ecosystems, investigate the effects of conservation tillage and conventional tillage on carbon sequestration and greenhouse gas emissions and their impacts on the yield of maize crops (see www.arc.agric.za).

Best management practises have been developed by a number of farming types (e.g. forestry, sugar, wine, potatoes, beef, ostriches, etc.) and the intention of these principles, criteria and indicators is not to address each, but rather to refer to general indicators that would apply to most farming types most of the time. Strong emphasis is placed on the regulations published in terms of the Conservation of Agricultural Resources Act since the best management practices appropriate for each land-use would be sector specific.

Indicator

3.3.1 Soil health is maintained or, where necessary, improved.

Soil is a living, dynamic resource that supports plant life, and on which agricultural crops depend for their growth. Each soil has its own characteristic chemical, physical and morphological properties. To make sound management decisions, farmers should know the major soil types

[21] GN R1048 GG 10029 of 25 May 1984 as amended – GN R280 GG 22166 of 30 March 2001.

on the farm. Fertiliser and herbicide applications, drainage systems, tillage practises, irrigation, conservation planning and crop selection (and their varieties) are all soil dependent. Ideally, all farms should have a soil parent material map, soil types and a soil survey indicating soil form, depth and percentage clay of each field.

Soil health is a concept that embraces the chemical, physical and biological functioning of soils (Lanz, 2009). Soil carbon is one of the most important factors in the biological functioning of soils and measuring total soil carbon (or soil organic matter content) is a good measure of soil health. Soil carbon:

- stores over 90% of the nitrogen of the soil
- has many sites that hold minerals and thus increase the soil's available nutrients
- prevents nutrient leaching by holding them
- promotes good soil structure
- encourages macro-organisms (e.g. earthworms) that form pores in the soil and thus assists plant growth by allowing micro-organisms to turn the nitrogen in the air into nitrate and ammonia
- improves soil water relationships by increasing rain absorption and decreasing water loss from run-off.

Farmers that cultivate their lands should consider seek expert advice or undertaking appropriate literature reviews should they be at all concerned over their current practices regarding soil fertility and health, particularly if yield is resulting in consistent declines over time. In general, farming practices that are encouraged to ensure healthy soil include the following (after Leu, 2007):

- Correct tillage – tillage is one of the oldest methods to prepare planting beds and to control weeds, but is also one of the most abused methods that results in soil loss, damage to the soil structure and carbon loss through oxidation when used incorrectly. Tillage should be done only when the soil has the correct moisture and should be done at the correct speed (so that the soil cracks and separates around the peds leaving them intact, rather than breaking them up), while minimum tillage ensures that the soil is less prone to erosion and oxidation and should thus be planted with a cover crop as soon as possible.

- Use of mulch tillage (i.e. any tillage system that retains a high percentage of crop residues on the surface of the soil) reduces run-off and erosion when compared with clean-tilled lands, white organic matter and total nitrogen contents of the soil increases significantly (Beale, Nutt and Peale, 1955).

- Reduced use of synthetic nitrogen fertilisers, which are one of the major causes of the decline in soil carbon. Rather use organic nitrogen fertilisers that contain a carbon source, such as composts, animal manures, green manures and legumes. To determine the exact nutrient requirements regular soil and leaf sampling should be undertaken. Soil test values and nutrient threshold levels can then be used to calculate the amount and type of nutrients required to achieve optimum crop growth.

- Reduced use of biocides, which cause a decline in beneficial micro-organisms that build humus, suppress diseases and make nutrients available to plants.

The CARA legislation aims to ensure that soil health is maintained or improved through appropriate agricultural practices. The regulations focus on minimising soil erosion - probably

the only parameter that can be reasonably legislated. The following regulations specifically address soil erosion:

- Except with written authority, no virgin land shall be cultivated (land which in the opinion of the executive officer has at no time during the preceding ten years been cultivated) (see also 3.2.3).

- Except with written authority, no land shall be cultivated if it:
  - has a slope of more than 20%; or
  - has a slope of more than 12%, and is situated in certain magisterial areas with specified erodible soils and physical properties. NB This prohibition does not apply to land which was under cultivation on the date of the commencement of the regulations (i.e. 1 June 1984), provided such land is protected against excessive soil loss due to erosion through the action of water.

- Cultivated land shall be protected against excessive soil loss as a result of erosion through the action of water by as many of the following measures as are necessary for each particular situation:
  - soil conservation works shall be established to divert run-off water or to restrict the speed of run-off water
  - land shall be cultivated in such a manner so as to restrict the speed of run-off water
  - land shall be used in accordance with a crop rotation system
  - alternate strips on which a cover crop occurs shall be left undisturbed annually
  - crop residues shall be left on the land to the extent that a sufficient mulch has been formed
  - the land shall be permanently removed from cultivation through the establishment of a grazing crop.

- Cultivated land shall be protected against excessive soil loss as a result of the actions of wind by as many of the following measures as are necessary for each particular situation:
  - land shall be cultivated in such a manner so as to restrict the surface movement of soil particles as a result of wind
  - land shall be used in accordance with a crop rotation system
  - alternate strips on which a cover crop occurs shall be left undisturbed annually
  - crop residues shall be left on the land to the extent that a sufficient mulch has been formed
  - the land shall be permanently removed from cultivation through the establishment of a grazing crop
  - soil conservation works shall be established to restrict the movement of soil particles through the action of the wind
  - strips of natural vegetation shall be left at right angles to the prevailing wind, or a suitable windbreak shall be constructed or suitable vegetation shall be established to serve as a windbreak
  - land shall not be left fallow
  - cultivation and grazing of lands during periods of high winds shall be avoided
  - establishment of crops of which the harvesting causes disturbance of the topsoil shall be avoided.

The use of *infield transport* and loading systems, and other heavy machinery, should be avoided when conditions are wet as compaction can occur, breaking down the soil structure.

Conservation terraces are another means of minimising soil loss from cultivated land. They should be properly designed structures where spacing is influenced by the slope, soil and management practises. Conservation terraces should be kept free of silt and debris and should be checked periodically for line, level and grade.

Farm roads can be a major source of soil loss, with sediment often finding its way into rivers and negatively affecting both the water quality and the aquatic biodiversity. Roads must therefore be sited, constructed and maintained to minimise soil loss. Routes should be selected to avoid sensitive areas such as indigenous forests, special natural plant communities, breeding sites, wetlands, archaeological or historical sites and other natural assets. Construction of river crossings should not result in concentration of the flow of the water in the river, and roads should not interrupt the hydraulic flow of a wetland. Roads should cross watercourses at right angles and the approach and departure verges should be grassed. All roads must be adequately drained, and the drains either grassed or paved. The correct number of drains must be constructed to meet the slope requirements of the road.

Road culverts should be able to accommodate a 1:10 year flood, and culverts should be protected by rock pitching. Regular maintenance to clean out plant debris should be conducted to avoid culvert blockage and potential erosion of the road. *Farm bridges* should be of a suitable capacity to accommodate a 1:10 year (secondary road) or 1:20 year (primary road) flood. Should a bridge, culvert or road affect the watercourse in terms of section 21(c) and 21(i) of the National Water Act, it may be necessary to apply for a water use licence. However, there is a provision under the General Authorisations which may ease the need for licensing under certain conditions (GN 26187 GG 398 and 399 of 26 March 2004 – www.dwaf.gov.za).

Harvesting operations should be planned to minimise negative environmental effects and should therefore take into account topography, soils (erodibility and compactibility), weather, extraction routes and loading zone sites. Vehicle operators should be made aware of the need to operate harvesting vehicles with care to minimise soil damage (radial ply tyres, low tyre pressures, ensuring total mass is distributed over all axles).

Finally, the choice of land to be planted should take into account environmental and economic factors. Soil type, land aspect, slope, and susceptibility to pests and diseases should be considered. Crops in close proximity to wetlands and water resources should be avoided. Different soils have different erodibility potential and can be categorised accordingly. Well-structured soils with a high clay content tend to be more resistant to erosion than sandy non-structured soils. Consideration should be given to the erodibility of the soil, particularly where cultivation takes place, as erodible groups require precautions and use must be made of both biological and mechanical conservation measures.

Indicator

3.3.2 Water resources on the farm are managed to conserve water and water use is legal.

The Constitution of South Africa (section 24) states that everyone has the right to have access to (amongst other things) sufficient water, and the State must take reasonable legislative and other measures within its available resources to achieve the progressive realisation of these rights. The National Water Act 36 of 1998 (NWA) is the primary legislation regulating water use in South Africa, and requires that the Minister establish a National Water Resources Strategy providing information about ways in which water resources will be managed. In 2000, a Department of Water Affairs and Forestry (DWAF) analysis showed that 11 of the 19 water management areas

in the country were facing a water deficit. These 11 catchment ecosystems have either been placed under severe stress, or users cannot rely on getting their fair share. South Africa is a water scarce country and climate change predictions show reduced future water availability, adding to these stresses, so we need to use our limited water supplies efficiently and effectively. To use water in these catchments in a more sustainable way, water use efficiency should be increased and invasive alien plant infestations removed.

Water use in South Africa is dominated by irrigation, which uses around 50% of all water. Domestic and urban use accounts for around 10%, while mining, power generation and industries account for around 11% and commercial forestry (through reduction of run-off into rivers and streams) only 3%. Stock watering and nature conservation together account for 3%. These figures do vary depending on the information source, but irrigation is clearly the greatest user of water and thus potentially an area for greatest savings by the application of best management practices (see Irrigation Management below).

The NWA requires all water use to be authorised. Very low-level use is authorised automatically as a Schedule 1 use. Schedule 1 allows for reasonable domestic use, gardening, small-scale subsistence farming, animal watering (not large scale stock watering), fire fighting and some recreation, and for the use of water stored from roof run-off. A second category of authorisation is that of Existing Lawful Use. In this case a user who was using water over the two-year period prior to the promulgation of the NWA in 1998 is deemed to be a lawful user and may continue to use this water. The third category is through actual licensing – and a prospective (new) user may apply for a licence, which can only be granted if sufficient water is available for allocation. The licensing process in some catchments is eased through the promulgation of a General Authorisation which allows the user to take and use water, up to a certain specified volume and under specified conditions, without having to apply directly for a licence, although such use must be registered with DWAF. Heavily used catchments have been identified and excluded from the General Authorisations[22]. Any prospective new user should clarify the availability of water for use, and the authorisation requirements, with DWAF.

All irrigated farms must be authorised to use that water. In most cases authorisation will be as Existing Lawful Users, with some post-1998 development under General Authorisation or through licensing. The use of water by agricultural crops may be traded across crops on the same farm, provided the volume authorised is not exceeded. Water may sometimes also be traded between different authorised users within a catchment but this requires a formal licensing process.

Dryland (rain-fed) agriculture does not need authorisation as a water use and is not, at present, controlled under the NWA. The only dryland crop that is regulated is afforestation, which has been identified as a stream flow reduction activity and requires authorisation from DWAF.

<u>Legislated Water Use Categories</u>

Farmers need to determine which categories of water use (as listed in section 21 of the Act) are applicable to their farming enterprise.

Schedule 1 Water Use

Schedule 1 water use is:

[22] GN26187 GG 398 and GG 399 of 26 March 2004

- water taken from a water resource to which that person has lawful access for domestic use, small gardening (not for commercial purposes) and the watering of animals (excluding feedlots)
- water stored and used from roof run-off.

Existing Lawful Water Use

Existing Lawful Water Use is consistent with use during the two years prior to the promulgation of the National Water Act on 1 October 1998. This water use must be registered with DWAF and users are required to pay for this water. Existing Lawful Use will, in time, be formalised through the issuing of a licence, although this might be for a reduced volume if the water is required for other priority purposes (i.e. the ecological reserve or in order to provide additional water for equity allocations under the Water Allocation Reform Programme). The licensing process is known as Compulsory Licensing and will include validation and verification of the use as Existing Lawful Use. Water use must be registered with DWAF who will in turn validate and verify that water use. Validation confirms how much water the user was actually using in the qualifying period, how much has been registered, as well as how much is currently being used. Verification determines the extent of existing lawful water use. In effect this determines if any previous laws would have limited the use on the qualifying period. If not, the use in the qualifying period is lawful.

General Authorisation of Water Use

Water use is authorised in terms of a General Authorisation published under the NWA.

- The taking and storage of water is within certain limits and satisfies certain conditions as outlined in the Government Gazette No. 26187 No.399 published on 26 March 2004
- The disposal of waste in a manner which may detrimentally impact on a water resource is permitted provided that the disposal is within certain limits and conditions as outlined in Government Gazette No. 26187 No.399 published on 26 March 2004.
- Impeding or diverting the flow of a river in a watercourse is permitted provided that the action and use meets certain provisions and conditions as outlined in Government Gazette No. 26187 No.398 published on 26 March 2004.
- Altering the beds, banks, course or characteristics of a water course is permitted provided that the action and use meets certain provisions and conditions as outlined in Government Gazette No. 26187 No.398 published on 26 March 2004.

NB. The taking of water from a wetland is never permitted under a General Authorisation and therefore requires a licence.

NB. DWAF recently issued a replacement of General Authorisation in terms of section 39 of the NWA[23]. This replacement notice was published in May 2009 for public comment. Once finally gazetted, those water users who exercised their water use entitlements under the existing general authorisation and are thus, under the new general authorisation unable to proceed with that use, must apply for a licence.

Licensed Water Use

Water use is authorised in terms of a licence issued under the NWA:

[23] To replace General Authorisation 1 and 2 to the Schedule of Government Gazette Notice No. 398 dated 26 March 2004.

- Taking and storage of water should be licensed unless constituting a Schedule 1 use or unless in terms of a General Authorisation, in which case it should be registered.
- The impeding or diversion of the flow of water in a watercourse has been registered and licensed provided such use does not fall within a general authorisation (which *may* require registration) or an existing lawful water use.
- The alteration of the bed, banks, courses or characteristics of a water course has been registered and licensed if such use does not fall within a general authorisation (which *may* require registration) or an existing lawful water use.
- The disposal of waste in a manner which may detrimentally impact on the water use has been registered and licensed provided such use does not fall within a general authorisation (which *may* require registration) or an existing lawful water use.

Wetland and water course protection

Vleis, marshes, water sponges and water courses are protected in terms of Regulation 7 of the Conservation of Agricultural Resources Act 43 of 1983 (CARA) and the NWA. Under CARA the following protection is in place:

- Utilisation of vegetation in a wetland (vlei, marsh or water sponge) must not damage the agricultural resources (defined as the soil, the water sources and the vegetation, but excluding weeds and invader plants)
- Utilisation of vegetation within the flood area of a water course or within 10 meters horizontally outside the flood area must not damage the agricultural resources (defined as the soil, the water sources and the vegetation, but excluding weeds and invader plants)
- No cultivation or drainage of a vlei, marsh or water sponge, or any land within the flood area or within 10m horizontally outside the flood area of a water course is permitted, unless authorised by the executive officer of the appropriate agricultural department (these prohibitions on cultivation or drainage do not apply to a wetland, the flood area of a water course or on land within 10m horizontally outside the flood area of a water course if the cultivation or drainage took place prior to the commencement of the regulations i.e. 1 June 1984, provided that the land is already protected effectively against excessive soil loss due to erosion through the action of water).

Regulations of flow pattern of water

Under regulation 8 of CARA, the flow pattern of runoff water is regulated. Thus:

- No run-off water from a water course may be diverted to another water course, unless authorised in terms of a run-off control plan approved by the Department of Agriculture, or through authorisation in terms of the Environmental Conservation Act or the National Environmental Management Act with approval by the Department of Water Affairs and Forestry.
- The natural flow patterns of water on a farm have not been disturbed by obstructions, unless the flowing-away or passing through of the run-off water is sufficient to ensure that the obstruction will not cause excessive soil loss caused by the action of the water or the deterioration of the natural agricultural resources (defined as the soil, the water sources and the vegetation, but excluding weeds and invader plants).
- Existing obstructions of the natural flow patter of run-off water may not be removed or altered if the removal or alteration would result in excessive soil loss through the action of water or deterioration of the natural agricultural resources (defined as the soil, the water sources and the vegetation, but excluding weeds and invader plants).

Wetland Management

Wetlands are defined in the NWA as "land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which or would under normal circumstances support vegetation adapted to a life saturated in soil".

The Department of Water Affairs and Forestry have published a guide to the identification of wetlands using soils, vegetation and position in the landscape (A practical procedure for identification and delineation of wetlands and riparian areas. www.dwaf.gov.za). Wetland soils can be defined as an area that is flooded for a sufficiently long period for waterlogging to become the dominant factor determining the diagnostic characteristics of the soil, with the presence of mottling or gleyed horizons due to the anaerobic conditions.

Farmers should identify wetlands and watercourses, map them and protect or rehabilitate as appropriate. Thus wetlands should not be planted to crops, alien invader plants should be removed, burning and grazing should be controlled etc. The Mondi Wetland Project is a valuable reference point for guidelines to protect and rehabilitate wetlands (wwf.wetlands.org.za/manage.htm).

Rehabilitation of wetlands will shortly appear under a General Authorisation which will have the effect of replacing the need for a water user to apply for a licence when undertaking rehabilitation. However, a basic assessment in terms of proposed EIA regulations is likely to be required for the reclamation of a wetland in due course[24].

Riparian zone management

The presence of riverine, fringing woody plants or reeds, bulrushes, sedges and hygrophilous grasses are clear indications of the presence of a watercourse that should not be planted to crops to within 10m (as laid down in regulation 7 of CARA). Indigenous vegetation along water courses should not be removed, and where it has been removed the re-establishment of suitable indigenous plants should be considered.

Irrigation management

Irrigation is controlled by both CARA and the NWA. The former requires that irrigated land is protected against water-logging and salination by as many of the following measures as are necessary for each particular situation:

- catchment dams, furrows and feeder channels used for irrigation water are impermeable
- land is not irrigated with water that is too high in salt content
- soil conservation works are constructed to draw off excess surface and subterranean water so as to dispose of it to prevent the water-logging and salination of lower lying land
- fertilisers that could contribute to salination should be avoided
- soil ameliorants should be applied to land showing signs of salination.

[24] GG No. 31885 Vol. 524 of 13 February 2009.

Existing irrigators (or water users) must register their water use with DWAF. Should farmers irrigate with effluent or sludge (a controlled activity in terms of the NWA) they may require a licence unless they fall into the requirements for a General Authorisation. Landowners should consult with their local DWAF office in this regard.

Best management practises should be implemented to ensure an efficient application of water and limit abstractions e.g.

- Timing and amount of irrigation should take account of the soil type, crop type and age and weather conditions. Scheduling techniques using either direct measurement of soil water status (soil auger, tension-meter or neutron probe) or estimated soil water content using computer model calculations and weather data should be used.
- Water usage should be metered to enable accurate quantification of water applied. Records should be kept to allow comparison against licensed allocated (or registered use) and actual use.
- New irrigation schemes should be designed in accordance with standards specified in the Irrigation Design Manual 1997, ISBN 1-919685-11-1 published by the Institute for Agricultural Engineering, Agricultural Research Council (www.arc.agric.gov.za) . Special consideration must be given to the soil water holding capacity, infiltration rate and chemical limitations of the soil or water source. Authorisation of new irrigation schemes will be required from DWAF.
- Irrigation systems should be maintained and checked annually to ensure operation is in accordance with the design specifications.
- Quality of irrigation water must be regularly monitored to keep any soil degradation to a minimum and to sustain crops.
- Salinization (accumulation of salts in the soil which adversely affects soil sustainability and thus crop production) is generally caused by poor water management such as inadequate drainage or over irrigation, which causes the water table to rise, concentrating minerals into upper soil layers. Landowners must ensure that these causes are avoided.

Storage of water

Storage of more that 10000m³ per farm may require registration of the dam or storage with DWAF. Dam safety requirements as specified in the NWA, including routine inspections, must be complied with. Any dam with a wall height of less than 5m does not require registration in terms of dam safety.

Water Neutral Scheme

WWF-SA, SA Breweries Ltd. and the Working for Water Programme (under the auspices of DWAF) recently launched a fully quantitative water scheme (www.wwf.org.za) aimed primarily at the private sector. The scheme promotes a process that allows participants to review, reduce and replenish their water supplies. It is currently aimed at major corporations, but there are likely to be indirect effects on farmers. For example, following a typical “cradle to grave” approach, a company that has invested in the scheme may find, when going through a review of its water use, that a significant amount of water is used in the growing of the raw material (e.g. irrigated food crops, irrigated pastures, timber, orchards, vines, etc.). There may therefore be a requirement for agricultural producers to undertake a review of their water use, particularly for products grown under irrigation, in an attempt to contribute to the reduction phase of the water neutral scheme. Irrigation best practices that focus on efficient water use, should be practiced. Note that efficiency is not just about water savings, but calculations of water use per unit area of

crop, or per kilogram (or ton) of product. Before embarking on such a scheme, farmers should be in a position to accurately measure current water use. From a practical perspective, this is likely to only apply to irrigated crops, since water extraction can be accurately measured.

Indicator

3.3.3 Veld and forage is managed to ensure sustainable production of vegetation, livestock and wildlife.

The legislation governing the use of veld and forage is contained in Section 6 of CARA which allows the Minister to prescribe control measures which must be complied with by land users to whom they apply. As far as grazing or use of natural vegetation is concerned, regulations have been published which apply to:

- the utilisation and protection of the vegetation;
- the grazing capacity of the veld; and
- the maximum number and the kind of animals which may be kept on the veld.

Regulation 6 requires that every land user shall protect the veld on the farm unit against destruction and deterioration using as many measures as are necessary. These include:

- alternative grazing and rest periods should be used;
- use of different types of animals;
- restriction on the number of units on the veld (see large stock regulation 11 below);
- use of soil conservation works to allow for grazing and resting periods, protection of the veld against excessive soil loss as a result of rain and wind, and for collection of sediments from run-off water;
- reduction in numbers of animals if the veld shows signs of deterioration or the withdrawal of grazing camps until there has been sufficient recovery of the veld.

Regulation 10 requires each extension office of the Department of Agriculture to have a topocadastral map that indicates the grazing capacity of the veld, expressed as a specified number of hectares per large stock unit. Should the extension officer decide that the grazing capacity of the veld on a farm unit differs appreciably from that specified on the topocadastral map, then another grazing capacity may be applied and the land owner notified in terms of directive (regulation 17).

Regulation 11 requires that every land user must restrict the number of animals, expressed as large stock units, kept on the farm to no more than the number that is obtained by dividing the area of the veld of the farm unit concerned, expressed in hectares, by the applicable grazing capacity as indicated on the appropriate topocadastral map kept by the extension officer. The regulations include a table that gives the large stock unit equivalent (LSU/Animal) or number of large stock units equal to one animal for grazing animals and includes cattle, small stock, horses, ostriches and game (wildlife).

While legislation is necessary to guide the application of the Act, it is recognised that we are dealing with a dynamic system that changes in response to the many environmental factors that directly affect plant growth and, since these environmental factors interact, they modify one another's effects on the vegetation (Tainton and Hardy, 1999) and, by implication, the carrying capacity for livestock and wildlife. The main factors governing the growth of plants and thus the development of various plant communities are climate, the soil, fire and the impacts of animals and man.

In South Africa, veld is often described using the terms sweetveld, mixed veld and sourveld. The main characteristics of these veld categories (adopted from Tainton, 1999(a)) are as follows:

Sweetveld in summer rainfall areas

- mostly at low, frost free elevations, but can occur at higher altitudes, where frost can be severe
- rainfall is erratic, and growth rates correspond to this variable rainfall pattern
- cover is sparse
- veld can be easily damaged by overgrazing of the edible species during the growing season
- recovery of species composition and density can be rapid, provided soil erosion has not been excessive
- it is prone to bush encroachment
- spring rains can be late, and thus the lack of availability of food at this time can be critical

Sweetveld in all-year rainfall areas

- can occur at a wide range of elevations
- rainfall is erratic, but can occur at any time of the year – plant growth is thus correspondingly erratic
- cover is sparse to moderate
- veld can be easily damaged due to overgrazing and the loss of edible species and invasion by less useful species
- veld is slow to recover its species composition and density
- grazing is most reliable in spring and autumn

Sweetveld in winter rainfall areas

- occurs at a wide range of elevations
- rainfall is variable
- cover is generally very sparse
- veld is easily damaged, particularly the perennial palatable species
- recovery of damaged veld is slow
- prone to encroachment of various indigenous fynbos–type species and a number of alien invasive plants

Sourveld

- occurs mainly at relatively high altitudes; summer temperatures are usually lower than in sweetveld areas
- rainfall is relatively high, and this is reflected in rapid and regular plant growth
- grass cover is dense
- veld can withstand moderate levels of overgrazing due to a relatively stable species composition – excessive overgrazing or selective grazing can result in a change of species composition to more pioneer and less palatable species, rather than a reduction in cover
- recovery of the veld composition to more palatable species is extremely slow, and may not occur in a farmer's lifetime
- sourveld provides good spring grazing

Mixed veld

- Tends to have the characteristics of both sweetveld and mixed veld, depending on whether the veld is sweet-mixed or sour-mixed.

NB: The *amount* of forage available for animal consumption, rather than forage *quality*, limits livestock production in sweetveld areas. On the other hand, forage *quality*, rather than *quantity*, limits animal production in sourveld areas.

As has been indicated by Tainton (1999), the form and function of the grazing lands in South Africa are extremely variable. As a result best management practices for the different biomes and the veld types within these biomes, as well as the capacity of the vegetation to support different types of livestock (either singly or in combination), will vary considerably across the country. Importantly, the majority of the grazing lands are extremely productive for livestock farming, and deserve careful management. In brief, the two production characteristics of natural veld that have the most important impact on livestock farming are the carrying capacity (i.e. potential stocking rate) and the season in which they are used.

The stocking rate possible at any one site can vary from year to year, depending on the actual rainfall. Stocking rates can also depend on the level of performance required for the animals and other factors such as species mix. The carrying capacity of the different types of grazing lands has been established (see Tainton, 1999(a)) which indicates that grasslands are the most productive at 1 – 5ha/AU/annum. AU (Animal Unit) equates to an animal with a mass of 450kg and a dry mater intake of 10kg/day or 3.65 tons/annum. The AU equivalent of animals of different mass may also be calculated from the equation :

AU equivalents = $M^{0.75} / 450^{0.75}$

Savannah areas have a moderate potential carrying capacity, which depends largely on the density of trees, amount of grass and extent of edible bush and is inherently variable within each region from one season to the next (4 – 35ha/AU/annum). The Karoo areas have low potential carrying capacity, with variability again due to the amount of grass in the sward, the acceptability of the Karoo shrubs in the veld to the animals (which varies considerably in that some shrubs are unpalatable due to plant compounds such as tannins) and rainfall (7 – 35ha/AU/annum). The fynbos areas also have a low potential carrying capacity, again depending on the amount of grass and when the area was last burnt (4 – 20ha/AU/annum). Natural forests produce very little grazing in the lower stratum and the potential carrying capacity is low (>35ha/AU/annum).

When it comes to season of use, sweetveld remains palatable and nutritious even when it is mature, whereas sourveld provides palatable material only during the growing season (Scott, 1947). Sourveld thus becomes unpalatable to stock in autumn and through winter. If left unburnt, the unpalatability persists in the old material while new material does not reach the same levels of acceptability (determined through the crude protein levels) as grass in newly burnt veld. Mixed veld is intermediate between the two extremes with sweet-mixed veld providing grazing for 9 – 11 months of the year and sour-mixed veld for between 6 – 8 months of the year (Tainton, 1999(a)).

These characteristics will largely determine the kind of management that best suits the veld, with the amount of forage available for animal consumption, rather than forage quality, limiting livestock production in sweetveld areas, while forage quality, rather than quantity, normally limiting animal production in sourveld.

In attempting to devise generic guidelines for managing veld, it became obvious that each farm would need to be addressed in a specific manner that allows for the farmer to demonstrate an understanding of the principles of veld management for his/her particular farm, as well as a means to demonstrate that the practices on a particular farm are sustainable in terms of the production potential of the veld, the requirement of the animal and the available finances. Farmers should therefore be able to demonstrate a knowledge and application of the following principles (after Tainton, Aucamp and Danckwerts, 1999):

Continuous grazing

The concept of continuous grazing is the type of management which implies that grazing animals are placed in a camp (in its most basic form, this could be the entire farm) at the start of the growing season and remain there (or are replaced) for the entire grazing period of the year, at the general grazing capacity of the area. It could also imply that there may be many camps on the farm, each stocked to the recommended grazing capacity for that camp.

Continuous grazing has some advantages but mostly disadvantages. The disadvantages (after Tainton, Aucamp and Danckwerts, 1999) are:

- area and species selective grazing occurs extensively and, unless the livestock stocking rate is adjusted, there is the risk of overgrazing of the selected sites, veld deterioration and erosion
- it is not possible to apply veld management measures such as resting, to encourage the more palatable species
- optimum economic stocking rate is lower than that for pastures grazed rotationally
- camp size, appropriateness of subdivision, placement of water points and adjustment of stocking rates to the grazing capacity are critical.

The only real advantage is economic, where lower requirements for fencing and water points can be considerable, although this decreases with the sophistication of the system.

Rotational grazing

The concept of rotational grazing is that there is at least one enclosure more than the number of animal groups on the farm. The objectives are to (from Tainton, Aucamp and Danckwerts, 1999):

- control the frequency at which the plants are grazed by controlling the frequency at which each camp in the system is grazed
- control the intensity at which plants are grazed by controlling the number of animals which graze each camp and their period of occupation
- reduce the extent to which veld is selectively grazed by confining a relatively large number of animals to a small proportion of the veld to minimise species selection.

While the concept of rotational grazing has been around for some time (see Booysen, 1967), the question as to whether to use lenient use or heavy use of a camp, or even some intermediate intensity, has given rise to a number of rotation systems, viz.:

NSG = non-selective grazing
CSG = controlled selective grazing
HUG = high-utilisation grazing
HPG = high-performance grazing

In essence, these rotation grazing systems vary the intensity of grazing which should be applied by the farmer before the animals are moved from one camp to the next, and therefore also the degree of selection which is permitted. The concept of short-duration grazing (SDG) is different to the systems above in that it focuses on the need for a short period of stay in a camp, followed by long periods of absence.

The application of the HPG/CSG system of lenient use, and the HUG/NSG system of intensive use and the SDG approach used in flexible (open camp) grazing management system can really only be applied by farmers who understand the underlying principles of the system, and who apply these principles without reference to a strict schedule. Strict schedules in fact cannot be applied due to the variability of the rainfall on a year by year basis, particularly in low rainfall areas.

Included in the application of rotational grazing systems are the periods of occupation and absence, and the number of camps. However, it is not usually possible to prescribe a general period of absence for rotation systems, as this will depend on the growth rate of the plants, whether the farm is in a sweetveld or sourveld (in a sourveld, the period of absence will be shorter than in a sweetveld). Periods of occupation and absence will also depend on the number of camps (Tainton, Aucamp and Danckwerts, 1999). In practice, livestock farmers usually have no more than two to three camps per group of animals – this is largely because of the costs associated with fencing materials and supplying water to each of the camps.

Stocking Rate

Stocking rate is the number of animals of a particular class which are allocated to a unit area of land for a specified period of time and is usually expressed in terms of animal numbers per hectare (Morris, Hardy and Bartholmew, 1999). Various models are available to describe the relation between stocking rate and the performance of grazing animals in terms of saleable product. However, their usefulness is dependent on the quality of the data used to derive the model, and are specific to a particular vegetation type, and class of animal and cannot be extrapolated to predict animal performance under different conditions, such as plant growth fluctuations within a season and between years. Models should therefore represent as wide a range of conditions as possible if it is to be useful for the farmer (Morris, Hardy and Bartholomew, 1999).

Veld condition assessment and monitoring

There are three main reasons for assessing veld condition (after Tainton, 1999):

1. to assess veld condition relative to its potential in a particular ecological zone. This information can be used by a farmer, for example, in determining the need to adjust the stocking rate on the farm or in a camp;
2. to assess the effects of the current farm management (i.e. stocking rate) on the veld condition, and to monitor changes in veld condition over time;
3. to classify the different vegetation types on a farm and to monitor their condition over time.

While there is recognised to be an agronomic and an ecological approach to veld condition monitoring, assessments using the ecological approach emphasise the long-term stability of the plant community and its ability to protect the soil from unacceptable rates of soil loss (Tainton, 1999).

Monitoring techniques vary according to the major vegetation types, viz. grassland, savannah and the Karoo. In the grassland, methods based on ecological principles are (after Hardy, Hurt and Bosch, 1999):

- the Benchmark method
- the Ecological Index method
- the Key Species method
- the weighted key species method.

The focus on the Benchmark method and the Ecological Index method is the classification of grassland plant species into categories that represent their behaviour under different grazing conditions (Hardy, Hurt and Bosch, 1999).

> *Decreaser species*: - species which predominate in good veld condition, but whose abundance declines when veld is either over-utilised (heavy grazing) or under utilised (little or no grazing and/or lack of burning at regular intervals).
>
> *Increaser I species*: - species *not* abundant in good condition veld, but whose abundance increases when veld is under-utilised (i.e. lack of fire and the veld succession proceeds beyond the fire-grazing climax).
>
> *Increaser II species*: - species *not* abundant in veld in good condition, but whose abundance increases when veld is over-utilised.
>
> *Increaser III species*: - species which are *not* abundant in veld in good condition but whose abundance increases when veld is selectively grazed.

In both these approaches, specialist knowledge is required to classify the species and there is the assumption that all species are equally sensitive to grazing pressure.

In the Key Species method, only species that are sensitive to grazing are used as an index to veld condition. In an application of this method to Highland Sourveld and Southern Tall Grassveld, three key species were recognised which could be used as an index of veld condition, viz. *Themeda triandra, Tristachya leucothrix* and *Hteropogon contortus*. The key species method has tremendous appeal in the grassveld because of its relative simplicity.

The veld condition score can be used to estimate current grazing capacity, using an agronomic approach and an ecological approach (Hardy, Hurt and Bosch, 1999). The ecological approach is to be preferred and could form a useful basis for estimating safe recommended stocking rates for a wide range of veld types in various condition classes (Hardy, Hurt and Bosch, 1999).

In the Karoo, a procedure known as the Ecological Index Method has been developed. It is ecologically based and, in broad terms, can assess the current condition and long-term trend of karoo veld and short grassveld in the Karoo (Vorster, 1999). It was developed specifically to monitor changes in the condition of veld in extensive areas and for the purpose of farm planning and decision making in veld management (Vorster, 1999). It is based on (after Vorster, 1999):

- the classification of plant species into ecological classes
- the allocation of a relative percentage of each ecological group, based on canopy spread (as a percentage of each ecological group)

The following ecological groups are recognised in the Karoo areas (after Vorster, 1999):

Decreaser species – those which dominate in veld in excellent condition (i.e. that community which is considered to be the most productive for the site and which is stable if well managed)

Increaser IIa species – those species which are rare in veld in excellent condition, but increase when veld is *moderately* over-grazed in the long-term Their relative frequency usually increases when that of Decreaser species declines.

Increaser IIb species – those species which are rare in veld in excellent condition, but increase in abundance as the veld is *heavily* over-grazed for an extended period. An increase in their abundance is associated with a decrease in Increaser IIa species

Increaser IIc species – those species which are rare in the veld in excellent condition, and increase when veld is *heavily* overgrazed for an extended period. Their numbers increase when the abundance of Increaser IIb species declines

Invader species – plants which are foreign to a given plant community, or which increase aggressively in the plant community where they occur naturally, but normally in only small numbers.

From an agro-ecological perspective, veld retrogression follows the pattern from excellent (climax grasses) through good to fair (subclimax grasses and relatively unpalatable karoo bushes and taller shrubs), fair to poor (perennial pioneer grasses and unpalatable karoo bushes and taller shrubs), poor to very poor (annual pioneer grasses and ephemerals) and very poor (extremely unpalatable and invader karoo bushes and tall shrubs). A veld condition index (VCI) is determined and compared against a veld benchmark (VBM) – which is the veld with the best possible botanical composition and cover. From this, veld condition trends can be established over time by monitoring the same sites at regular intervals (Vorster 1999). Note that the better (higher) the VCI, the higher the grazing capacity.

In Savannah, the assessment of the condition of the grass layer will follow the same procedures outlined under Grasslands (above). However the important characteristics of the woody component of savannahs which may need to be assessed include (after Tainton, 1999):

- the density of the woody component
- the species of woody plants and the density of key species (for example, useful browse species)
- the size distribution of the woody plants.

The term 'tree equivalent' (with tree defined as a 1,5m tall tree or shrub) can be used to express tree populations of different sites in a common currency, expressed as TE/ha.

For monitoring purposes, it is essential that the farmer has a clear objective of what he/she is wanting to monitor. For example, to establish the increase/decrease in a particular valuable browse species, seedlings of that species can be counted regularly over time.

The Grassveld, Karoo and Savannah vegetation types all require different techniques of veld condition assessment. Farmers should be able to demonstrate that veld condition has not deteriorated, from a particular benchmark or, if it has, that steps are being taken to ensure that the veld condition on the farm is not deteriorating or degrading.

Soil organic content

Because veld condition monitoring requires a certain expertise, it has been suggested that the organic content of soils could be a cheap, simple yet effective indicator of sustainable farm management practices. However, considering the multiple factors that may affect soil organic content besides grazing management, soil organic content should probably be used in conjunction with other methods of evaluation, at least until the farmer is acquainted with how soil organic matter correlates with veld condition on that particular site.

Soil organic matter is a key component in any ecosystem, the loss of which leads to a poorer soil structure, a decline in water infiltration and thus a decline in the water retention capacity and fertility of the soil, a corresponding increase in surface sealing and thus an acceleration of wind and water erosion (Snyman, 1999).

While the organic matter of soils in the semi-arid regions of southern Africa are inherently low (normally less than 2,5%), these levels decrease with veld degradation, soil cultivation and increased aridity (Snyman, 1999). Analysis of the organic carbon content within the upper 50mm layer of a fine sandy loam soil 15 years after an induced change in the veld condition from good to moderate to poor, declined by 20,5% and 32,5% respectively.

Once organic matter is lost from the soil, recovery to previous levels is slow with both carbon and nitrogen being required for restoration of the soil. The carbon originates mostly from decaying underground root material, but, in the absence of sufficient nitrogen, there is the possibility of rapid carbon loss from the soil (Snyman, 1999). In the arid and semi-arid regions of South Africa, dry matter production declines as veld condition declines resulting in less organic matter being added to the soil. Soil temperature will increase as cover declines (Snyman, 1999).

In attempting to reconcile the complex interactions between grazing and the organic matter content of the soil, Snyman (1999) quoting various sources, indicates that the most important factors which can contribute to a change in organic matter content, with or without grazing, include:

- the condition of the veld
- environmental factors such as soil water and soil temperature
- the grazing history of the veld (i.e. intensity and frequency of grazing) and the type of animal.

Again, Snyman (1999) quotes various sources that indicate that grazing intensity influences both the organic carbon and nitrogen content of soils but with inconsistent results. For example, a re-examination of sites in Zimbabwe after 17 years since the first analysis showed that at the end of this period, carbon and nitrogen were significantly lower on the communally grazed areas than the lightly grazed areas; other studies have reported that grazing increases both the organic carbon and nitrogen content of soil; while others have reported that grazing has no influence on either soil carbon or nitrogen.

At the GreenChoice – Grasslands Sustainable Livestock Forum (24 March 2009), Dick Richardson reported that his farm in the Vryburg area produced 25kg of beef per hectare in 2006 from camps with a soil carbon content of 0,7% and 4,1% in the sand and vlei areas of the farm, where the production per hectare in the same region using conventional methods was 9 – 13kg of beef per hectare. This difference was attributed to an improvement in the soil carbon content from 0% in the sand areas and 2,6% in the vlei areas between 2000 and 2006.

Intensifying Grassland Production – radical veld improvement

Veld intensification practices and procedures are those which are designed to increase the productivity of the land, above that achieved by the natural veld (Booysen, 1981(a)). More specifically, veld intensification is that procedure that increases the productivity of the land in terms of the quantity of grazeable and nutritive herbage produced per unit area of land. Veld intensification, also known as radical veld improvement (RVI) includes two procedures, namely veld fertilisation and veld reinforcement.

Veld fertilisation is only economically viable in climatic regions of greater than 625mm of rain per annum. The objective is to increase the yield of the herbage, the nutritive value and the acceptability of the herbage to the animal (Booysen, 1981(a)). While the application of nitrogen and phosphate fertilisers to grassveld in areas greater than 625mm rainfall per annum results in the production of herbage of increased quantity and improved nutrition value and acceptability (various sources quoted in Booysen, 1981(a)), there still remains the question of whether these benefits more than offset the cost of the operation. Farmers opting for any form of fertilisation would need to assess the economic benefits carefully, since a simple event like lower than average rainfall could negate the application of nitrogen and phosphate fertilisers. Unfortunately, fertilisation of grasslands can result in changes in the species composition of the veld, as well as a decrease in basal cover of the grasses. Basal cover is important to reduce rainfall run-off and thus soil erosion. Farmers adopting the practice of veld fertilisation should be in a position to monitor the effects of this practice not only in terms of economic return, but veld condition in general so that the long-term sustainability of the farm is not adversely affected. The practice should thus only be applied on level ground and, in the summer rainfall area, where average annual rainfall is in excess of 625mm (Booysen, 1981(a)).

While the objective of veld fertilisation is to increase soil fertility, the process of veld reinforcement aims to achieve higher levels of herbage production than the natural veld through the introduction into the veld of pasture species that are genetically predisposed towards greater herbage production. This is only feasible where both soil fertility and the moisture regime will permit the attainment of these high yields (Booysen, 1981(a)). Thus, veld reinforcement is only likely to be successful if it is accompanied by fertilisation in high rainfall areas. Irrigation in low rainfall areas is generally not successful, due to the costs and the relatively low productivity of reinforced veld.

The reinforcement system i.e. the techniques for applying seed (or sods) and fertiliser vary from simple to sophisticated and from inexpensive to costly. For example, over-seeding alone is the cheapest and least sophisticated, but success can be limited by a number of factors, while sod-seeding, which involves the removal of the indigenous plants in a strip, is economically expensive and sophisticated. Irrespective of the methods used for veld reinforcement, the maintenance of the reinforced veld can present serious management problems. For example, if the introduced plants fail to survive, then they can be replaced by low producing unpalatable species.

Radical veld improvement should only be practical where management interventions are possible that ensure the long-term future of the reinforced veld in the interests of sustainable farming.

Intensifying Grassland Production – cultivated pastures

Cultivated pastures are characterised by the complete removal of existing vegetation, soil disturbance and seedbed preparation. They may be sown as part of a rotation of crops in order to increase the productivity of the soil with the objective of replacing them after a predetermined period of time, and to return to the original, or another, crop – this is the classic crop rotation system where the one crop enriches the soil (e.g. through nitrogen fixation) for a different and subsequent crop. These are known as ley pastures. On the other hand, permanent pastures are cultivated pastures which have been established for an indefinite period of years (Booysen, 1981(b)).

For cultivated pastures to be successfully established, the following requirements are necessary (after Booysen, 1981(b)):

- in areas of less than 600mm of rainfall, pastures must be irrigated
- in areas of between 600 – 700mm of rainfall, pastures can be readily established, but productivity can be significantly increased if supplementary irrigation is available during low periods of precipitation
- in areas of greater than 750mm of rainfall, there is usually sufficient rainfall to ensure sustained high production on dryland sites
- a deep soil profile is not a requirement as pasture crops are relatively shallow rooted; however in annually cultivated crops, a deep soil is important
- cultivated pastures can be developed on slopes of up to 15%.

Site selection is the first critical step in the process of cultivated pasture establishment. Both the landscape position and the soil series of the site determine the type of pasture to be established, the appropriate pasture species and the technique of improvement that should be adopted (Booysen, 1981(b)).

Edwards and Scotney (1978) grouped the over five hundred soil series of the National Soil Classification system into soil groups for pasture use. The soil groups so derived are also rated for their production potential under optimal levels of fertilisation, and for their erodibility. Other factors taken into account are the landscape position, diagnostic top-soil horizon, dominant colour and sub-soil drainage.

Ultimately, the soil groups for pasture used gave five potential classes for pasture establishment; viz. very high potential, high potential, moderate potential, low potential and very low potential. Edwards and Scotney (1978) also stress that the basic erosion hazard of the soil class should be considered when planning land development as it plays a role in determining sites, techniques and plant species selected, as well as conservation measures needed.

Site preparation needs to consider run-off and erosion, with the steepness of the land being the main consideration for the control of excess run-off and the encouragement of infiltration of water. Contour walls, terracing and broad strips of creeping or sod-forming grasses are the most popular means, depending on the slope of the land. The sub-soil is also important as impermeable types prevents deep percolation water and causes the top-soil to become water-logged (Booysen, 1981(b)).

Seed-bed preparation is one of the essentials to obtain a good stand of pasture crop. The methods adopted vary considerably due to climate and soil type, but, in general terms, it appears that soil must be ploughed a few months prior to seeding to ensure good surface tilth and to allow breakdown of plant material from previous crops.

Other considerations that a farmer should take into account are the methods of seeding the cultivated pasture, the depth of sowing, the time of sowing, the rate of sowing and the desirability of sowing mixed as opposed to single-species pastures. Each farming situation needs to be considered in relation to the site taking into account the profitably as a major factor.

The cultivated pasture system, while not being a natural system, still has the structural and functional attributes that characterise a natural ecosystem. The difference is that they are manipulated to achieve a high growth rate and a high producing system. High growth rates require high rates of energy and nutrient flow, which requires high nutrient inputs into the system (Booysen, 1981(c)). The development of an economic and efficient fertilisation programme is essential for the establishment and maintenance of cultivated pastures. Landowners need to understand the interactions between the major fertilisers, the soil and the specific pasture crop. Pasture establishment is a costly process, and, once established, the pasture should be maintained in a productive condition. The maintenance fertilisation programme is important in determining the productivity of the pasture, and will depend on whether it is harvested as green feeding, hay or ensilage, or whether it is grazed by livestock.

Not only is the correct application of fertiliser important for maintenance of the pasture, but excessive application is costly and can lead to excess fertiliser being washed into adjoining rivers with associated environmental impacts.

In concluding this section of the guideline document, it is again clear that, given the range in biome types, soil health, rainfall, animal types, stocking rates and others, farmers are faced with complex interactions, some of which are beyond their control. It is imperative that farmers should apply best management practices appropriate to their areas which incorporate a knowledge of the various grazing systems, veld condition assessments, stocking rates and the need to ensure effective recycling of plant (and animal) remains that improve or maintain the health of the soil.

When it comes to intensification of grassland production, farmers should be in a position to demonstrate an understanding of this complex practice, particularly the rates of fertiliser application (as well as efficient irrigation if appropriate).

Indicator

3.3.4 Plant and animal diseases are prevented and controlled.

The Agricultural Pests Act 36 of 1993 provides for the control and prevention of plant diseases, which may require a farmer to destroy crops to prevent the spread of the disease. Farmers are also required to notify the local department of agriculture if flying locusts arrive and/or deposit eggs, or if breeding swarms of red-billed queleas are present (section 5).

There are many regulations published under this Act that would affect farmers. For example:

- prohibition relating to the occurrence and removal of certain pathogens and insects
- prohibition relating to the keeping, planting or cultivation of certain plants
- obligation relating to the cleansing or destruction of certain plants
- regulations relating to cotton
- control measures relating to honeybees
- regulations relating to imports

Where chemicals are used for pest and disease control, those with the least impact on human health and the environment should be selected. In particular, chemicals that contaminate ground and surface water should be avoided. Manufacturers' specifications must be strictly adhered to. Only chemicals that have been registered for the control of a particular weed, pest or disease may be used. Organised farming sectors should establish a list of approved chemicals that their sector members may use.

A useful website for farmers has recently been launched – Pests of Field Crops in Southern Africa (www.pestsandcrops.com) – which contains information on pest identification, life cycles, damage and control. The focus is primarily on field crops and also provides an answering service for enquiries.

The Animal Health Act 7 of 2002 was promulgated to, *inter alia*, promote animal health and to control animal diseases and to regulate the importation and exportation of animals. Of particular relevance to landowners involved with the farming of domestic animals or wildlife are the following:

- No person may export any animal from the Republic unless in possession of an export certificate (section 8).
- No person may import any animal into or convey any imported animal through the Republic unless in possession of a permit (section 9).
- The government may erect fences, gates, grids etc. on any land to prevent movement of animals into or out of such land (section 12); a landowner may be issued with directive to ensure compliance with the Act.
- Animal health schemes may be established in respect of any controlled purpose or for the improvement of animal health (section 16). **NB** Controlled purpose is defined in the Act and effectively refers to the prevention or combating or control of an outbreak, or the spreading, or the eradication, of any animal disease.
- Any landowner of land on which there are animals must take all reasonable steps to (section 17):
  - prevent infection of his/her animals with any animal disease
  - prevent the spreading of any animal disease
  - eradicate any animal disease or parasite on his/her land or in respect of the animal
  - apply the prescribed treatment to any infected animal
  - report the incidence of any controlled animal disease to the national executive officer and the provincial executive officer. NB Controlled animal disease is any animal disease prescribed to be a controlled animal disease for the purpose of this Act, or not indigenous to the Republic.
- The Minister may make regulations regarding the designation of specified animal diseases, the designation of specified areas as control areas, the application of veterinary procedures, the movement of any animal, the hunting, shooting capture and disposing of game and others.

Landowners need to be aware of any control measures applicable to their particular area, and to be able to demonstrate compliance with these particular control measures.

Indicator

3.3.5 Acquisition and use of agricultural remedies and fertilisers is controlled.

Agrochemicals include all herbicides, fungicides, insecticides, nematicides, biocides, and plant growth regulators used in agriculture. Many of these compounds have the potential to be harmful not only to man, but to the environment if not used responsibly.

Legislation controls the manufacture, registration, importation, packaging, labelling, storage, transport, disposal, handling and application of agrochemicals. The principal pieces of legislation are the Fertiliser, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947 and the Hazardous Substances Act 15 of 1973. It is the responsibility of every farmer who uses any form of agrochemical to be familiar with the precautions necessary to ensure that a product is safely stored and applied, and that chemical residues and containers are disposed of correctly.

Prohibition of certain agricultural remedies

Farmers are prohibited, in terms of the Fertilisers, Farm Feeds and Agricultural Stock Remedies Act 36 of 1947 from acquiring and using agricultural remedies that contain:

- 2,4-D (dimethylamine salt)
- 2,4-DB (sodium salt)
- Dicambia (dimethylamine salt)
- any other salts or esters of 2,4-D (except APM salt) on farms in certain magisterial districts of KZN

The aerial application of agricultural remedies listed above, as well as any agricultural remedy containing 2,4-D (iso-acytl esther), NCPA (potassium salt), MCPM (sodium salt), any salts or esters of triclopyr or salts of dicamba is prohibited in KwaZulu Natal.

Farmers are prohibited from acquiring, selling, disposal or using any agricultural remedy containing chlorobensilate while the sale and use of fertiliser “Super phosphate + Cu” is prohibited in KwaZulu Natal and Mpumalanga.

Storage of agrochemicals and fertilisers

The buildings or storerooms where agrochemicals are kept need to be of sound construction, well ventilated and secure, and have adequate warning signs posted. Highly Toxic Group 1 poisons, in terms of the Hazardous Substances Act, need to be secured in a separate, locked storage area. No agrochemical may be stored near food or animal feed and the building or storeroom must not be accessible to unauthorised people. Normal safety requirements must be available e.g. water and washing facilities, fire fighting equipment and any other special requirements specified on the product label. The storage area must be easily drained and a sealed sump constructed where spillage can be collected.

Application of fertiliser and agrochemicals

To ensure the correct type and quantities of fertiliser, soil samples should be taken at regular intervals. Calibration of fertiliser equipment, placement of fertiliser application all affect crop performance and farmers should pay special attention to their management as over-fertilisation can lead to an impact on the soil and lead to acidification and nutrient imbalance.

Agrochemicals must be applied under the conditions and in the manner specified on the product label. These would typically include the concentration or application rate, the target crop, correct time (crop stage) and under the correct weather and soil conditions.

After application, washing of equipment must be done in a manner that avoids contamination of soil and water.

Disposal of containers and unused chemicals

The disposal of product containers must be carried out in a responsible manner. The containers of highly toxic Group 1 poisons must be returned to the supplier for safe disposal. Other containers may be disposed of on the farm, but must be perforated and rendered unusable after draining and triple rinsing.

All disposal pits should be away from human habitation, preferably in a heavy clay soil and positioned in such a manner that leachate from the pit would not contaminate water sources. (See also 3.2.5.)

Indicator

3.3.6 The development, production, release and use of genetically modified organisms is strictly controlled through the adoption of the precautionary principle.

Since the 1970s, recombinant DNA technology (the ability to transfer genetic material through biochemical means) has allowed the genetic modification of plants, animals and micro-organisms and the introduction of a diversity of genes into living organisms, including genes from unrelated species (Glazewski, 2000). Genetically modified organisms (GMOs) have evoked safety and ethical concerns around risks to human health and biodiversity, with the Convention on Biological Diversity (1992) providing in Article 19(3) that each contracting party to the Convention (South Africa being a contracting party) shall, as far as possible and as appropriate:

> "Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from bio-technology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking into account the risks to human health".

In South Africa, this requirement of the CBD has been addressed in the Genetically Modified Organisms Act 15 of 1997, which came into effect on 1 December 1999. The Act is administered by the Department of Agriculture and applies to the following situations (Section 2(1)(a) – (c)):

- the genetic modification of organisms;
- the development, production, release, use and application of GMOs (including viruses and baceteriophages; and
- the use of gene therapy.

Section 2(2)(a) – (c) stipulates that the Act does *not* apply to the following three techniques:

- those involving gene therapy (equivalent to human cloning);
- those in which recombinant DNA molecules or GMOs are not employed; that is:
  - in *in vitro* fertilisation in humans and animals;
  - in conjunction, transduction, transformation, or any natural processes; and
  - in any polyploidy induction;
- those in which GMOs as recipient or parental organisms are not employed:
  - in mutagenesis;
  - in the construction and use of somatic hybridoma cells; and
  - in cell fusion (including protoplast fusion) of plant cells.

The definition of a GMO (section 1(xiii)) is

> "…. an organism the genes or genetic material of which has been modified in a way that does not occur naturally through mating or natural recombination of both, and 'genetic modification' shall have a corresponding meaning."

It is important to note that the Act defines "organism" as (section 1(xx))

> "…. A biological entity, cellular or non-cellular, capable of metabolism, replication, reproduction or of transferring genetic material and includes a micro-organism."

In order to ensure a degree of independence in the decision making process, the Act establishes three administrative institutions. The first is the Executive Council for Genetically Modified Organisms, made up mostly of government departments (including DEAT). The objectives of the Council are to advise the Minister on "all aspects concerning the development, production, use, application and release of GMOs, and to the development, production, use, application and release of GMOs are performed in accordance with the provisions of this Act" (section 4).

The Council's powers and duties centre around the issue of permits to persons who have applied for a permit to use facilities for the development, production, use or application of GMOs, or to release GMOs into the environment (section 5(a)). Any application may be required to submit a risk assessment and environmental impact assessment of the development, production, use, application or release, as the case may be (section 5(a)). In addition to the GMA Act, the National Environmental Management Act 107 of 1998 has published regulations (GN R386 in GG 28753 of 21 April 2006 and amended by GN R613 in GG 28938 of 23 June 2006) that identify activities in terms of section 24(2)(a) and (d) of this Act, which may not commence without environmental authorisation and in respect of which an investigation, assessment and communication of the potential impact must follow the procedures of the environmental impact assessment regulations described in Regulations 22 to 26. Those listed activities include the release of GMOs in instances where assessment is required by the Genetically Modified Organisms Act 15 of 1997 or the National Environmental Management: Biodiversity Act 10 of 2004. Importantly, the EIA Regulations only focus on the "release" of GMOs, while the GMO Act deals with the development, production, use *and* release of GMOs.

The second administrative institution is the Registrar, whose function is to issue permits and other related functions (section 9).

The third administrative institution is a scientific Advisory Committee (section 10) which, by its very nature, is an advisory body that bases its decisions on scientific data. It is made up of "knowledgeable persons in the fields of science applicable to the development and release of GMOs", as well as "persons from the public sector who have knowledge of ecological matters and genetically modified organisms" (section 10). The functions of the Advisory Committee are to advise the Minister and the Council on various matters concerning GMOs.

Regulations published under the GMO Act by the Department of Agriculture[25] impose permit requirements in that no person may import, export, develop, produce, use and apply GMOs without authorisation; and makes provisions for risk assessment registration and maintenance of records, public notice of trials, accidents, management of waste and others.

[25] R1420 in GG NO 20643 on 26 November 1999.

Importantly, the Act supports the precautionary principle in section 17(1) in providing:

> "Users shall ensure that appropriate measures are taken to avoid adverse impact on the environment which may arise from the use of genetically modified organisms."

Furthermore, section 17(2) adds that:

> "The liability for damage caused by the use or release of a genetically modified organism shall be borne by the user concerned: Provided that when such an organism was in the possession of an inspector as set out in section 15(4), the user concerned at the time of such release shall not be held liable for any damage unless such user foresaw or should have foreseen such damage and could or should have prevented the damage but failed to take reasonable action to prevent such damage."

Interestingly, the term user is widely defined as "….any natural or legal person or institution responsible for the use of genetically modified organisms and includes an end user or consumer (section 1(xxviii) Definitions).

It is clear then that South Africa has established the means to regulate, manage or control the risks associated with the use and release of GMOs, but despite this, there is still strong public sentiment against the use of GMOs.

In a position statement issued in May 1999 and revised in May 2001, WWF International (www.panda.org) indicated that alien genetic material "can trigger changes in species' adaptability and relationships, altering the natural balance and affecting established ecosystem processes which are essential to a stable environment.... The release or escape of GMOs into the general environment further threatens the declining natural resource". This issue, and others, are further spelt out in the "Background Paper on the need for a Biosafety Protocol as part of the Convention on Biological Diversity" (WWF International, 1995). See also *Genetically Modified Organisms (GMOs): A danger to sustainable Agriculture. A contribution by WWF Switzerland to the international public debate. November 2003*. The report analyses the current critical issues concerning the GMO debate in Europe and reputedly gives the reader enough information on which to make an informed position. It does not discuss what will be done and how it will be done.

With so much at stake, WWF International has adopted the precautionary approach to the use and release (escape) of GMOs into the wild, and as an organisation, seeks:

- a moratorium on use or release of GMOs into the general environment until ecological interactions are fully researched and safeguards put in place;
- transparent, comprehensive environmental impact assessment of planned releases into the environment, to include consideration of the impacts of changing crop management practices, as well as the invasion of natural and semi-natural habitats or competitive displacement of native species by transgenic plants and animals;
- avoidance of additional impacts through genetic modification which:
  - facilitate or stimulate greater use of chemicals;
  - harm pest controlling and other locally beneficial insects associated with crops;
  - lack safeguards against gene flow into native organisms;
  - use artificially constructed genes (whose effects are harder to predict and control);
- control of gene technology, including government regulation and the establishment of independent statutory authorities, scientific and community assessment, and effective

monitoring of the use and spread of GMOs, including effects on different habitats and species, and on human health and livelihoods; and
- recognition of the role of traditional knowledge in crop breeding and appropriate benefit sharing.

WWF will:

- alert governments, aid agencies, industry and the public to both good and bad practices as it impacts on WWF's mission to protect and enhance the environment and sustainable livelihoods;
- support moratoria on the use and release of GMOs in crops until there is wide consensus that research on ecological impacts has been completed and evaluated, and risks identified to being acceptably low;
- support calls for eco-labelling to promote consumer awareness and informed decision-taking.

Landowners exploring the concept of the use of GMOs, need to be aware of both the local legislative requirements, as well as the international debate around the use of GMOs. The use of sustainable farming principles should mitigate the need for the use of GMOs as a first step to improving productivity and adapting to climate change.

CONCLUDING REMARKS

The development of the Reference for Well-Managed Farms had the benefit of exposure to four stakeholder meetings. Each time, attention was drawn to omissions in the current draft. It is hoped that this final draft encompasses all of those omissions, bearing in mind that this is a generic system which will guide the development of sector specific verifiers, and even the expansion of the indicators to more accurately reflect the particular farming practice. It should also be noted that this is a living document that will undergo future review and amendments.

It is hoped that this Reference will provide guidance towards a more sustainable agricultural future, one that allows for the conservation of biodiversity and ecosystems in the agricultural landscape. There is currently a lack of indicators to assess the effectiveness of any conservation agricultural initiatives. This Reference could be a first step towards providing indicators of success. Further, it is hoped that the Reference will promote understanding of the value farmers place on ecosystems, as it is this value that will conserve the integrity of ecosystem services and the diversity of species that drive them the farm's needs and value systems Edwards and Abivardi (1998).

When adapting these generic guidelines for emerging growers in South Africa, cognisance should be taken of the fact that many of the social issues, for example, are based on the law of the land. The general environmental principles should however apply at whatever scale of farming is being considered.

Finally, the success, or otherwise, of this Reference is only likely to contribute to sustainable agriculture if they are actually implemented through their adaptation to specific agricultural industries, and any changes are monitored over time.

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ABBREVIATIONS / ACRONYMS

BCEA	Basic Conditions of Employment Act
CALM	Carbon Accounting for Land Managers
CARA	Conservation of Agricultural Resources Act 43 of 1983
CLA	Country Land and Business Association
CO_2e	Carbon dioxide equivalent
DEAT	Department of Environmental Affairs and Tourism
DoA	Department of Agriculture
FSA	Forestry South Africa
FSC	Forest Stewardship Council
IFOAM	International Federation of Organic Agricultural Movements
ILO	International Labour Organisation
LDS	Livestock Development Strategy
LTMS	Long Term Mitigation Scenario
NBSAP	National Biodiversity Strategic Action Plan
NEMA	National Environmental Management Act 107 of 1998
NEM:BA	National Environmental Management: Biodiversity Act 10 of 2004
NSBA	National Spatial Biodiversity Assessment
PC&I	Principles, Criteria and Indicators
PES	Payment for Ecosystem Services
RTRS	Round Table on Responsible Soy Association
SUPAR	Sustainable Utilisation and Protection of Agricultural Resources Bill
SuSFarMS	Sustainable Sugarcane Farm Management System
ToPs	Threatened or Protected Species
WESSA	Wildlife and Environment Society of South Africa
WWF	World Wide Fund

DEFINITIONS

Definitions can be found in all the legislation. However, for sake of convenience, the following commonly used definitions, taken from appropriate legislation, are provided.

agricultural remedy	any chemical substance or biological remedy, or any mixture or combination of any substance or remedy intended or offered to be used – (a) for the destruction, control, repelling, attraction or prevention of any undesired microbe, alga, nematode, fungus, insect, plant, vertebrate, invertebrate, or any product thereof, but excluding any chemical substance, biological remedy or other remedy in so far as it is controlled under the Medicines and Related Substances Control Act 101 of 1965, or the Hazardous Substances Act 15 of 1973; or (b) as plant growth regulator, defoliant, dessicant or legume innoculant ….. (FFFARSR Act 36 of 1947)
altering the bed, banks, courses or characteristics or a watercourse	the temporary or permanent alteration of a watercourse for – (a) prospecting, mining and quantifying; (b) agriculture; (c) management of waste disposal sites; and (d) construction and maintenance purposes of infrastructure such as – (i) roads, footpaths, bridges, culverts ….; (ii) artificial recharge structures (iii) boreholes and well points (iv) structures for water abstraction (v) structures for routing water supply and other pipelines (vi) structures for creation of pools, bays and peninsulas (vii) telecommunications or power cables (viii) ….. (ix) structures for slope stabilisation and erosion protection (NWA 36 of 1998 section 21(i), GN 398, GG26187 of 26 March 2006, section 2.6)
biological diversity or biodiversity	the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species and of ecosystems (NEM: Biodiversity Act 10 of 2004)
competent authority	the organ of state charged in terms of NEMA 107 of 1998 with evaluating the environmental impact of the activity and, where appropriate, with granting or refusing an environmental authorisation in respect of that activity (NEMA 107 of 1998)
diverting flow	the temporary or permanent diversion of flow for – (a) prospecting, mining or quarrying; (b) agriculture; (c) management of waste disposal sites; and (d) construction and maintenance purposes of infrastructure such as

	– (i) …. roads, footpaths, bridges, culverts ….; (ii) artificial recharge structures; (iii) boreholes and well-points; (iv) structures for water abstraction; (v) structures for routing water supply and other pipelines (vi) structures for creation of pools, bays and peninsulas (vii) telecommunications or power cables (viii)structures for slope stabilisation and erosion protection (GN 398, GG26187 of 26 March 2006, section 1.6)
ecosystem	a dynamic system of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit (NEMA 107 of 1998)
environmental authorisation	the authorisation by a competent authority of a listed activity in terms of the National Environmental Management Act 107 of 1998
family member	a labour tenant's grandparent, parent, spouse (including a partner in a customary union, whether or not the union is registered), or dependent (Land Reform (Labour Tenants) Act 3 of 1996)
farm worker	an employee who is employed mainly in or in connection with farming activities, and includes an employee who wholly mainly performs domestic work in a home on the farm (Basic Conditions of Employment Act 75 of 1997)
farm worker	a person who is employed on a farm in terms of a contract of employment which provides that (a) in return for the labour which he or she provides to the owner or lessee of the farm, he or she shall be paid predominantly in cash or in some other form of remuneration, and not predominantly in the right to occupy and use land; and (b) he or she is obliged to perform his or her services personally (Land Reform (Land Tenure) Act 3 of 1996)
Impeding or diverting the flow of water in a watercourse	the temporary or permanent abstraction or hindrance to the flow of water into a watercourse by structures built either fully or partially in or across a watercourse including – (a) bridges and culverts; (b) weirs which are capable or impounding or storing water; (c) boreholes and well-points; (d) structures for water abstraction; (e) structures for routing water supply and other pipelines (f) telecommunications or power cables (g) mooring sites, other anchorage facilities and slipways (NWA 36 of 1998 section 21(c) and GN 398, GG26187 of 26 March 2006, section 1.6)
invader plant	means a kind of plant which has under section 2(3) of the Conservation of Agricultural Resources Act 43 of 1983 been declared an invader plant …..
invasive species	any species whose establishment and spread outside of its natural distribution range – (a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and

	(b) may result in economic or environmental harm or harm to human health (NEM: Biodiversity Act 10 of 2004)
labour tenant	a person (a) who is residing or has the right to reside on a farm: (b) who has or has had the right to use cropping or grazing land on the farm, referred to in paragraph (a) , or another farm of the owner and in consideration of such right provides or has provided labour to the owner or lessee; and (c) whose parent or grandparent resided or resides on the farm and had the use of cropping or grazing land on such farm or another farm of the owner, and in consideration of such right provided or provides labour to the owner or lessee of such or such other farm, including a person who has been appointed a successor to a labour tenant in accordance with the provisions of section 3(4) and (5) in the Land Reform (Labour Tenants) Act 3 of 1996, but excluding a farm worker
listed activity	an activity identified in terms of section 24(2)(a) and (d) of NEMA 107 of 1998, i.e. (a) activities which may not commence without environmental authorisation from the competent authority (d) individual or generic *existing* activities which may have a detrimental effect on the environment and in respect of which an application for an environmental authorisation must be made to the competent authority (NEMA 107 of 1998)
listed ecosystem	any ecosystem listed in terms of section 52(1) of NEM: Biodiversity Act i.e. an ecosystem that is threatened and in need of protection
National agricultural resources	the soil, the water sources and the vegetation, excluding weeds and invader plants (CARA 43 of 1983)
occupational disease	any disease mentioned in the first column of Schedule 3 of the Compensation for Occupational Injuries and Diseases Act 130 of 1993 arising out of and contracted in the course of an employee's employment
occupational health	includes occupational hygiene, occupational medicine and biological monitoring (OHS Act 85 of 1993)
sectoral determination	a sectoral determination made under Chapter Eight of the Basic Conditions of Employment Act 75 of 1997
virgin soil	land which in the opinion of the executive officer has at no time during the preceding ten years been cultivated (CARA 43 of 1983)
waste	any matter, whether gaseous, liquid or solid or any combination thereof, which is from time to time designated by the Minister by notice in the Gazette as an undesirable or superfluous by-product, emission, residue or remainder of any process or activity (ECA 73 of 1989)

	Waste has been further defined in GN 1986 GG 12703 of 24 August 1990 and amended by GN 292 GG 24938 of 28 February 2003 as follows: An undesirable or superfluous by-product, emission, residue or remainder of any process or activity, any matter, gaseous, liquid or solid or any combination thereof, originating from any residential, commercial or industrial area, which – (a) is discarded by any person; or (b) is accumulated and stored by any person with the purpose of eventually discarding it with or without prior treatment connected with the discarding thereof; or (c) is stored by any person with the purpose of recycling, re-using or extracting a usable product from such matter, excluding – (i) water used for industrial purposes or any effluent produced by or resulting from such case …. (ii) any matter discharged into a septic tank or French drain sewerage system ….. (iii) any radio-active substance ….. (iv) any minerals, tailings ….. (v) ash produced ….. for generation of electricity …..
waste	Includes any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, compaction or manner as to cause, or to reasonably likely to cause, the water resource to be polluted. (NWA 36 of 1998 section 1)
waste	Means any substance, whether or not that substance can be reduced, reused, recycled and recovered, that – (i) is surplus, unwanted, rejected, discarded, abandoned or disposed of; (ii) the generator has no further use of – for purposes of production, reprocessing or consumption; (iii) that must be treated or disposed of; or (iv) is identified as waste by the Minister, provided that a by-product shall not be considered to be waste and provided further that any portion of waste once reduced, reused, recycled and recovered ceases to be waste. (NEM: Waste Act 2009).
water course	a natural flow path in which run-off water is concentrated and along which it is carried away (CARA 43 of 1983)
watercourse	(a) a river or natural spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which or from which, water flows; and (d) any collection of water which the Minister may, by notice on the Gazette, declare to be a watercourse and a reference to a watercourse includes, where relevant, its bed

	and banks (NWA 36 of 1998)
water resource	includes a watercourse, surface water, estuary or aquifer (NWA 36 of 1998)
water use	(a) taking water from a water resource; (b) storing water; (c) impeding or diverting the flow of water in a watercourse; (d) engaging in a stream flow reduction activity (i.e. afforestation); (e) engaging in a controlled activity (i.e. irrigation of land with waste; modification of atmospheric precipitation; intentional recharging of an aquifer with waste); (f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; (g) disposing of waste in a manner which may detrimentally impact on a water resource; (h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process; (i) altering the beds, banks, course or characteristics of a watercourse; (j) removing, discharging or disposing or water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and (k) using water for recreational purposes. (NWA 36 of 1998 section 21)
wetland	land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil (NWA 36 of 1998)