MILK SA

Sustainability in the SA dairy Industry: A Status and Progress Report

Approved by the Milk SA Board of Directors

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Executive summary

The report on sustainability is structured according to the FAO-IDF Dairy Declaration of Rotterdam (DDoR) and the Dairy Sustainability Framework (DSF), which endorses the UN 2030 Agenda for Sustainable Development and provides guidelines for sustainable development. The report in particular pays attention to (1) environmental integrity as it pertains to greenhouse gas (GHG) emissions, soil health and nutrient supply, waste management, water quality and quantity, and biodiversity; (2) socio-economics in terms of market development, rural stability and farm worker conditions; (3) dairy product quality and safety, and (4) animal care.

Measurements show that GHG emissions of dairy cattle is 10% of the ca 30 000 Gg CO_2 eq/annum for all livestock in the country and 1.3 to 1.5 kg CO_2 eq/kg milk, which compares favourably with prominent dairy producing countries. Since 1990, the number of cows has declined by 24 % while total milk production has increased by 56 %. This implies that efficiency has improved, and GHG emissions, waste and water use per unit product have declined. A more effective way of reducing GHG is to sequester atmospheric CO_2 into soils which can be achieved with regenerative and conservation driven agriculture methods. These methods can also improve soil quality and carbon stocks substantially. In an experiment on soil analysis from Swellendam to Humansdorp, soils from kikuyu-ryegrass systems and shallow tilled soils recorded carbon contents of 50.3 kg C/m^3 and 54.3 kg C/m^3 respectively, vs only 34.6 kg C/m^3 for deep tilled (conventional) soils. In the Tsitsikamma it has been shown that carbon sequestration can nullify GHG emissions although much work is still required on many farms.

Healthy soils support proliferation of soil microbes and nutrient cycling, in turn supporting sustainable production and reduced costs associated with fertilizer application. Generally, an improvement of 1% carbon in the upper 30 cm soil will coincide with atmospheric N fixation of 25 kg. If soil health is also improved, turnover will increase and more NH_4–N which results from chemical fertilizer, and otherwise will be converted into the GHG N_2O, can be utilized to the benefit of plant growth. The N and P use efficiency on pastures in the Eastern Cape was 29 and 36% respectively which compares favourably with figures elsewhere in the world. It should be noted that the variation from farm to farm is substantial (in the vicinity of seven-fold), which suggests that further input into research, extension and training is required.

Waste is of concern from pre-farm gate through to dairy processing plants. Most dairy farms have waste disposal and sewage systems that allow them to use the solids as fertilizers and the water either in irrigation or to recycle for cleaning. Some of the large dairy processing companies have waste reduction and water cleaning operations, some of which generate CH_4 for electricity generation, whilst the purified water is recycled for cleaning operations. The best route for disposal or reuse of industrial waste depends on specific characteristics of the waste stream. In recent years there has been development in the ability of dairy processors

to collect and harness the economic value of various waste streams, which ultimately also drives more environmentally sound methods of disposal. The threat which plastic pollution poses to the environment remains a topic of concern. South Africa is fortunate in that it has a fairly robust plastic recycling industry which contributes to the ability of dairy operations to divert this form of solid waste from landfill disposal sites. Cross-contamination of packaging with dairy product waste remains a limiting factor which can devalue the material before being received by recyclers. This highlights the need for efficient 'at source' separation of waste which has become a standard practice for dairy processors.

Water is a finite and vulnerable resource and must be dealt with responsibly, both as it applies to quantity and quality. Recent developments and initiatives around water in the South African Dairy Sector are steadily contributing towards creating a culture of circularity and sustainability. A water stewardship program has been introduced by the MPO in collaboration with the WWF-SA, encouraging innovative initiatives in water management, ecosystem protection, recycling, and effluent treatment in dairy factories. Participation by several processors and farmers in this initiative over the past year indicates that water is a growing concern in the sector and that the program has established a platform for knowledge-sharing. A second initiative is to develop best practice guidelines for determining aquatic and wetland buffer zones for dairy farms, and a third one is to establish minimum water requirements of forage species. The latter aims to compare and calibrate different irrigation scheduling systems of different pasture mixes for various topographic, soil and climatic conditions under normal and restricted water conditions.

South Africa is a country with a rich endowment of natural resources, which include its biodiversity and ecosystems. The National Biodiversity Strategy and Action Plan (NBSAP) is responsible to fulfil the objectives of the Convention on Biological Diversity (CBD). With the adoption of the CBD's Strategic Plan for Biodiversity, the NBSAP has outlined a path to ensure that the management of biodiversity assets and ecological infrastructure continue to support South Africa's development path and play an important role in underpinning the economy. As the demand for agricultural products has increased, driven by the nutritional needs of a growing population, the importance of developing a biodiversity-based agricultural system to ensure future sustainability should be regarded as a key driver for the Industry. Dairy farms across South Africa have widely undertaken (although still not always to a formal extent, especially among smaller-scale farmers) to integrate biodiversity-conscious approaches in their businesses. The vast costs involved in repairing damaged soils are understood and therefore the benefits in monitoring soil health, structure, nutrients and biological activity are recognised. In general, therefore, the dairy industry supports the vision and strategies of the NBSAP.

The dairy industry is one of the most deregulated industries in the world. The industry is not subject to any statutory intervention in the production and marketing of its products aimed at managing or influencing the supply and demand of unprocessed milk and dairy products,

and it is not supported by government subsidies. A totally free and competitive dairy market prevails which creates a very dynamic industry that continuously adapts to the changing needs of consumers and industrial users. However, this results in other challenges which require sophisticated and continuous analyses of market signals and the collection of information, also from consumers. Consumers and dieticians are also trained and informed through a Consumer Education Project which has received accolades by the International Dairy Federation (IDF). Various important markets have been identified with the potential of serving as trading partners, with the Sub-Sahara African market perhaps being the most prominent, especially as an export market.

In rural development the core emphasis is to promote competitive, profitable, and sustainable existing black and new enterprises by contributing to the reduction of commercial venture constraints. The initiative is aligned with the South African developmental priorities, namely food security, poverty reduction, promoting equitable economic transformation and contributing to general economic development and growth. Skills and knowledge development are supported by Milk SA to ensure the continuation of an appropriate skills and knowledge dispensation. In the context of rural economy development, Milk SA's Skills & Knowledge Development Program supports training at new and black-owned dairy enterprises. However, the rural dairy economy is not only supported by the organized dairy industry through Milk SA, but also by several provincial departments associated with agriculture which drives entrepreneurial programs and training. There is a need to measure the impact of training in the formal and informal markets. This coincides with a need to measure the impact of subsistence/smallholder dairy farming on the rural economy. Such an initiative could provide a measure of success of general empowerment.

Working conditions in the Dairy Industry, as in other industries, are informed by several Acts associated with the Bill of Rights of the National Constitution. These provide regulations and guidelines for the right of freedom of association of both the employer and employee, the protection of employers and those seeking employment, the protection of the rights of employees, the organizational rights of employees such as access to the workplace by a representative of the trade union, collective bargaining rights, the right of employees to strike and the right of an employer’s recourse to lockout, unfair dismissal and unfair labour practices. Employers in the dairy industry should commit themselves to the following, if they have not done so already:

- Comply with the conditions legislated for fair labour practice.
- Contribute to employee unemployment benefits.
- Contribute to the skills development of employees.
- Provide for compensation of death or disablement resulting from occupational activities.
- Provide for the safety and health of the employees at work.
- Uphold the rights of labour tenants and farm occupiers to reside on land and to acquire land where appropriate.
- Ensure that recreational areas on the farm are available.

- Participate in actions towards establishment of a sustainable local economy.

In terms of product quality and safety, the dairy quality and safety initiatives of Milk SA are the responsibility of the Dairy Standard Agency (DSA), a non-profit company established by the industry. The DSA monitors and supports procedures to ensure product compliance with product composition and food safety standards. Promotion of compliance with standards relating to milk and other dairy products is a demanding and multi-dimensional task which the DSA fulfils. Complexity through regulations relating to product composition, food safety, animal health, animal feed, milking parlours, transportation of milk, processing plants and storage, all of which are regulated by different Acts (also managed in different government departments), requires careful monitoring. In terms of its mandate the DSA has progressively moved to a landscape where today it is well-recognised by the respective government bodies, the organised primary and secondary dairy industry and other stakeholders, for example national consumer bodies and the retail sector. The DSA has the capacity to maintain successful milk and dairy product monitoring programs; maintain a remedial action program for regular contraveners of legal standards; identify non-conformances in the industry in respect of milk and other dairy products; and maintain an effective communication program with all stakeholders concerned. The lack of a harmonised (standardised) system at national level for the calibration of laboratory instruments for the measurement of fat, protein, lactose, milk urea nitrogen, somatic cell count, and other quality parameters of milk, also created a need for the DSA to initiate a national independent laboratory service. Expansion to the services and tests provided by the DSA are continuously evaluated. To that effect methods of analyses need to be developed or compared, a recent example being a comparison of methods to determine antibiotic and other residues in milk.

Animal care in the DSF criteria is only defined in the context of welfare. However, health and production are also components of animal care, with the different components influencing one another. From a scientific and farmer perspective, an animal is in a good state of welfare if it is healthy, comfortable, well nourished, safe, relatively able to express its innate behaviour, and is not suffering from negative states such as pain, fear and distress. Good animal welfare requires amongst other disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling, transport and eventually, humane slaughter. The dairy industry is committed to the implementation of best practices to ensure animal welfare. As a member of the IDF and by consulting the IDF's Guide to Good Animal Welfare in Dairy Production and the SABS SANS 1694 guide for dairy cattle welfare, the DSA with the assistance of other stakeholders has developed auditable criteria to measure compliance with relevant animal welfare standards. The purpose is to assist farmers in the process of risk identification, to evaluate the risks, and to implement management practises which can improve welfare. In animal health, research programs are running to control and prevent mastitis, liver fluke and hoof health. The focus is on prevention and alternative treatment to limit the use of antibiotics and drugs. New developments include the control of

typical African diseases, the cryptosporidiosis influence on calf mortality, a ketosis monitoring kit, APPs for various diseases and a Global Information System (GIS) for disease reporting.

In conclusion, the Dairy Industry has recorded significant progress in most of the sustainability goals as defined in the DDoR and the DSF. It should be recognised that this is an endeavour which requires continuous attention through research, monitoring and training, and ultimately adoption by all role players across the dairy value-chain in the country. Several programs have therefore been documented. The report should be viewed as dynamic and should be updated regularly to reflect changes in the industry as additional information becomes available and new initiatives are developed.

The Report

1. Guidelines and principles

The South African (SA) dairy Industry is a signatory to the FAO-IDF Dairy Declaration of Rotterdam[1] which endorses the UN 2030 Agenda for Sustainable Development[2] in so far as it guides sustainable development from a social, environmental, economic and health perspective. The Declaration highlights the following:

- The vital role of dairy for food security and poverty reduction and the important livelihood and development opportunities for family farmers, small holders and pastoralists.
- The critical contribution the industry makes to balanced, nutritious and healthy foods, countries' economies, income and employment; in the management of terrestrial ecosystems, and the need to address environmental degradation, climate change and biodiversity.
- The diversity of dairy production systems and dairy breeds, contexts and priorities.
- The need for continuous and open dialogue and joint actions at all levels.

The SA dairy industry is a member of the Dairy Sustainability Framework (DSF)[3] whose vision aligns with the Rotterdam Declaration, and reads: "A vibrant dairy sector committed to continuously improving its ability to provide safe and nutritious products from healthy cattle, while preserving natural resources and ensuring decent livelihoods across the industry". The DSF focuses on 11 key globally accepted dairy sustainability criteria. Each criterion has an indicator on which the DSF reports on an aggregated basis for the global dairy value chain. The criteria with their respective goals are:

- *Greenhouse gas emissions (GHG):* GHG emissions across the full value chain are quantified and reduced through all economically viable mechanisms.
- *Soil nutrients:* Nutrient application is managed to minimize impacts on water and air, while maintaining and enhancing soil quality.

- *Waste:* Waste generation is minimized and, where unavoidable, waste is re-used and recycled.
- *Water:* Water availability, as well as water quality, is managed responsibly throughout the dairy value chain.
- *Soil:* Soil quality and retention is proactively managed and enhanced to ensure optimal productivity.
- *Biodiversity:* Direct and indirect biodiversity risks and opportunities are understood, and strategies to maintain or enhance it are established.
- *Market development:* Participants along the dairy value chain are able to build economically viable businesses through the development of transparent and effective markets.
- *Rural economies:* The dairy sector contributes to the resilience and economic viability of farmers and rural communities.
- *Working conditions:* Across the dairy value chain, workers operate in a safe environment, and their rights are respected and promoted.
- *Product safety & quality:* The integrity and transparency of the dairy supply chain is safeguarded, so as to ensure the optimal nutrition, quality and safety of products.
- *Animal care:* Dairy animals are treated with care and are free from hunger and thirst, discomfort, pain, injury and disease, fear and distress, and are able to engage in relatively normal patterns of animal behaviour.

The status of the SA dairy industry and the progress made are provided according to the 11 DSF criteria.

2. Advances in key DSF criteria

Greenhouse Gas Emissions

Prelude: Plants when growing use carbon dioxide (CO_2) from the atmosphere and nitrogen (N) from the soil and re-distribute it among different pools, including both above and below-ground living biomass, dead residues and soil organic matter (stocks). The CO_2 and other greenhouse gases (GHG), such as methane (CH_4) and nitrous oxide (N_2O), are in turn released to the atmosphere by plant respiration, by decomposition of dead plant biomass and soil organic matter, and by combustion. Thus, there is a continuous flux in and out of pools. Anthropogenic activities (e.g. cultivation of croplands, deforestation, poor rangeland management and destroying wetlands/ecosystems) and changes in land use or cover (e.g. conversion of forest lands and grasslands to cropland and pasture) can cause additional changes to these natural stocks and fluxes. These agricultural activities lead to increased emission of CO_2 and non-CO_2 emissions primarily from CH_4 from enteric fermentation in livestock and N_2O from manure storage, agricultural soils and biomass burning. The increase in GHG is associated with rising atmospheric temperature with already experienced profound climatic alterations with mostly negative effects, such as increased flooding, droughts, wild

fires, early frosts and frequency and intensity of severe weather events, across the globe, also in South Africa. To counteract these negative effects GHG emissions of agriculture and all other sectors must be reduced, preferably to pre-industrial levels.

Status of GHG knowledge: The estimated annual GHG for agriculture in SA in 2010 was 50 568 Gg CO_2 eq/annum[4], which is 9.3 % of total emissions. For livestock the direct emissions were 29 708 Gg CO_2 eq, of which dairy contributed about 10%. Per kg of milk this figure amounts to about 1.3 to 1.5 kg CO_2 eq/kg milk which compare satisfactorily with numbers reported in Australia, Europe, the UK and the US[5]. From low to high it nevertheless illustrates the vast potential in mitigation, which in this case largely reflects the amount of milk produced per unit input, i.e. efficiency.

Using BFAP[6] and other models, baselines were projected towards 2050, which take into account growth in the sector and the food requirements of an increasing population. The 'business-as-usual' scenario projection indicates increases for Agriculture to 69 621 Gg CO_2 eq/annum and for livestock to 41 178 Gg CO_2 eq/annum by 2050, which is a 38 % increase, presumably about the same for milk production if milk production per cow and per unit input is not addressed. To that effect significant strides have been made in the commercial dairy sector: Since 1990, the number of dairy farms has declined by 92 % and the number of cows by 24 %, yet total milk production has increased by 56 %[7]. This, obviously, implies that not only GHG emissions but also waste and water use per unit product have declined to the benefit of sustainability.

In a comprehensive study on pasture based dairy systems in the Eastern Cape of SA, the average of 1.39 kg CO_2 eq/kg ECM was higher than an average of 1.00 kg CO_2 eq/kg ECM reported in a New Zealand study[8]. The authors of the study concluded, in line with the discussion above, that the most logical approach to mitigating the potential negative environmental impacts associated is to increase farm productivity and efficiency. An example of this is the association between purchased concentrates fed per kg milk produced and the environmental impact measures: More efficient feed conversion was associated with higher N use efficiency and lower GHG emissions. Another example of increased efficiency contributing to reduced environmental impacts is the association of these measures with milk production per hectare: Increased milk production per hectare was associated with higher N use efficiency and lower GHG emissions. Milk production was closely correlated to stocking rate which is logical as stocking rate and milk production per hectare are positively influenced by various practices which also contribute to higher N use efficiency and lower GHG emissions. These practices include rotational grazing management, improved genetic value of cows, increased weight of replacement heifers, improved health care of animals and more effective feeding practices.

A more effective way of reducing GHG is to sequester atmospheric CO_2 into plants and, in particular, into soils. Soils rich in organic carbon are associated with enhanced biodiversity, water cycling, agricultural productivity, and climate change mitigation and adaptation[9]. The

global carbon pool in soils to a depth of 2 m is triple that of the atmosphere (~3,000 Gt C compared to ~830 Gt C)[10]. In this context, both increases in soil organic carbon and protection against losses from this pool are important strategies to counteract CO_2 accumulation in the atmosphere. Management practices that raise soil organic carbon are furthermore largely low in cost compared to alternative greenhouse gas abatement[11]. To put the potential for sequestration further into perspective, a South African estimate[12] of carbon storage in the most important rangeland biomes utilised for livestock grazing showed numbers for Savanna (358 473 km^2) of about 2 billion ton carbon, Grassland (224 377 km^2) 2.3 billion ton carbon and Nama and Succulent Karoo (334 812 km^2) 580 million ton carbon. The associated estimates indicate that the annual flux in and out of all rangeland and ecosystems, which is about 297 million ton carbon/annum, is over twice the total emissions from the country from all anthropogenic sources.

Carbon sequestration into soils will be increased upon conversion of plough tillage to no-till farming, generally referred to as conservation agriculture (CA). Application of manures and other organic amendments is another significant strategy. Several long-term experiments in Europe have shown that the rate of soil organic carbon sequestration is greater with application of organic manures than with chemical fertilizers[13]. Furthermore, soils under diverse cropping systems generally have a higher soil organic carbon pool than those under monoculture. Work in this context is also been done in SA.

On the south-eastern seaboard of SA milk production is primarily from cultivated pastures. Before 1990 monoculture pastures were conventionally established with deep tillage, resulting in deterioration of soil quality and loss of organic carbon. Since the late-nineties minimum tillage practices have been introduced, including the successful pasture management system of kikuyu over-sown with ryegrass. This has improved soil quality and carbon was dramatically sequestered. In an experiment on soil analysis from Swellendam to Humansdorp[14], soils from kikuyu-ryegrass systems and shallow tilled soils recorded carbon contents of 50.3 kg C/m^3 and 54.3 kg C/m^3 respectively, vs only 34.6 kg C/m^3 for deep tilled (conventional) soils. This represents an improvement of 50% in soil carbon stocks. Pastures established with minimum tillage including the kikuyu-ryegrass management system now comprise 70-80 % of commercial dairy farms in this area, which amounts to about 60 000 ha and a grazing capacity in the order of 240 000 dairy cattle. The improvement in soil carbon stocks on the 60 000 ha amounts to 10.4 million ton carbon (38.1 million ton CO_2 eq), whereas the methane emission of 240 000 dairy cattle amounts to a mere 25 000 ton CO_2 eq/year. Minimum tillage practices have also been adopted in crop rotation systems integrated with livestock in the Mediterranean region of SA, which has been associated with increasing soil carbon stocks[15].

GHG work in progress: Despite the favourable results discussed above, there is a lack of scientific evidence to exploit eco-efficient ways of farming, e.g. reducing CO_2 emissions, on pasture based dairy systems in SA. These pastures are usually irrigated and dairy farmers still

use high concentrations of fertilizers to promote plant growth, even though CA is practiced and soil carbon is improved. Therefore, nutrient loading (N and P in particular) on dairy farms is a problem generally experienced, which in turn is associated with leaching and environmental pollution. Management guidelines are therefore developed and impact categories considered which should improve eco-efficiency. The aim of the project in progress is to improve eco-efficiency: (1) by determining the global warming potential of dairy pasture systems in SA, and (2) by developing and implementing a Lifetime Nitrogen Efficiency (LNE) and a Lifetime GHG Cycle Assessment (LCA) and sequestration[16].

Soil and Soil Nutrients

These two DSF criteria are discussed together as soil nutrient status is influenced by soil health.

Prelude: High rates of soil organic carbon sequestration are obtained with no-till farming, crop residue retention as mulch, growing cover crops in the rotation cycle and integrated nutrient management, including applying manure and through restoration of degraded soils. While improving soil quality and agronomic productivity, agricultural intensification through adoption of these principles also improves water quality, increases fixation of N from the atmosphere, reduces general pollution by decreasing dissolved and sediment loads, and reduces net rate of CO_2 emission through carbon sequestration[13,17].

Pasture growth is a highly active process and therefore cannot be sustained without the replenishment of nutrients removed during the growth phase. The supply of soil nutrients to plants can be through natural processes like mineralisation (i.e. the conversion of organic nutrients into inorganic, plant available forms) following CA and the preferred management options described above, or in the form of chemical fertilisers. Nutrient cycling in soil relies on soil microbes and soil fauna, such as earth worms. A healthy soil supports proliferation of soil microbes and nutrient cycling, thereby supporting sustainable production and guaranteeing reduced costs associated with fertiliser application[18]. There is also an interaction between soil microbes and earth worms, as earth worms act as biochemical reactors to convert labile plant compounds into stabilized soil microbial biomass[19].

Status: A generally accepted norm in crop production is that an improvement of 1% carbon in the upper 30 cm soil will coincide with fixation of 25 kg N from the atmosphere[20]. If however soil health is improved, turnover can be improved and more NH_4 –N, which results from chemical fertilizer and otherwise can be converted into the GHG N_2O, can be utilized to the benefit of plant growth. As an adjunct, in a study at Delmas, improvement in soil organic carbon coincided with a 27 ppm increase in utilizable P. This equated to 100 kg P at a soil depth of 30 cm and when calculated relative to the equivalent cost of applying the chemical fertilizer MAP 33, the saving was R3000/ha, or R10 million for the farm of 3300 ha[20]. Thus, improved soil health status can result in considerable savings in fertilizer costs.

Excessive N fertilizer application could result in excess imported N and in more GHG emissions. The N efficiency range in an Eastern Cape dairy pasture based study[8] was 9%—76% with an average of 29%. Thus, a higher maximum, but a similar average N-use efficiency, was found when compared with the results of other studies conducted globally. Similarly, wide ranges of P use efficiency have also been found across dairy farms worldwide and the average P use efficiency of 36% found in the Eastern Cape study was similar to the average of 32% reported in Australia. In general, the nutrient use efficiency was low, resulting in excessive N and P generated from pasture-based dairy farms in the Eastern Cape. These excess nutrients have the potential to generate negative environmental impacts through accumulation in the soil, loss to the atmosphere through volatilization, loss to surface water through run-off, and/or loss to ground water through leaching. The authors recommended that future research should be directed at better understanding the cycling and loss of nutrients on pasture-based dairy farms, so that the environmental impact of these farms can be minimized.

Soil work initiated: To address the wide range in nutrient use efficiencies discussed above, a project[18] was initiated to investigate the influence of fertilizer application rates on the health of dairy farm pasture soils as well as soil health with the aim of identifying fertilizer guidelines which will optimise soil health, pasture productivity and profitability. The motivation results because the health of many South African soils under pasture is poor and therefore lacks the ability to support high productivity. In such instances, large amounts of chemical fertilizer are used by farmers as a supplementary source of nutrients. However, farmers should be made conscious of how over-fertilization poses an environmental risk and inhibits the natural processes in soils, and furthermore results in reduced profitability. It is crucial that nutrients are replaced according to the specific demand of plants. Complete elimination of chemical fertilization is unlikely, as pasture systems in South Africa, specifically in the Tsitsikamma, lose more nutrients than what they can naturally replace. These soils are sandy with poor soil organic matter content, leaving them prone to nutrient leaching. Improving the health of these soils is a sustainable mechanism to improve pasture yield, and farm productivity and thus reducing the need to fertilize frequently.

Waste

Prelude: Waste is of concern pre-farm gate as well as at the dairy processing plant. Waste at the farm is both a safety and a resource pollution risk. For example, syringe needles which are not properly disposed of may be dangerous to children and animals, whereas milk obtained from antibiotic or drug treated cows which are flooded to pasture may affect soil

chemistry and biology. Although whey disposal into streams/natural river systems is controlled by strict legal regulations, there are challenges in terms of proper handling especially in terms of dilution and ability to remove residual milk solids. Furthermore, recycling and value-addition largely depends on yield, infrastructure as well as energy and water costs. This would typically require a comprehensive analysis and feasibility assessment.

Status: Most dairy farms have waste disposal and sewage systems that allow them to use the solids as fertilizers and the water either in irrigation or to recycle for cleaning. Some of the large dairy processing companies have waste reduction and water cleaning operations, some of which generate CH_4 for electricity generation, whilst the purified water is recycled for cleaning operations.

Manure slurry is recognised as a valuable resource which, through the application of efficient management, farmers can re-invest valuable nutrients and organic matter back into soils. Dairy farmers should be encouraged to adopt nutrient management plans which in turn contribute towards the alleviation of water pollution and improved environmental control. This is widely practiced by commercial farms in South Africa with recommended manure management practices contributing to enhanced soil infiltration rates, improved water holding capacity and increasing soil carbon levels. Although many regions in the country have experienced severe drought conditions, inclement weather can place pressure on slurry storage capacity and restricts slurry spreading opportunities. Slurry separators are used in some cases to separate solids from the slurry mixture. This enables reuse of the liquid fraction, either for flushing of walkways and milking parlour floors or for convenient pumping out onto fields for irrigation of crops. The solids can readily be accumulated and further incorporated as part of a soil fertilization regime.

Efficient and safe industrial waste management is a critical contributor towards maintaining environmental integrity. Due to its high organic matter and nutrient content, dairy effluents should be managed carefully. Solid waste emanating from dairy processing can be either organic or inorganic in nature. Typical organic waste includes milk solids, effluent sludge, spent product, paper and cardboard. In comparison, inorganic solid waste would include materials that are derived from non-renewable resources such as metals, glass and plastics. The best route for disposal or reuse depends on specific characteristics of the waste stream. In recent years there has been much development in the ability of dairy processors to collect and harness the economic value of various waste streams, which ultimately also drives more environmentally sound methods of disposal. As has been experienced in the International landscape, the waste market in South Africa is being placed under increasing pressure due to escalating landfill costs, which means that processors and waste producers are more likely to seek alternative means to dispose of spent organics or packaging materials. Regulation from National Government and local municipalities ensure that adherence to legislation is followed. The Department of Environmental Affairs and Development have developed the

Integrated Pollutant and Waste Information System through which waste generators and handlers are controlled. Compliance to this, as well as local municipal by-laws, ensures that waste is disposed of in the most environmentally sound manner possible. Record keeping of all generated and discarded waste is considered essential towards implementing sound waste management practices and enables the establishment of waste recycling baselines which can be used to benchmark waste recovery activities.

Through the implementation of controlled waste sorting operations and in many cases, the appointment of dedicated waste contractors to assist in waste recovery operations, dairy processors in South Africa are minimizing waste generation while improving on their waste recovery and recycling ability on waste streams which are unavoidable. This includes a combination of solid and organic waste streams. Key waste metrics based on DSF guidelines at farm level should be whether a farm has implemented a Waste Management Plan (WMP), while at the Processor level being able to report on the amount of waste being sent to landfill is regarded as a valuable sustainability criterion. These should be the basis on which the industry develops baselines for waste disposal and management.

The threat which plastic pollution poses to the environment remains a topic of concern internationally, with South African consumers also increasingly aware of its negative impact. South Africa is fortunate in that it has, in particular, a fairly robust plastic recycling industry which contributes to the ability of dairy operations to divert this form of solid waste from landfill disposal sites with varying degrees of success. Cross-contamination of packaging with dairy product waste remains a limiting factor which can devalue the material before being received by recyclers. This highlights the need for efficient ‘at source’ separation of waste which has become a standard practice for processors.

Producers and manufacturers of dairy products will need to continue efforts towards finding alternative packaging solutions which are environmentally sound without compromising product integrity. Commitment and progress have been demonstrated through manufacturers using packaging which comprises a percentage of recycled material as well as using materials which are sustainably sourced, such as cardboard which is certified by the Forest Stewardship Council (FSC). Processors are further encouraged to reduce or if possible, eliminate any unnecessary plastic packaging from their supply chain which will contribute to the prevention of unintended and environmentally harmful consequences. Ultimately, the ability to recycle is dependent on the availability of recycling facilities and the locality of dairy processing operations to such sites. Developing the recycling industry post-consumer in this country will unlock our potential to divert waste from landfill.

‘Zero waste to landfill’ could be viewed as the ultimate long-term waste disposal target for the sector although this presently is still not the most economically viable route. Waste incineration offers a means to combust organic materials to release heat which in turn can be used to generate electricity while also fulfilling a role in reducing landfill volumes. Although there are emission concerns with this technology advances in emission control can

circumvent exposure to toxic by-products. South African manufacturers face increasing public scrutiny around the topic of plastic packaging, while food waste is a topic which will need to be addressed by the sector as the Carbon Footprint of this form of waste has been shown to be significant[21].

Waste to Energy projects in the South African Dairy Industry have been challenged by National and Provincial policy, especially gaining the required approvals which can be a lengthy and costly process. This is often accompanied by the need for numerous specialist studies to adhere to all the relevant regulations which escalate project costs and can impact feasibility. Successful implementation of such technology has been achieved by Woodlands Dairy in the Eastern Cape Province using a combined effluent stream which emanates from several different production processes. The membrane bioreactor system converts wastewater into energy and clean water, which can then be safely discharged or reused for other applications. The methane gas produced through this process serves as a clean energy source which is used to fuel the onsite biogas boiler.

In addition to more conventional waste streams, dairy farmers and processors are also responsible for controlling the disposal of chemical and hazardous wastes. From an agricultural perspective, chemical waste would include insecticides and pesticides used for crop spraying. The National Environmental Management Act provides clear guidelines as to how these wastes should be discarded as spillage or improper disposal has the potential to cause severe environmental degradation. Irrigation run-off can transfer chemical residues into natural river systems and this need to be managed responsibly.

Waste is generated during the processing of milk and dairy products and this poses a threat to water quality. Chemical Oxygen Demand (COD) is used by most dairies as an indicator to assess the level of organic compounds in their effluent stream. Through using either onsite treatment systems or preventative measures to reduce organics from entering their effluent stream, dairies can reduce their relative COD load, thereby minimising the impact of their effluent. Emphasis should be placed on reducing COD levels before primary treatment. In the case of most processors this would be before final discharge. As per the DSF guidelines, the adoption or implementation of an Effluent Management Plan (EMP) is regarded as the most important sustainability indicator around controlling the impact of dairy effluent on the environment.

Water

Principles and initiatives: Water in South Africa is a finite and vulnerable resource and must be dealt with responsibly, both as it applies to quantity and quality. Importantly, water is essential towards ensuring the production of high-quality dairy products as it is required throughout the processing chain serving critical functions in cooling, heating, washing and cleaning. Apart from rain water, dairy pasture based systems use irrigation to promote productivity of pastures; the general use being high compared to other agricultural systems and with the further implication of nutrient leaching and pollution of watercourses and

wetlands. This initiated several projects which promote sustainable methods of production and stimulates innovation.

Recent developments and initiatives around water in the South African Dairy Sector are steadily contributing towards creating a culture of circularity and sustainability. A water stewardship program has been introduced by the MPO in collaboration with the WWF-SA[22], encouraging innovative initiatives in water management, ecosystem protection, and recycling, and effluent treatment in dairy factories. As per the WWF definition, water stewardship encompasses increased improvement in water usage, a reduction in all water related impacts and a commitment to collective action which includes other businesses, NGO's, communities and government departments. The program needs to be rolled out to as many participants as possible, the initial action being to conduct a survey to establish needs and application. Participation by several processors and farmers over the past year indicates that water is a growing concern in the sector and that the initiative has established a platform for knowledge-sharing around water throughout the dairy value chain in this country. It further emphasizes recognition from the wider dairy industry that water stewardship is of great importance.

A second initiative is to develop best practice guidelines for determining aquatic and wetland buffer zones for dairy farms. The supporting research[23] will firstly refine the current approach which has been developed by the WWF-SA for a wide range of sectors, through focusing on sector specific aspects that would allow for improved wetland and watercourse management; and secondly by undertaking a cost-benefit analysis to inform sustainable wetland and watercourse management. The benefit to the dairy industry will be a sector specific approach to determine buffer zones and therefore directly focusing on aquatic and wetland ecosystem sustainability, in addition to maintaining biodiversity.

In view of the envisaged impact of climate change of progressively increasing temperatures and therefore more evaporation, together with decreasing precipitation, it is important to establish minimum water requirements of forage species[24] of importance to dairy farming. However, despite significant advances in irrigation equipment and precision technology there is still a lack of reliable information regarding water requirements of over-sown pasture systems. Therefore, as a third initiative, water requirements and irrigation scheduling systems and their suitability to topography, climate, soil, irrigation system and water availability need to be established[23]. The aim is to compare and calibrate different irrigation scheduling systems for different pasture mixes for various topographic, soil and climatic conditions under normal and restricted water conditions. In association, the various scheduling systems need to be compared against common pasture irrigation types to identify compatibility.

From a dairy processing perspective, organizations across South Africa have adopted a wide range of approaches to improve their water resilience and operational efficiencies. Dairy

processing, along with many other agro-processing industries, requires a high net usage of water and in turn also contributes to higher effluent outputs. Depending on the process requirements, each factory or processing facility has unique opportunities for water use reduction, water recovery and re-use as well as effluent recovery and cleansing. Through technological advancements in the re-use of water as well as wastewater recovery and treatment, processors are driving down consumption while reducing the demand on municipal water supply systems.

Many South African Dairies have placed focus on areas of water consumption that can readily be managed and where immediate reductions in water usage are possible. Processors across the country use staff training and awareness as a primary means to reduce water wastage. Optimization of CIP systems has presented dairies with steady water savings through efficient sequence planning of product batches as well as modifications which enable the re-routing to rinse water to ensure collection and re-use. Water use efficiency (typically the volume of water used per volume of product manufactured) reporting is the key metric to initiate and measure continuous improvement programs or projects related to water consumption.

Though water scarcity challenges face numerous provinces in South Africa, it is possible to augment water through alternative means while doing so in an environmentally beneficial manner. This has been successfully demonstrated by the establishment of an integrated water and waste recovery system implemented by Woodlands Dairy in the Eastern Cape Province. The wastewater treatment plant was required due to under capacity of the municipal wastewater system to effectively deal with effluent. The integrated system can recycle wastewater using reverse osmosis technology to convert it back to potable standard. This allows for reuse of the water inside the factory. In addition to reclaiming water, an anaerobic bioreactor enables methane to be produced from the organic content. This gas in turn serves as a fuel source to drive a boiler which contributes a portion of the processing plants steam requirements.

Biodiversity

Vision and strategy: South Africa is a country with a rich endowment of natural resources, which include its biodiversity and ecosystems. The diversity of these ecosystems delivers a range of services that are essential to people and the development and growth of the econo-my. The National Biodiversity Strategy and Action Plan (NBSAP) nested in the Department of Environmental Affairs are responsible to fulfil the objectives of the Convention on Biological Diversity (CBD). With the adoption of the CBD's Strategic Plan for Biodiversity, the NBSAP has outlined a path to ensure that the management of biodiversity assets and ecological infrastructure continue to support South Africa's development path and play an important

role in underpinning the economy[25]. The vision is to: Conserve, manage and sustainably use biodiversity to ensure equitable benefits to the people of South Africa, now and in the future.

The strategic objectives are:

- Management of biodiversity assets and their contribution to the economy, rural development, job creation and social wellbeing to ensure that it is enhanced.
- Investments in ecological infrastructure to enhance resilience and ensure benefits to society.
- Biodiversity considerations are mainstreamed into policies, strategies and practices of a range of sectors.
- People are mobilized to adopt practices that sustain the long-term benefits of biodiversity.
- Conservation and management of biodiversity is improved through the development of an equitable and suitably skilled workforce.
- Effective knowledge foundations, including indigenous knowledge and citizen science, support the management, conservation and sustainable use of biodiversity.

Prelude: Agriculture is widely associated with the loss of biodiversity, largely through habitat destruction because of the conversion of natural lands for agricultural use, coupled with the intensification of agricultural practices. These have contributed to the pollution of soils through the application of fertilizers and pesticides, while soil erosion through unsustainable farming practices places mounting pressure on ecosystems. This is a pressing issue and one which the industry must address. As the demand for agricultural products has increased, driven by the nutritional needs of a growing population, the importance of developing a biodiversity-based agricultural system to ensure future sustainability should be regarded as a key driver for the South African Dairy Industry. Such a system aims to develop input services without significantly decreasing agricultural production[26]. These ecosystem services are defined by land use management practices coupled with soil and climatic conditions. The development of a resilient agricultural system relies on a balance between the exploitation and use of biodiversity, ecosystem services and the natural environment. Both agriculture and nature will ultimately benefit through the adoption of approaches towards resilient systems. These would focus on optimising the use of agro-biodiversity while reducing both economic and natural long-term risks through the application of ecosystem services, rather than external inputs[27]. Dairy farms across South Africa have widely undertaken (although still not always to a formal extent, especially among smaller-scale farmers) to integrate biodiversity-conscious approaches in their businesses. The vast costs involved in repairing damaged soils are understood and therefore the benefits in monitoring soil health, structure, nutrients and biological activity are recognised. This extends to the careful management of fertilizers, manure and pesticides, with specific attention to application rates and timing to maximize soil retention of nutrients and prevent unwanted leaching into waterways. Other key services

include the diversity of animals and gene pools which contribute to the overall resilience of the ecosystem. This also holds true for crops, where a mixture of crop varieties tend to reduce vulnerability against diseases, pests and nutrient deficiencies. The CBD vision and objectives could be aligned to the South African Dairy Industry as dairy production does impact biodiversity and ecosystems, not only through changes made to habitats but also factors such as the application of fertilizers and other input products, nutrient losses and associated greenhouse gas emissions.

The dairy industry supports the vision and strategies of the NBSAP

Status: South Africa is known for preserving animal and plant genetic resources, although there are concerns regarding scarce gene pools. Dairy farming operates primarily in intensive and closed environments, but the industry is conscious of the importance of conserving bordering wetlands and ecosystems as the stewardship programme and the implementation of programs to enhance soil microbial and fauna contents discussed above suggest. They also are, as elsewhere in the world, conscious of the narrowing of genetic diversity within dairy breeds resulting from semen use of international sires with exceptional breeding values. However, this is closely monitored and occasionally crossbreeding is implemented as a way out, usually with coinciding benefits to the immune system and longevity. In support, a program has been implemented with genomic testing[28] to identify superior South African sires which should be helpful.

Market development*:*

Prelude: Internationally compared, the South African dairy industry is one of the most deregulated industries. The industry is not subject to any statutory intervention in the production and marketing of its products aimed at managing or influencing the supply and demand of unprocessed milk and dairy products, and it is not supported by government subsidies. A totally free and competitive dairy market prevails in South Africa which created a very dynamic dairy industry that continuously adapts to the changing needs of consumers and industrial users. Functionally, market development is supported by (1) market signals and information, which are made available to the industry through formal publications and other measures; (2) customs and market access, by being involved with an initiative in international trade relations, export certification activities, import monitoring activities and animal health; (3) consumer education, which aims to empower the consumer with information to enable them to make responsible choices, and (4) pursuance of new market opportunities.

Status and initiatives: Market signals and information are made available to the industry through formal publications and other measures on a continuous basis. A selection of variables includes:

- Import and export statistics quarterly;
- Unprocessed milk production monthly;
- Processing of unprocessed milk into various dairy products monthly;
- Geographic distribution of unprocessed milk production;
- Composition of the concentrated and liquid products markets;
- Year-on-year change in demand and prices of dairy products;
- The domestic and international economic situation;
- International unprocessed milk production and dairy product volumes and prices.

Consumer information and education is provided by the Consumer Education Project (CEP) of Milk SA[29]. The project aims to convey the health and nutritional benefits of dairy and is continuously evaluated and developed. The project is multidisciplinary as it uses expert knowledge from different disciplines that is communicated to the target audiences through television, radio and print. A combination of sound scientific information and good understanding of consumer perceptions anchors the project. The project conveys messages that cannot be communicated adequately through conventional branded advertising. The purpose of the project is not only to serve the interests of the dairy industry but also to empower consumers with information to help them make informed and responsible choices on dairy.

Of important markets which have been identified with potential as trading partners, the Sub-Sahara (SS) African is maybe the most prominent, especially as export market. However, the industry does not have knowledge of their regulatory environment, food safety and other control measures, and therefore a project has been registered[30] to acquire information to: promote and stimulate export; provide informed contributions on the contents of the trade agreements which South Africa may negotiate; harmonize the legal standards of SS African countries which are applicable to the composition, safety and metrology of unprocessed/fresh milk and dairy products, and protect the country against unfair competition from imported dairy products.

Rural economies

Goals and developments: The core emphasis is to promote competitive, profitable and sustainable existing black and new enterprises by contributing to the reduction of commercial venture constraints. The initiative is aligned with the South African developmental priorities, namely food security, poverty reduction, promoting equitable economic transformation and contributing to general economic development and growth. Based on needs assessment of existing dairy enterprises along the dairy value chain and according to Milk SA criteria, Milk SA intervenes with the following assistance: supply of electricity, pregnant heifers, veterinary services, on-farm infrastructure, technical know–how, establishment of permanent pasture,

technical training, development of business plans and feed supply during critical drought periods. After the initial support for assets which was funded 100% by Milk SA, entrepreneurs are encouraged to acquire additional assets such as heifers on a 40/60% cost sharing basis between the entrepreneur and Milk SA respectively. The goal of this approach is to instil an enterprise / entrepreneurial culture in project beneficiaries.

Skills and knowledge development are supported by Milk SA to ensure the continuation of an appropriate skills and knowledge dispensation. In the context of rural economy development, Milk SA's Skills & Knowledge Development Program supports training at new and black dairy enterprises.

The rural dairy economy is not only supported by the organized dairy industry through Milk SA, but several provincial departments associated with agriculture which drive entrepreneurial programs and training. The most notable programs are offered by KZN, the Eastern Cape and the Western Cape. For example, the Eastern Cape's initiative[31] is in association with the company Amadlelo as strategic partner with community based large dairy operations such as at the Fort Hare Dairy Trust; Middledrift Dairy Production; Keiskammahoek Dairy Production; Ncora Dairy Production; Shiloh Dairy Production; Mantusini Dairy Production, and with the Du Plessis brothers at Wittekleibos Dairy Production.

Needs: (1) There is a need to measure the impact of training in the formal and informal markets. Coinciding is there a need to measure the impact of subsistence/smallholder dairy farming on the rural economy. To some extent an initiative of this nature will measure the success of general empowerment. The larger motivation though is that it is not known what the magnitude is of not yet commercialised dairy production in the country and how progress of such ventures will affect both the formal primarily city market and the informal primarily rural market. (2) The successful entry of the emerging sector into farming is often prevented by lack of capital. One reason is that such farmers do not own the land and therefore cannot borrow from banks since they cannot provide security. The Free Market Foundation with their Khaya LAM project[32] has been highly successful in negotiating tenure in informal settlements. This should be explored for rural dairy farming as well.

Working conditions

Applicable Acts: This section is informed by The Labour Relations Act (Act 66 of 1995)[33], The Employment Equity Act (Act 55 of 1998)[34], The Basic Conditions of Employment Act (Act 75 of 1999)[35], The Skills Development Act (Act 97 of 1998)[36], The Compensation for Occupational Injuries and Diseases Act (Act 130 of 1993)[37] and The Land Reform (Labour Tenants) Act (Act 3 of 1996)[38].The overriding principle is that farmers need to ensure that the rights and well-

being of farm workers and their families are upheld and that they contribute to the social and economic development of the local community and on the periphery.

The Labour Relations Act deals with rights as contained in the Bill of Rights in the Constitution of South Africa. Those relevant to the dairy industry are: the right of freedom of association of both employer and employee, the protection of employers and those seeking employment, the protection of the rights of employees (Sections 4 and 9), the organizational rights of employees such as access to the workplace by a representative of the trade union, collective bargaining rights, the right of employees to strike and the right of an employer's recourse to lockout (Sections 64-71), unfair dismissal and unfair labour practices (Sections 185-197).

The Basic Conditions of Employment Act was promulgated to advance economic development and social justice by giving effect to the right to fair labour practices. It is supported by a Code of Good Practice which deals with fair working hours and the impact of working time on the health, safety and family responsibilities of employees. The Skills Development Act was introduced to develop the skills of the South African workforce, improve their quality of life, their prospects of work and labour-associated mobility, improve the productivity in the workplace and therefore the competitiveness of employers, promote self-employment and improve the employment prospects through training and education. The Compensation for Occupational Injuries and Diseases Act is designed amongst others to provide for the health and safety of people at work, those that use or are exposed to potential dangerous equipment and those on the periphery of where the work is conducted. Finally, The Land Reform (Labour Tenants) Act was introduced to provide for security of tenure of labour tenants and people occupying or using land because of their association with labour tenants. The Act also deals with the acquisition of land and the rights to land by labour tenants.

Employer obligations: Employers in the dairy industry should commit themselves to the following, if they have not done so already:

- Comply with the conditions legislated for fair labour practice.
- Contribute to employee unemployment benefits.
- Contribute to the skills development of employees.
- Provide for compensation of death or disablement resulting from occupational activities.
- Provide for the safety and health of the employees at work.
- Uphold the rights of labour tenants and farm occupiers to reside on land and to acquire land where appropriate.
- Ensure that recreational areas on the farm are available.
- Participate in actions towards establishment of a sustainable local economy.

One way of participating in such actions is to adopt a policy of preferential employment of residents from the local community or from labour tenants on the farm. Applicable research results suggest 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. The umbrella principle is that farmers are the mainstay of the economy of towns, townships and the surrounding rural environment, and they have the knowledge and skills to support development towards a viable and sustainable local economy.

Product safety and quality

Prelude: The dairy quality and safety initiatives of Milk SA are the responsibility of the Dairy Standard Agency (DSA), a non-profit company established by the industry. The DSA monitors and supports procedures to ensure product compliance with product composition and food safety standards. This is a prerequisite for the growth of the dairy industry, as substandard products reaching the retail market can harm both the industry and the consumer. Promotion of compliance with standards relating to milk and other dairy products is a demanding and multi-dimensional task of the DSA, because of the involvement of regulations relating to product composition, food safety, animal health, animal feed, milking parlours, transportation of milk, processing plants and storage, all of which are regulated by different Acts which are managed in different government departments.

Status and progress: In terms of its mandate the DSA has progressively moved to a landscape where today it is well-recognised by the respective government bodies, the organised primary and secondary dairy industry and other stakeholders, for example national consumer bodies and the retail sector. The current functions of the DSA include:

- Support and interact with existing government regulators responsible for maintaining standards;
- Support and interact with existing risk identification structures / initiatives;
- Monitor milk and other dairy products offered to the consumer, for compliance with legal standards;
- Primary support to existing government, dairy industry structures that maintain standards;
- Liaison and co-operation with other organisations with similar objectives;
- Support to existing government and food industry risk identification structures.

To that effect the DSA has the capacity to maintain successful milk and dairy products monitoring programmes; maintain a remedial action program for regular contraveners of legal standards; identify non-conformances in the industry in respect of milk and other dairy products; and maintain an effective communication program with all stakeholders concerned.

Laboratory support: The lack of a harmonised (standardised) system at national level for the calibration of laboratory instruments for the measurement of fat, protein, lactose, milk urea

nitrogen, somatic cell count, and other quality parameters of milk, created technical barriers and added to potential legal disputes. Therefore, the DSA Laboratory Services was established. The resulting infrastructure also addresses the need for an independent proficiency testing scheme (laboratory ring test) for dairy laboratories in South Africa. Milk SA considered the harmonisation of standards as critical to the dairy industry of which some of the benefits are:

- Uniform standards for the calibration and use of measuring equipment to the benefit of the primary and secondary dairy industry;
- Improved reliability of test results obtained from individual in house laboratories;
- Comparative test results from external test laboratories;
- Test results to support research and development as well as statistical data used during herd health management programs;
- Mitigation of disputes between milk producers and milk buyers as a result of payment on quality parameters of milk from the use of calibrated equipment using harmonised standards.

Expansion to the services and tests provided by the DSA are continuously evaluated to provide a more comprehensive service to the industry. To that effect methods of analyses need to be developed or compared, a recent example being a comparison of methods to determine antibiotic and other residues in milk: A variety of commercial kits are used by milk buyers and external laboratories in the industry for detecting antibiotic residues in milk during milk reception. Most of these kits provide qualitative data, indicating the presence or absence of such residues without being able to specify/identify the type of antimicrobial compound(s). A newer testing system, the AOAC approved Randox methods, is able to detect and identify a wide range of antibiotic residues and antimicrobial substances. A project was therefore registered[39] to compare the results of the Randox system with the generally applied methods used in the industry, amongst others the Copan Milk test.

Various other tests which are considered to be standardized include: Presence of rBST in milk, and if possible differentiation between natural and rBST; differentiation between A1 and A2 milk; and degree of denaturation of β-lactoglobulin for heat load specifications.

Animal care

Prelude: Although animal care in the DSF criteria is only defined in the context of welfare, health and production are also components of animal care, with the components having an effect on one another. Whereas health and production are well understood, what people interpret to be acceptable animal welfare can be influenced by many factors including personal values, religion, nationality, gender, previous experiences, age, socio-economic

status, etc. From a scientific[40] and farmer perspective, however, an animal is in a good state of welfare if it is healthy, comfortable, well nourished, safe, relatively able to express its innate behaviour, and is not suffering from negative states such as pain, fear and distress. Good animal welfare requires amongst other disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling, transport and eventually, humane slaughter. For farmers, the interaction between the three components of animal care is recognisable through the following[41]:

- A realization that there is a critical relationship between animal health and welfare.
- The recognized "five freedoms" provide valuable guidance in animal welfare management (these are: freedom from hunger, thirst and malnutrition; freedom from fear and distress; freedom from physical and thermal discomfort; freedom from pain, injury and disease; and freedom to express relatively normal patterns of behaviour).
- The use of animals carries with it a duty to ensure the welfare of such animals to the greatest extent practically possible.
- Improvements in farm animal (livestock) care can often improve productivity and lead to economic benefits.

Developments: The dairy industry is committed to implementation of best practices to ensure animal welfare based on scientific evidence. As member of the IDF and by consulting the IDF's Guide to Good Animal Welfare in Dairy Production[42] and the SABS guide for dairy cattle welfare[43], the DSA with the assistance of Milk SA, the Milk Producers Organisation (MPO), South African Milk Processors Organisation (Sampro) and other stakeholders developed auditable criteria to measure compliance with relevant animal welfare standards at the milk production level. The purpose of this outcome based driven auditable and assessment criteria is to assist farmers in the process of identification of risk areas, to evaluate the risks, and to implement management practises which can improve welfare. The audit programme should be in operation already in 2020.

In animal health research programmes are running to control and prevent mastitis, liver fluke and hoof health. The focus is on prevention and alternative treatments to limit the use of antibiotics and drugs. New developments include control of typical African diseases, the cryptosporidiosis influence on calf mortality, a ketosis monitoring kit, APPs for various diseases and a Global Information System (GIS) for disease reporting. In production new developments include selection of more drought resistant forages, alternatives to rye grass such as plantain, alternatives to grain in supplements, automatic management system programme expansion to include genetic evaluations and efficiency measures in the software, and selection for functional traits such as disease resistance and calving performance through genomic testing.

3. Concluding remarks

The South African Dairy Industry has recorded significant progress in most of the sustainability goals as defined in the Dairy Declaration of Rotterdam and the Dairy Sustainability Framework, particularly as it applies to the environment. It should be recognised that this is an endeavour which requires continuous attention through research, monitoring and training, and ultimately adoption by all role players across the dairy value-chain in the country. Several programs, which are either existing or in various phases of development, and which align to the aforementioned sustainability goals, have therefore been documented. The report should be viewed as dynamic and should be updated regularly to reflect changes in the industry as new information becomes available and progress is made in related initiatives.

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